THE

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AND

INSTITUTIONS IN UNION,

AND

OFFICIAL RECORD OF ANNUAL INTERNATIONAL EXHIBITIONS.

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119th Session.] FRIDAY, NOVEMBER 22, 1872. [No. 1,044. Vol. XXI.

PROCEEDINGS OF THE SOCIETY.

FIRST ORDINARY MEETING.

Wednesday, November 20th, 1872, Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman of the Council, in the chair.

The following Candidates were proposed for election as Members of the Society:—

Adams, William, Bow and Bromley Institute, E.
Ball, Edmund C., 73, Strand, W.C.
Bayley, James Alfred, 28, Canonbury-square, N.
Boor, George, 1, Artillery-lane, Bishopsgate, E.
Brayshay, William Hutton, West-view, Ickley, Yorkshire.
Bromfield, John Coley, 38, Russell-square, Brighton.
Carson, Rev. William, Kildwick, Leeds.
Chant, J. R., 1, Ludgate-hill, E.C.
Coker, Frederick, 32, Cheapside, E.C.
Cumings, Alphious Charles, 4, Victoria-road, Kilburn, N.W.
Davies, D. Griffith, Bridge, Cardigan.
De la Penha, Eugene, 19, Sackville-street, W.
De Wette, Augustus, 7, Catherine-court, E.C., and Cross Deep, Twickenham.
Dodson, Arthur John, Penrhyn-lodge, Cambridge-park, Twickenham.
Foy, Rev. William Henry, Barningham-Norwood, Holt, Norfolk.
Fry, George, 99, Ethelburga-house, 70, Bishopsgate-street-within, E.C.
Fursey, Samuel Dunn, 9, Buckingham-road, Shoreham.
Gadsby, Alfred, Lancaster-house, 39, Finchley New-road, N.W.
Galloway, George Bell Errington, West Ferry-road, Millwall, E.
Geach, Robert Gichard, Cragg's-wood, Rawdon, Bradford.
Gower, Lord Ronald Sutherland Leveson, M.P., Stafford-house, St. James's, S.W.
Guest, John, 63, Leadenhall-street, E.C.
Halfpenney, G. W., Lower Shadwell, E.
Harding, Major Charles, F.R.G.S., 52, Springfield-road, St. John's-wood, N.W.
Haworth, Richard, Manchester.
Hempleman, Frederick Sebaud, 5, Whalebone-terrace, Stratford.
Henderson, James, 9, Mincing-lane, E.C.
Hernamann, John, Salvador-house, Bishopsgate, E.C.
Ingledew, Joseph, 191, Bishopsgate-street Without, E.C.
Isaac, Albert, 27, Somerford-grove, Stoke Newington, N.
Johnston, David W., Dalriada, Belfast.
King, Nathaniel, 2, East-street, Worthing.
King-Harman, Captain W. H., R.A., Royal Artillery Institution, Woolwich, S.E.
Lanyor, Captain William Owen, A.D.C., Craigton, Kingston, Post-office, Jamaica.
Lees, Colonel Nassau, LL.D., Conservative Club, S.W.
Leishman, John B., 26, Kensington-gardens-square, W.
Lutscher, Peter, 8, Austin-friars, E.C.
Lyell, Robert, 30, Brunswick-gardens, Campden-hill, W.
Marks, Murray, 395, Oxford-street, W.
Macleay, Alexander Donald, Carlton Club, S.W.
Meakin, John Forster, 84, Baker-street, W.
Morgan, George Victor, 39, Blackheath-hill, Kent.
Nicholson, Henry, 3, Montague-place, Russell-square, W.C.
Oswin, Frederick, 2, Weymouth-street, Portland-place, W.
Page, Charles Albert, 38, Leadenhall-street, E.C.
Parry, Edward, 290, Camden-road, N.
Parsons, J. R., 95, Wigmore-street, Cavendish-square, W.
Partington, Edward, Woolfold, Bury, Lancashire.
Phelps, F. W., 10, Albion-grove, Barnsbury, N.
Prothero, Alfred John, 45, Great Marlborough-street, W.
Randle, Howard, Buxton College, Forest-lane, West Ham, E.
Ratcliff, Daniel R., Mossley-hill, Liverpool.
Rau, Theodor, 148, Buckingham-palace-road, S.W.
Renny, Rev. James, M.A., Ph.D., Barnet.
Rose, Henry, 8, Porchester-square, W.
Sadler, F. A. Turnford-hall, Cheshunt, Herts.
Schacht, Theodor, Wismar-house, Lee-terrace, S.E.
Seymour, W. Digby, Q.C., LL.D., 2, Dr. Johnson's-buildings, Temple, E.C.
Shelford, William, 7, Westminster-chambers, Victoria-street, S.W.
Skelton, Thomas Alfred, 37, Essex-street, Strand, W.C. and Southampton.
Smith, Reginald Masters, Queen's Bench Office, Temple, E.C.
Stewart, Charles P., 92, Lancaster-gate, W.
Thomson, Walter, Beheea, East Indian Railway, Bengal.
Vandersee, Henry, Clifton-lodge, Elgin-crescent, Notting-hill, W.
Wagstaff, James Poole, Highbury-lodge, Islington, N., and Manor-park, Potton, Bedfordshire.
Whitehead, W. H., Ontario-lodge, 10, Kilburn-priory, N.W.
Williams, Edward, 23, Birchin-lane, E.C.
Windover, C. S., 32 and 33, Long-acre, W.C., and Sandford-hall, Huntingdon.

Wylie, Andrew, Prinlaws, Leslie, Fifeshire, N.B.
Zimdars, Conrad Edward, 28, Red Lion-square, W.C.

AND AS HONORARY CORRESPONDING MEMBERS.

Echegaray, His Excellency Don José, K.G.C., St. M. and St. L., Minister of Education, Public Works, Agriculture, Industry and Commerce, Calle de Olozaga, No. 13. Madrid.
Fontanals, The Most Illustrious Don Antonio M., Director-General of Statistics, Agriculture, Industry, and Commerce, Calle de Alcalá, No. 7, Madrid.
Martos, His Excellency Don Cristino, K.G.C.M., LL.D., &c., Minister for Foreign Affairs, Calle de Serrano No. 20, Madrid.
Merelo, His Excellency Don Manuel, K.G.C.I.C., &c., Under-Secretary of the Minister of Foreign Affairs, Calle del Barquillo, No. 13, Madrid.
Ritz, Dr. Wilhelm Carl, 12, Römer-strasse, Bremen.

The CHAIRMAN then gave the following

ADDRESS.

In undertaking the duties of Chairman of Council, I labour under great disadvantage in succeeding one like Lord Henry Lennox, M.P., who so ably filled the post for several years in succession, and by his zeal for the interests of the Society, and his position in the Legislature of the country, as well as by his personal qualities, was able to serve the Society so efficiently. I am, however, encouraged by knowing that the Council is composed of those that earnestly desire to forward everything that falls within our legitimate sphere, many of whom have long been connected with it, and whose names are associated with the active work carried on by the Society for several years past. I trust, therefore, that the coming year may see us following the example of those that have preceded us, and effecting much for the public good.

The principal duty which devolves upon me at this, the opening meeting of the one hundred and nineteenth Session of the Society, is that of laying before you a statement connected with the principal matters that the Council has under consideration. Before doing so, I have to follow our established custom, and name to you a few of those more or less active members of the Society whose loss by death during the past year we have to deplore.

Among these no name will be more familiar to members and readers of the *Journal*, than that of the late Mr. William Bridges Adams.

As a youth he was of delicate constitution; but, having completed his education, he for a time found occupation in the workshops of his father, who was a carriage builder in Long Acre. He soon, however, left the workshop to study engineering and mechanics, under the late Mr. John Farey, then an active member of our Society, and at a later period Chairman of the Mechanical Committee.

Under Mr. Farey's tuition, Mr. Adams soon became thoroughly familiar with the structure of machinery, and the most economic means of applying it to industrial purposes. But his health failed, and he, as a last and almost hopeless resource, left this country for South America. He remained abroad for some years, and ultimately established his constitution. While in America, Mr. Adams taught the natives the English method of making candles, and he treated tallow under steam pressure, separating the stearine from the oil and other matters. Long years after his return to England, he saw a similar process patented and applied to the manufacture of candles in this country.

Mr. Adams was a man of keen observation, and an original thinker, and much that he saw while abroad he endeavoured to apply for the benefit of his countrymen at home. He had especial sympathy with the labouring classes, and formed many schemes for ameliorating their condition.

When again settled in England, Mr. Adams recommenced carriage building; but the railway era was approaching, and as it came on, he foresaw the influence it was destined to have, for a time at least, upon his business, and he accordingly gave up ordinary carriage building for the purpose of establishing works on a large scale, for the construction of railway carriages and plant by the aid of machinery. These works he located at Fairfield, Bow, and there achieved some of his greatest successes, and met also with his greatest misfortunes. He had the entire responsibility of the engineering concern at Bow, but nothing whatever to do with the monetary department; and without his knowledge he was made liable under bill transactions for a sum of money that utterly ruined him. But he was, in the highest sense of the word, a man of honour, and met his liabilities by giving up every shilling he possessed for the benefit of his creditors.

It is due to his memory to state, that Mr. Commissioner Fane, in delivering judgment, said the case of Mr. Adams was one of great misfortune; he appeared to be a man of great diligence and talent, and of very economical habits, and he considered him as well entitled to a certificate of the first class as any bankrupt who had appeared in his court.

If there was any one period in the life of Mr. Adams, when there was the least trace of pride in his nature, it was only made visible when circumstances led him to refer to the ruin which had been brought upon him, and when he felt that in passing through the fire he had not sacrificed the principle of honesty and self-respect to that of personal aggrandisement.

During his residence away from England he was more than once in imminent peril of shipwreck, and his mechanical knowledge was at times brought to bear in the relief of his fellow sufferers. It was during one of these occasions of peril that he saw the ship's carpenter "fish" a mast which had been splintered by the storm; and while conducting his business at Fairfield Works, Bow, he invented the fish-joint for rails, thus adapting the principle to railways which he had seen applied on board ship. Although circumstances, the particulars of which he has himself published in *Engineering*, led him to part with his interest in the fish-joint for railways, so that he never obtained any advantages from it, yet others, to whom he gave shares in the patent, realised large sums of money. By this as well as by many other inventions, Mr. Adams has made the railway world very greatly his debtor. He has sowed in that world golden seed; while it is a fact that ought not, in justice, to be forgotten, that he reaped no harvest. He died a poor man.

The question is arising in many minds whether it would not be a just and generous act on the part of the railway community, who have reaped, and will continue to reap, the fruits of Mr. Adams' genius and labours, to allow his widow and children to participate in those fruits; for he might have exclaimed, in the words used by Baskerville, when writing to his friend Dr. Franklin, "After having obtained the reputation of excellence in the most useful art known to mankind, of which I have your testimony, is it not to the last degree provoking that I cannot even get bread by it!"

Delabere Roberton Blaine died on the 13th of December, 1871, after a severe illness. He was a barrister, and was well known for his skill and learning in all matters connected with the law of copyright. When the Society took up the question of artistic copyright, with a view to the amendment of the law, he joined the Society's Committee, and worked ably and energetically upon it. The first bill was drawn by him as a labour of love, and ultimately, after seven years of continued work, was taken up by the government. Under the able guidance, in the House of Commons, of the present Lord Chancellor, then Attorney-General, and of Lord Westbury, then Lord Chancellor, in the House of Lords, the Bill became law in 1862, and under it copyright was secured for the first time for pictures, photographs and drawings, which, up to that time, had no legal protection whatever. Mr. Blaine was subsequently made a county court judge, and had just been transferred from Lincoln to Marylebone, when he was attacked by a severe illness, from which he never recovered. He became a member of the Society of Arts in 1857, and soon after was elected upon the Council, where his sound judgment and independent views, coupled with a remarkably genial and courteous manner, rendered his presence always acceptable.

Sir Francis Crossley, Bart., M.P., died on the 5th of January, at his seat, Bellevue, Halifax. Sir Francis, the son of Mr. John Crossley, an enterprising carpet manufacturer at Halifax, was born in 1817, and at an early age entered his father's business, in which he became joint-partner with his brothers, Messrs. John and Joseph Crossley. These gentlemen have been great benefactors to the town of Halifax, where they employ above 5,000 workpeople, and have recently erected and partially endowed an Orphanage for the maintenance and education of 400 children, besides contributing munificently to other benevolent undertakings. Sir Francis Crossley presented to his native town, in 1857, a handsome park and pleasure-ground, and he built a row of almshouses for aged people, whose support is provided for by endowment. He was elected a member of the Society of Arts in 1856, and co-operated most usefully with the Council in its action relative to the improvement of labourers' dwellings, a subject to which he had given great attention in his own district.

Colonel W. H. Sykes, M.P., in November, 1856, delivered an address in this room, as Chairman of the Council. The great interest he evinced in all matters affecting the welfare and advancement of industry, both at home and in India, and the active part he took in the discussion on questions of Indian produce and social advancement in this room, made him personally known to, and esteemed by, many who now hear me, while his fearless advocacy of every cause calculated to advance the well-being of the community at large, whenever an opportunity for so doing was afforded him as Member for Aberdeen, is well known. He was elected a member of the Society of Arts in 1855.

Richard Westmacott, R.A., F.R.S., inherited his artistic taste and powers from his father, the celebrated sculptor, the late Sir Richard Westmacott. Born in London, in the year 1799, he was brought up under his father's eye, and in 1820 he went to Italy, where he spent some five or six years in studying the galleries of ancient art. Soon after his return to England, in 1827, he began to exhibit at the Royal Academy. In 1838 he was chosen an associate of that body, to the full honours of which he was admitted in 1849, and ten years later he was appointed Professor of Sculpture. He had retired some years from the active work of his profession, but was well known both as a lecturer and a writer on artistic subjects, upon which he contributed largely to our cyclopædias and other serial publications. In the year 1867 he gave a course of Cantor Lectures before the Society, on "The History and Theory of Sculpture," which many present will, no doubt, remember to have listened to with pleasure.

In Mr. C. H. Fielder, a young member of the Society, was lost one whom its sphere of action had brought into activity. Being the secretary of an Indian tea company, he was, by joining our ranks, induced to seek our co-operation in promoting the objects in which he was interested. His contribution of a paper to our Society's *Journal* led to greater attention being paid to the science of tea culture, to the improvement of tea manuals, and the award of medals by this Society and the Agri-Horticultural Society of Bengal. His premature death brought to a close what promised to be a useful career.

The late Samuel Morse was less connected with us, as one of the inventors of telegraphic improvements, than by the circumstance that, when studying in this country in his earlier career as an artist, he received one of the prizes which the Society had for so long a period granted for the encouragement of art.

Amongst the better known of those other members whose loss the Society has to deplore, relative to some of whom notices have appeared from time to time in the *Journal*, are Thomas Howard, Joseph Pease, John Platt, M.P., the Earl of Lonsdale, James Stansfeld, and Alderman Hale.

The Cantor Lectures, which have become an important feature in the Society's yearly action, and have, night after night, for several Sessions, brought together crowded audiences in this room, will be continued this Session, and it is hoped that the subjects selected will prove not less interesting and instructive than those treated in former years. It may be mentioned, with some justifiable pride, that the substance of one of a past series has formed the text-book for the Government examinations in the subject treated, and that of another has led to the establishment of a professorship at the Royal Academy.

The large attendance that these lectures attract show how highly the valuable labours of the able men that have delivered them are appreciated. They form, in fact, a concise account of the present state of knowledge on the subjects treated, and therefore cannot fail to be of great interest to our members.

The first course this Session will be on "The

Practical Applications of Optics to the Arts and Manufactures, and to Medicine," by Dr. C. Meymott Tidy, Joint Lecturer on Chemistry, and Professor of Medical Jurisprudence at the London Hospital; it will consist of five lectures, to be delivered on Monday, the 25th instant, and the four subsequent Monday evenings. Other courses will also be given during the Session; one, by the Rev. Arthur Rigg, whose course last Session on Mechanism excited so much interest, will be "On the Energies of Gravity, Electricity, Vitality, Affinity, Light, and Heat, especially with reference to the Measurement and Utilisation of them."

The Food Committee of the Society has already brought forward much valuable and interesting information, and will continue its labours. The high price of meat at the present time renders the subject of its inquiry just now of more than ordinary importance.

Count Rumford, in his essay on Food, says:—"As providing subsistence is, and ever must be, an object of the first concern in all countries, any discovery or improvement by which the procuring good and wholesome food can be facilitated must contribute to increase very powerfully the comfort, and promote the happiness of society." The Society of Arts from its foundation has ever held a like opinion, in confirmation of which I would refer those who do not know the early history of the Society's labours to the Transactions which it published previous to its incorporation by Royal Charter in 1847.

I may, however, state that the Society caused our own people to learn the art of catching turbot, which a century since they were ignorant of. The turbot were caught on our own coasts by the Dutch, by whom they were supplied to the London market.

The Society did very much both to improve and increase the supply of fish generally to the London markets, and upon this work it spent several thousands of pounds. It also spent large sums upon the cultivation of root crops and vegetables, and in the introduction of new sources of supply it has never ceased action.

The question of Food Supply is not in any degree less important now than at any previous period since the Society's foundation; and as some attention has been given to the subject outside the Society, during the last four or five years, I have thought that it might be well to state briefly what the Society itself has done since the new era of its existence was inaugurated.

In 1844, beef and mutton were mere refuse products in Australia. A leg of mutton could be bought for 6d., and a barrow full of the inferior joints for a like sum, indeed in some cases they might be had for the trouble of fetching. At that time sheep and oxen were grown for their wool, skins, bones and fat; some attempts were certainly made to reduce the lean of meat into a solid condition as a portable soup, and to export it to this country, but, previous to 1845, all these attempts failed, owing to the charring of the gelatine in the reducing pans. In 1844-5, however, the use of the water-bath was introduced, and the objectionable burnt flavour of the concentrated product was, to a large extent, got rid of; and in 1845-6 the Society awarded its Gold Isis Medal to Mr. G. Warriner, for the preparation and importation of the essence of beef from Australia. The essence of beef was imported in the form of tablets of various sizes, intended for simple beef-soups, or in combination with rice, sago, tapioca, and other farinaceous substances, vegetables and condiments; little more was then required than to dissolve the tablets in a sufficient quantity of water, and the soup was ready for use.

Like other concentrated meat extracts, it required some little skill and judgment on the part of the cook, or person using it, to make it generally acceptable; and, therefore, though good in itself, it has not become, to any appreciable extent, an article of commerce.

In 1845, the year of the terrible famine in Ireland, owing to the failure of the potato-crop, the Society had placed at its disposal, to be offered as a prize, the sum of £105 "for the invention of a mixture of a material for a wholesome, nutritious, and palatable bread, to be sold at a low price, and used as an economical substitute for wheaten bread, biscuits, or potatoes." The prize was offered, and the minutes of our Society state that in April, 1846, a new sort of bread and biscuits, by Timothy O'Brien, baker, of Dublin, was received by the Society through C. E. Trevelyan, Esq., Secretary of the Treasury (now Sir Charles Trevelyan). The Society had bread made in London by Mr. Day, according to the receipts furnished by Mr. O'Brien, and the secretary reported that Mr. Trevelyan had informed him that Mr. O'Brien was a highly respectable master baker; that he was manufacturing bread similar to that sent to the Society on an extensive scale; and that he had exerted himself in a very praiseworthy manner to endeavour to overcome the prejudices of the people, and assist the Government in their attempts to alleviate the distress of the peasantry of Ireland.

Mr. O'Brien submitted samples of bread of various kinds to the Committee of the Society. The first sample was made of white Indian meal and wheaten flour, the proportions being 6lbs. of meal to 1lb. of flour.

The second sample was made of yellow Indian meal and wheaten flour, in the same proportions. The biscuits were of two kinds, made of the same materials and of like proportions with the bread.

Eighteen other persons also submitted samples of breads, or sent in receipts for the making of bread, but no baker in London would make the breads proposed except Mr. Day, who made bread after Mr. O'Brien's receipt.

After a lengthy consideration of the subject, it was resolved by the Committee to award the large Gold Medal of the Society to Mr. O'Brien, in acknowledgment of the excellence of his bread, and of the merit of his exertions for the promotion of the same objects for which the premium of the Society was originally offered.

It will be seen from the foregoing that, in 1845, Indian corn was not used either in Ireland or this country as a bread-making substance; and when its use was proposed during a period of famine, the people were greatly prejudiced against it; indeed, at times, so great was the excitement of the people that many refused to eat it. Since that time the use of Indian corn has become almost universal, and it may be doubted if any baker could now be found in the United Kingdom who does not use it to a greater or less extent. Prejudice to be overcome in reference to any new food-substance is the great difficulty in the way of much being done that might be done, and we should not forget that, even so late as the beginning of the present century, the peasantry in some parts of England would not eat potatoes.

A prize was also recommended to be offered for a paper on the mode of averting the evil which may arise from the deterioration of the potatoes to be used as seed, pointing out the source from which the best seed may be obtained; and a short address was ordered to be prepared, calling the attention of agriculturists throughout the country to the state of the potato crops, and suggesting the formation of local committees to assist the poorer classes, and provide seed for the next year.

The Society's Gold Medal was also offered in 1847-8, for the importation of any new plants likely to be a useful substitute for the potato crop; and the Society subsequently published an account of a plant called the "Gold of Pleasure," or *Camelina sativa.* This plant is a native of the northernmost parts of Siberia, and does not exhaust the soil; it may be grown after the corn crop, and may be sown with all sorts of clover. Mr. W. Taylor, F.L.S., the introducer of the plant into England, resolved to offer it to the Irish farmer, in consequence of the calamitous state of the country from the failure of the potatoes, flax, and other crops.

The Gold of Pleasure is a cruciferous plant, having smooth stalks, and the seed in husks, but the stalk is without fibre; its seed is more valuable as a food for cattle than linseed, and a fine oil is produced from it. It yields a crop of about 40 bushels of seed per acre (see "Transactions," 1846-8, page 53), but no large amount of attention has hitherto been paid to its cultivation, either in Ireland or in this country.

In the address given by the late Mr. Harry Chester, when acting as the Chairman of your Council, at the opening of the 100th Session of this Society, allusion was made to the British possessions and colonies as a source of our food supplies. Why, he asks, should Australia export only the wool of her sheep, and boil down the carcases merely for their fat? Is it impossible to preserve the flesh, and to export it in a satisfactory condition to this country, where butchers' meat is not over-abundant?

In March, 1857, the Council had placed at its disposal, by Sir. W. C. Trevelyan, Bart., the sum of £70, to be awarded as prizes for essays on the "Application of the Marine Algæ, and their Products as Food and Medicine for Man and Domestic Animals;" and on the 14th February, 1862, a paper was read before this Society, by Mr. Edward C. C. Stanford, upon the "Economic Application of Seaweeds." Previous to the paper being read, the Trevelyan Prize had been awarded to Mr. Stanford, upon the report of the late Mr. Thomas Graham, who, in recommending the communication for reward, stated that though the investigations of Mr. Stanford did not lead to the probable utilisation of the algæ of our coasts as articles of food for the people; nevertheless, the results of his investigation were of such novelty and importance as to render it probable that a new source of industry would be created in these islands.

In consequence of the opinion thus expressed, the author of the communication requested permission to withdraw it from the Society for the purpose of securing, by letters patent, the discoveries therein made known; this he was allowed to do, and works on an extensive scale have ever since been in operation on the coast of Scotland. The communication referred to will be found at page 185, Vol. X. of the Society's *Journal.*

The prize of Sir W. C. Trevelyan thus again remained in the hands of the Society, and the Council were authorised to offer it for award in such directions as they thought most likely to be useful to the community.

They accordingly offered it in the Session of 1863-4, for an analogous subject, viz., as a prize for "Preserved Fresh Meat" in the following terms:—"The sum of £70, placed at the disposal of the Council by Sir W. C. Trevelyan, Bart., with the Society's Medal, is offered for the discovery of a process for preserving fresh meat better than by any method hitherto employed, applicable to the preservation of meat in countries where it is now almost valueless, so as to render it an article of commerce, and available for stores on shipboard."

The Council from that time has never ceased to pursue its inquiries in relation to the food supply. A Food Committee was appointed in 1866, and year by year it has reported on the progress made towards the solution of that all-important question. Although the Committee have not at present felt justified in recommending the award of the prize, yet great national good has resulted from the investigations which have been carried on, and from time to time it has felt itself in a position to commend and recommend certain classes of preserved food products, such as the Australian meats, and the Swiss and English preserved milks, which were previously unknown to commerce, for acceptance by the public. The people have been greatly benefited by the yearly importation of Australian and other preserved meats in tins, and the increasingly large importation indicates that the prejudice against them is passing away. It is also gratifying to note that a very marked improvement is taking place in the preparation, due, it is not unreasonable to conclude, to the labours of our Committee. The importation of cooked meat does not, however, solve the great and important problem of fully utilising the vast herds and flocks now almost wasted in other parts of the world.

The Council and the Food Committee still look forward to the early solution of the problem in Australia or elsewhere, viz., how to preserve meat fresh and in carcase during its transport from the port of shipment to the markets of this country. The economical production of ice or its equivalent of cold has hitherto appeared to be the chief obstacle to the realisation of the desired result. When the investigation began, some six or seven years since, the quantity of ice produced per ton of coal consumed did not amount to more than four or five tons, and the displacement of cargo on ship-board was excessive; but by recent improvements in the processes of evaporation and condensation, that quantity of ice or its equivalent has been raised to 15 or 20 tons.

It has been reported within the last few weeks that the difficulty in the way of the economical production of ice or its equivalent had been surmounted in Australia, and that cargoes of fresh carcase meat have been shipped from Australia to New Orleans, and preserved fresh during the voyage, notwithstanding that the temperature of the atmosphere ranged as high as 90 deg. The Council hope to learn that this statement is borne out by fact, and to find themselves in a position to award the prize so long since offered, a prize which they have now the pleasure of announcing has been increased to £100, by a further donation of £30 by Sir W. C. Trevelyan; to this also will be added the Society's Gold Medal.

While on the subject of food, let me point out that the International Exhibition to be held next year includes this as one of its divisions; and at the request of her Majesty's Commissioners, the services of the Society's Food Committee have been enlisted on behalf of this section of the Exhibition, the particular portion undertaken by the Society being that of "grocery, drysaltery, and preparations of food," the other portions being in the charge of the Royal Agricultural Society and the Royal Horticultural Society. In order the more effectually to secure a complete representation of this class of objects, the Food Committee has sought and obtained the assistance of a numerous body of gentlemen specially conversant with the various articles of commerce included in this section. A strong Committee of Advice has been formed, through whom, it may be confidently expected, a valuable and instructive collection will be obtained, and a display prepared that will exercise an important influence in promoting an improved supply.

Great changes have already been made during the past two years in relation to the structure and use of our common roads, and long and important discussions have, from time to time, taken place in this room as to the expediency of introducing tramways on the roads of our principal cities and towns. The question of expediency has now been settled by the fact that tramways have been introduced, and are at work in London and in many other parts of the country, and some attempts have been made to combine the system of tramways with an improved construction of the road surfaces themselves.

Much, however, still remains to be done before we shall attain to a perfect combination of rail and road surfaces. Asphalt, tar-concrete, wood, stone-pitching, macadam, and iron have all been tried, separately, or in combination with the iron trams; but until we obtain a good durable surface, capable of general and economical application, we can, it is to be feared, do but little to improve the cleanliness of our streets and roads.

The questions of the surface-covering of roadways, carriage-ways, and foot-pavements, involve those of the economy of tractive force. They also involve many sanitary questions—as to the dust and dirt produced, and the means of cleansing, which have yet to be determined for the guidance of Local Administrations. In reference to these, the Council has voted a sum of money for the determination by a dynamometer of the different tractive forces required on different sorts of pavement—the old granite pavements, boulder and macadam, and wood, and the different species of asphalt pavement. Our member, Mr. Amos, who has had great experience in the use of the dynanometer, has liberally undertaken to conduct these trials for the Society. I regret to say that he has had a serious illness, which has delayed these trials, but he is, happily, now recovering, and hopes to enter upon them shortly. The new and improved machine to be used in the experiments is now completed. The investigation, being confined to the ordinary conditions of roadways in towns, presents few difficulties, and is likely to be attended with more correct results than if an attempt were made to determine the larger question of draught upon all surfaces and declivities. Should the system of asphalt paving become common, we may hope for a very great improvement in the comfort and convenience of omnibuses and other public carriages.

The Council have also taken steps to obtain analyses of the mud produced by the concussion of vehicles on the different sorts of pavements, which may be said to be analyses of the different sorts of dust generated by vehicular traffic, and inhaled by the population, as well as spread over their skins. An analysis of the mud from the old granite pavement in the City gave more than 50 per cent. of horse dung, 17 per cent. of abraded iron, and the rest a mixture only too likely to be conducive to disease of the tuberculous organs. How this composition is produced by the percussive force brought to bear on the several descriptions of pavements, will be shown by analyses which the Council propose before long to have completed. Corresponding experiments are promised us from Paris, to be made at the Arts et Métiers, by Mons. Tresca, of the Institute.

And here I would take occasion to refer to a bequest by our late member, Mr. Thomas Howard, of £500, which the Society has recently received, and the interest of which is to be applied "for the purpose of presenting periodically a prize or medal to the author of a treatise on the properties of steam generally, or any of them particularly, as applied to motive power, or it may be of air or permanent gases, or vapours, or other agents so applied, or to the invention of some new and valuable process relating thereto." The Council has accordingly included in the list of premiums which it is preparing for issue, a prize in accordance with Mr. Howard's bequest, and it is to be hoped that the attention of men of science, engineers, and others, will be directed to the solution of the problem, how a motive-power engine can be constructed so as to admit of its being used as a tractive power on the tramways of our common roads without creating a nuisance, and with safety and advantage to the public generally.

Had the conclusions enunciated in the discussions of the Society on the expediency of the adoption of telegraphic communication as part of the postal system of the country, been acted upon when attention was claimed and due for examination and action, an immense sum of money would have been saved to the public, who might by this time have had the advantage of sixpenny telegraphic rates, such as those long enjoyed, with immense advantage to Arts, Manufactures, and Commerce, in Switzerland, Belgium, and Germany. The same conclusions had, it appears, been formularised and presented for attention within the department itself, but without effect. Now every year's inattention and delay may be said to have cost the public not less than half a million of money, until the adoption of the principles in question, as respects the inland telegraphs. The identical principles are applicable to the ocean telegraphs, and it is to be remembered that there is a similar large cost accruing during the delay of the adoption of those same principles, an adoption which, if we are to keep pace with Continental states, may be declared inevitable. In the former case it was represented that the government could do what trading companies could not do; that the government could utilise numerous existing postal offices, and an immense postal service; that it could make extensions of stations with a profit, or at the cost of the service, which the trading companies could not do without loss; that it might make reductions of tariffs, and sustain temporary reductions of income, which could not be done by trading companies; that it, by unity of management, as well as by utilising existing establishments, could effect savings which might be divided between the public and the shareholders. All this, which was done in respect to the inland telegraphs, is incontestably applicable to the ocean telegraphs. These changes were indeed comprehended in the original scheme, but were left out for want of time. It is to be borne in mind that the saving of time by the inland telegraphs is of hours and days, but by the ocean telegraph of weeks and months; and social messages being comparatively few, or of no account, in ocean telegraphy, it may be set down that, as a rule, every telegram moves at least one transaction in manufactures and commerce, and that this new power of movement is applicable to upwards of six hundred millions annually of imports and exports. The chambers of commerce will appreciate—have, for the most part, appreciated—the importance of the movement undertaken by the Society.

The following declaration has already been signed by more than forty merchants, shipowners, and others in support of the movement:—

> "We, the undersigned merchants, shipowners, shipbrokers, and agents, trading as hereunder stated, are of opinion that it is necessary for the improvement of commerce, that, as proposed by the Society of Arts, the ocean telegraphs should be taken by the government as part of the general postal system of the empire, to be used at lower rates of charge than those now made by the trading companies. And we express our confident belief that at such lower rates as have been proposed to begin with, of one shilling a word to Canada, or British North America, and to the United States, and at 2s. 6d. per word for messages to India and to the Australian colonies and New Zealand, we should expend a greater amount of money than we now do in ocean telegraph messages."

It may have been in pursuance of such an opinion that some of the companies have already adopted a system of word telegraphs, which is a check to the practice of "packing"—a practice created by dear rates. When the colonies are made aware of the movement and its objects and means, they cannot hesitate to join it. The charge for Australian telegrams of £9 a message is one that must be prohibitory of almost all social messages, and of all but messages for the largest transactions.

Lord Henry Lennox, in the House of Commons last session, gave notice of a motion for a committee on the subject, and will doubtless continue to press the question forward next session of Parliament.

The Council have reason to hope that the actual establishment of national scholarships for music, to be competed for in many of the counties of the United Kingdom, will take place in the course of the ensuing year. From the list of upwards of 80 subscribers may be named the following:—Sir Titus Salt, Bart., has promised to devote £1,000 to the foundation of a scholarship, when the National Training School for Music is established, to be called the Saltaire Scholarship. Mr. Frank Morrison will subscribe £50, for five years, for an Invernesshire Scholarship. Mr. C. Minton Campbell will give £50, for five years, for a Staffordshire Scholarship. Mr. Hawkshaw, C.E., promises £25, for five years, for a Sussex Scholarship. Mr. H. A. Hunt promises a donation of £100. The Marquis and Marchioness of Westminster will subscribe £15 annually. The Marquis and Marchioness of Lansdowne, £5 5s. annually. The Musical Committee will be requested to advise in reference to the necessary details for regulating the holding of these scholarships, and the Council have special satisfaction in announcing that H.R.H. the Duke of Edinburgh is personally interesting himself in the plan.

Although the Cotton Supply Association of Manchester has seen fit to bring its labours to a close, after a career of great utility, there still remains much to be done for the promotion of cotton culture. The same reasons which prompted the formation of that association, long before the American war, still exist, and the culture of cotton is far from having reached its proper extension in India, Queensland, and our other colonies, countries in the development of which our Society has always taken great interest.

The Council will endeavour to supply that organisation which may be necessary, and that may perhaps best be done by the formation of a Cotton Supply Committee.

The Council readily consented to give the cooperation of the Society to the Cotton Department of this year's International Exhibition, and it is in a great degree by this means that the successful display of raw material in every shape was effected, and particularly in the large collection of living plants. This latter feature has given an example which it is hoped will be successfully followed in the next year's exhibition of silk, when the hatching of many varieties of worms can be observed on the spot.

The India Committee and Silk Supply Committee will still continue to occupy themselves with their respective subjects. Great attention is being given, both in Australia and at the Cape of Good Hope, to silk-growing. Last year, it will be remembered, the Society's Gold Medal was bestowed on Mr. Chubb, for silk cocoons grown in Queensland, the quality of which met with high approbation from the Macclesfield Chamber of Commerce. Information has just reached the Society of samples which have lately been sent over from the Cape of Good Hope, the quality of which is spoken of in the highest terms of commendation by the manufacturers of Macclesfield. The formal report is expected very shortly, and will be published in the *Journal*. One of the great difficulties the silk grower has of late had to contend with is the silk worm disease and the difficulty of obtaining eggs uncontaminated with it. The world is ransacked for healthy seed, as it is termed; and how to breed healthy worms is a great desideratum. An enterprising lady, a Queensland colonist, has lately come to Europe in search of a solution of this problem, and has just gone back with information, by means of which she hopes to render Queensland a source from whence we may expect to draw our supplies of healthy seed. It appears that, after repeated unavailing attempts in various directions, she heard of a gentleman in Switzerland who had suceeded in so treating the worms as to reach the object sought. She at once placed herself in communication with him, and having made herself thoroughly acquainted with the system employed, has gone back to the colony to carry it out, in full confidence that in a short time success in this direction will crown her efforts.

The success of the Society's exertions in obtaining the constitution of an agricultural and industrial organisation of the government departments in India, will render the study of the various products of our empire of more importance, and give scope for the exertions of our India Committee. One advantage resulting from our labours is that, by means of the correspondents of Indian journals in London, the various objects discussed are widely made known to those locally interested by the press of India.

The subject of fibres is one of great importance in reference to the supply of raw material for various manufactures, and the Council will continue to give to it the same active attention as during late years, and they trust the efforts they have made in Turkey will lead to practical results.

The action of the Society in respect of improving the convenience and accommodation of steamers employed in the Channel passage, has stirred up a great amount of feeling in favour of the object; and this not only among the general public, which suffers so much from its horrors, but among those connected with and interested in the existing arrangements. It is hoped that, without waiting for the long-talked-of improvement of the French harbours,* much may be done in the way of general arrangement, and ventilation, and shelter, that will materially add to the comfort of passengers.

The Council, by special invitation of one of their members, Mr. Bessemer, visited that gentleman's house on the 9th inst., to witness a series of experiments, made with a working model of his invention for overcoming the effects of the motion of vessels at sea. The success which has already attended Mr. Bessemer's endeavours to effect improvements in various branches of industry, leads to the hope that he will ultimately succeed in accomplishing the object in view.

The proposals of Captain Dicey and of Mr. Mackie, for modifying the structure of vessels, are also being watched with great interest by the Council, who are glad to find that the South-Eastern Railway Company have already placed an improved vessel on the Channel, by which the comfort of passengers is increased.

The great success which attended the Review of Schools held last summer, under the inspection of H.R.H. the President of the Society, and the gratification which was afforded by it to the boys, make the Council deprecate the idea of not carrying out the same plan during the next season; but the expense attending it is such that unless special contributions are made for the purpose, they will hardly be justified in doing so. Those in charge of schools where drill is sytematically carried on, cordially agree in its great value as a means towards the cultivation of mental and moral discipline, and it is to be hoped that this display of what is being done in this direction may continue to be brought before the public.

A conference was held in August last, under the presidency of H.R.H. Prince Arthur, well attended by eminent manufacturers and members of City Companies, to consider the important question of Technological Examinations, and the Society has this year undertaken to inaugurate a system which will, perhaps, ultimately supersede the system of examinations established at the instance of the late Mr. Harry Chester. These latter it had been the intention of the Council to discontinue this Session; but they received from several of the principal Institutions in Union with the Society so earnest an appeal against this course, that they decided to retain a certain number of the subjects for next year. The establishment by the government of examinations for the National Schools, and by the Universities of Oxford and Cambridge of their local examinations, will no doubt ultimately render further action on the part of the Society in the same direction unnecessary. The Council is now, therefore, turning its attention to the development of such a system of examinations as shall tend to promote an extended technical knowledge of the arts and industries of the country, and thereby give rise to a further development of commerce. In many of the continental cities trade schools exist, but in England we have not hitherto possessed any such institutions, if we except the School of Mines and the College of Chemistry.

The want of such schools is daily making itself more and more felt in each of our manufacturing centres, and it is the desire of the Council to inaugurate such a system of action, through the Union of Institutions, as may ultimately lead to that being done in relation to industry which has been, or is being, done for the general education of the future workpeople of the United Kingdom.

With the help of committees of gentlemen specially conversant with various branches of manufacture, the Council has already prepared programmes explaining the mode in which it is proposed to hold examinations in the art and technology of the manufactures of cotton and paper; and similar programmes for silk, steel and carriages are in course of preparation. I may mention that these examinations will be divided into three parts. The first includes those branches of science, a knowledge of which is considered requisite as a foundation for sound technical instruction, taking into consideration the present limited opportunities for obtaining a scientific education in this country. The second part relates to the technology of the manufacture, or the special application of the various branches of science to it, and the third to the practical skill in the manufacture itself.

The requisite knowledge, as respects the first part, will be tested by the May Examinations of the Science and Art Department, while for the second, technology, special examination papers will be set. The practical skill will be judged by the returns of the candidates' employment in the manufacture itself.

These technological programmes will be circulated in the various centres of industry, and the Council hope this Session to make a beginning with some, at least, of the manufactures just mentioned; but the system is as yet so new, and the technical education of the English artisan so imperfect, that they are not sanguine of obtaining a large number of candidates the first year.

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* By the Parliamentary notices just issued, there appears one by the South-Eastern Railway Company, to empower them to raise capital for the improvement of Boulogne harbour.

The Council have, from time to time, had under their consideration the improvement of the *Journal*, and now contemplate some alterations, which, they hope, will render it more interesting and instructive, as well as more attractive in type and appearance. It must be remembered that the *Journal* is principally a record of the Society's proceedings, and forms, at the end of each year, the volume of "Transactions." All other matter is subordinate to this, and has to take its chance of the varying amount of space in any week which the Society's proceedings proper leave available for it. The *Journal* in no way competes, nor is it intended to compete, with commercial journals, which can readily devote a definite number of pages to each class of subject with which they undertake to satisfy the tastes of a numerous body of readers.

The catalogue of the library has been re-arranged in a more convenient form for reference, and about two thousand additional entries have been inserted. This will show that we possess many valuable books connected with our work, and that a most useful institution is available for the information of the members.

Through Sir William Bodkin, from a gentleman who does not wish his name to appear, the Council has received the very liberal offer of £500, to be used in such a way as they may consider best, for some means of economising the use of coal for ordinary domestic purposes, without diminishing its efficiency.

The great rise in the price of coal has again brought this question more prominently before the public, and the Council cannot but express their admiration of the practical philanthropy which has urged a private individual to contribute so handsomely towards an attempt at its solution. It is not intended to entertain any proposals which are suitable only for the mansions of the rich, or have relation to cooking for large numbers, but rather, taking a room as the place for experiment, to offer prizes for grates suitable for existing chimneys, which shall fulfil the conditions of warming and ventilating, or of cooking in combination with these. But though thus inviting the manufacturers of grates, among others, to compete, it is obvious that any widely-spread and real improvement depends mainly on the designers and builders of houses. Year after year we hear of the same result, owing to the extravagance and waste of valuable material, in producing a miserable substitute for warmth and comfort in ordinary dwellings, and year after year we see the same type of enormous fire-places and chimneys, in many cases constructed without even the application of the form which experience shows to be the best, rising up on every side. However much we may hope that builders will, some day or other, have the courage to strike out a new line altogether, we can only at present advise, with regard to the money entrusted to us, that it be awarded in connection with the arrangement of houses already built, and that the improvements should be of such a character that the dwellings of the many should be able to profit by them.

While upon the subject of prizes given by individuals to the Society for special objects, I may again refer to the bequest of Mr. Thomas Howard and to the food prize offered by Sir Walter Trevelyan, as it gives me the opportuity of pointing out how much the Society is indebted to the liberality of its members, and of expressing a hope that some of those interested in any particular inquiry will follow such noble examples.

The Albert Gold Medal, established in memory of H.R.H. the Prince Consort, President of the Society during eighteen years, is awarded annually for "distinguished merit in promoting Arts, Manufactures, or Commerce." As you are aware, this medal has just been awarded to a gentleman whose name is well known among the skilled and enterprising of all nations for his improvements in the manufacture of steel—improvements which have redounded, not only to his own personal advantage, to the national wealth and the national honour (for a nation is honoured in the honourable success of her sons), but also to the benefit of all countries where arts and manufactures are in use.

The Gold Medal, in furtherance of the terms of Dr. Fothergill's will, is this year offered for the production of an incombustible paper, so as to render the ledgers of commercial men, bankers, &c., ordinarily indestructible by fire.

The Silver Medal, in furtherance of the will of Mr. John Stock, is this year offered to female artists, for the best cameos designed and executed on any of the shells ordinarily used for that purpose.

I may mention that the Council offer the following prizes for improved cabs, the terms connected with which have already been published:—

One prize of £60 for the best-improved cab of any description.

Two prizes of £20 each for the two next best.

Two prizes of £10 each for two next best.

It will not be out of place to mention here that the Council have appointed a committee to consider the conditions under which the Gold Medal of the Society may be awarded for the best steel exhibited in the International Exhibition in 1873. Though aware of the very great difficulty and care required in submitting any material to such tests as shall furnish a reliable conclusion as to its real properties and value for commercial purposes, the Council expect that some valuable data will be obtained from the experiments to be made on the various samples.

The Council will shortly issue a list of subjects for premiums, and in asking for communications upon them, it is aware that some of the suggestions proposed to be put forth may, at first sight, appear somewhat difficult of realisation. In some instances the thing asked for involves the use of known substances, and their employment in the industrial arts in a manner in which they are not at present used, but in which they have reason to believe they are capable of being applied with economy. In other cases the aid of the chemist is sought to develop such a form of action upon the material used, as will induce the creation of new industries, or aid the extension of old ones, by economising processes, or rendering them less detrimental to health, or lessening the risk of accident to those employed. It is believed that when chemists turn their attention to the production of a compound for the generation of force, and its use as a motive power, such compound will be found, and put into a form that will admit of its use with safety to the public.

It is believed that not one of the things that will be asked for in the list referred to is incapable of realisation; and the Council hope that men of science—engineers, manufacturers, colonists, and tillers of the soil—will combine with men of capital to bring about the desired results.

I have now briefly laid before you a statement of some of the objects that will be dealt with by the Society during the coming Session. It appears to me that each year adds to the importance and responsibility of the duties belonging to it. It is true our work cannot hope to possess the interest that attaches to societies which, having a specific and defined object in view, can annually present the evidences of progress towards perfection. But, on the other hand, there is no limit to the number and variety of questions on which we can profitably confer, nor of appliances, the improvement of which we may forward. Our country is passing through another phase of its history, a period of change which cannot but be deeply interesting, and ought to be full of hope for the future. Manufactures in which this country stood for many years predominant and almost alone, are now being abundantly produced by other nations. Coal and iron, the raw materials of industry and wealth, are rising in price at home, while they are being more abundantly produced abroad. Educated skill is acknowledged to be an important element in commercial success and national character. It behoves us not to rest in past success, but that our members should do their utmost to help forward every class of society, and to unite them in the one common object of social improvement. We are fortunate in having amongst us men gifted with those gifts of intellect, wealth, or enlightened philanthropy, in the energetic use of which they can advance the cause of national prosperity, and bring blessings to themselves and others. Let us hope that the coming Session may fulfil the earnest wishes of the Council in these respects.

The Chairman then distributed the following medals and prizes, which had been awarded during the last session, viz. :—

His Royal Highness the Prince Consort's Prize of Twenty-Five Guineas to William Pollitt, aged 20, Salford Working Men's College, clerk, who has obtained the following First-class Certificates :—

1869—German—First-class Certificate, with Second Prize.
,, English History—First-class Certificate, with First Prize.
1870—Book-keeping—First-class Certificate.
,, Logic—First-class Certificate, with Second Prize.
1871—Latin—First-class Certificate, with First Prize.
,, English Language—First-class Certificate, with Second Prize.
1872—Domestic Economy—First-class Certificate, with First Prize.
,, Metric System—First-class Certificate, with Second Prize.
,, Mensuration—First-class Certificate.

Gold Medal to Hamilton's Windsor Iron Works (limited), of Liverpool, for the best iron ship's lifeboat.

Gold Medal to Messrs. Woolfe and Sons, Shadwell, for the best wooden ship's lifeboat.

Silver Medal to Monsieur Dormoy, for his revolving rabble, for use in the common puddling furnace.

For papers read during the session the Society's Silver Medal—

To R. Johnstone, Esq., for his paper entitled "Observations on the Esparto Plant."

To Peter Lund Simmonds, Esq., for his paper "On Nuts and their Uses."

To the Rev. H. Highton, M.A., for his paper entitled "Telegraphy without Insulation, a Cheap Means of International Communication."

BETHNAL GREEN MUSEUM.

The following declaration is in the course of signature, and has already been signed as below. Any Member of the Society desirous of having his name attached thereto, is requested to communicate with the Secretary of the Society of Arts, and give him authority for that purpose :—

1. We, the undersigned members of the Council and members of the Society for the Encouragement of Arts, Manufactures, and Commerce, request the attention of Her Majesty's government to the remarkable proof of the public desire for instruction and pure enjoyment afforded by the examination of works of Art and Science, which has been shown by the opening of the Bethnal-green Museum.

2. This museum, established in one of the poorest and busiest districts of London, where men, women, and children are most laboriously employed, has been frequented during three months by more than 700,000 visitors, a number which probably exceeds that of the visitors to all the other metropolitan museums and galleries during the same period.

3. The undersigned submit that this museum could never have come into useful existence, and have been instrumental in conferring great benefits on the people, without the aid of Parliament; and they desire to press this fact upon the consideration of Her Majesty's government, with the hope that they will submit to Parliament the policy so essentially national of voting increased means to facilitate the establishment of museums, libraries, and galleries of Science and Art in large centres of population, wherever such localities are willing to bear their share in the cost.

(Signed)

Abel, F. A., F.R.S., *Vice-Pres.*	
Akroyd, Col. Edward, M.P. ..	Halifax.
Amory, John Heathcote, M.P. ..	Tiverton.
Bartley, G. C. T., *Member of Council.*	
Bath and Wells, Bishop of	
Bazley, Sir Thomas, Bart., M.P.	Manchester.
Beaumont, Somerset A., M.P. ..	Wakefield.
Bessemer, Henry, *Member of Council.*	
Bodkin, Sir W. H. (*Assist.-Judge*)	*Vice-Pres.*
Bourne, Lt.-Col. James, M.P. ..	Evesham.
Brocklehurst, William C., M.P. ..	Macclesfield.
Brooks, William Cunliffe, M.P. ..	Cheshire (E.)
Carpenter, William B., M.D., LL.D., F.R.S.	
Cassels, Andrew, *Member of Council.*	
Cawley, Charles Edward, M.P. ..	Salford.

Churchill, Lord Alfred, *Member of Council.*	
Clarke, Hyde, *Member of Council.*	
Clements, R. G., F.R.G.S.	
Cole, Henry, C.B., *Vice-Pres.*	
Colman, Jeremiah James, M.P.	Norwich.
Cooper, Sir Daniel, Bart., *Vice-Pres.*	
Cowper-Temple, Right Hon. Wm., M.P. *Vice-Pres.*	Hants (S.)
Dalrymple, Dr. Donald, M.P.	Bath.
De L'Isle & Dudley, Lord, *Vice-Pres.*	
Denman, Lord	
Dickinson, Sebastian S., M.P.	Stroud.
Dilke, Sir Charles W., Bart., M.P.	Chelsea.
Dimsdale, Robert, M.P.	Hertford.
Dixon, George, M.P.	Birmingham.
Dodds, Joseph, M.P.	Stockton.
Donnelly, Major, R.E., *Member of Council.*	
Drax, John S. W. S. E., M.P.	Wareham.
Du Cane, Major E., R.E.	
Eastwick, Edward B., M.P.	Penryn & Falmouth.
Eardley-Wilmot, Major-General F., R.A., F.R.S., *Chairman of the Council.*	
Ebury, Lord	
Edwards, Henry, M.P.	Weymouth.
Egerton, Hon. Wilbraham, M.P.	Cheshire (Mid.)
Exeter, Marquis of	
Filliter, Freeland	
Fitz-Gerald, Rt. Hon. Lord O. A., M.P.	Kildare County.
Forster, Charles, M.P.	Walsall.
Fortescue, Earl	
Gower, Lord Ronald Leveson, M.P.	
Gray, Lieut.-Col. W., M.P.	Bolton.
Hambro, Charles J. T., M.P.	Weymouth.
Hardwicke, Admiral the Earl of	
Henderson, John, M.P.	Durham.
Henry, J. Snowdon, M.P.	
Hick, John, M.P.	Bolton.
Holdsworth, John James	
Holland, Samuel, M.P.	Merioneth.
Hoskyns, Chandos Wren, M.P.	Hereford.
Howard, James, M.P.	Bedford.
Hutt, Right Hon. Sir Wm., K.C.B., M.P.	Gateshead.
Lancaster, John, M.P.	Wigan.
Lawrence, Edwin, *Treasurer.*	
Lennox, Lord Henry George C. G., M.P., *Vice-Pres.*	Chichester.
Lichfield, Earl of	
Longford, Earl of	
McArthur, William, M.P.	Lambeth.
McClean, J. R., M.P.	Staffordshire (E.)
McLagan, Peter, M.P.	Linlithgow.
Millar, John, M.D.	
Morley, Samuel, M.P.	Bristol.
Ommanney, Vice-Admiral Erasmus, C.B., F.R.S., *Member of Council.*	
Paget, Admiral the Right Hon. Lord Clarence, K.C.B., *Member of Council.*	
Pakington, Rt. Hon. Sir J. S., Bart., M.P., *Vice-Pres.*	Droitwich.
Parry, Love Jones, M.P.	Carnarvonshire.
Pease, Joseph Whitwell, M.P.	Durham (S.)
Rawlinson, Robert, C.B., *Member of Council.*	
Redgrave, Samuel, *Vice-Pres.*	
St. David's, Bishop of	
Salomons, Sir David, Bart., M.P.	Greenwich.
Saye and Sele, Lord	
Scott, Robson J.	
Strange, Lieut.-Col. A., F.R.S., *Member of Council.*	
Straight, Douglas, M.P.	Shrewsbury.
Sutherland, Duke of	
Tite, Sir William, M.P.	Bath.
Torrens, Lt.-Col. Robert R., M.P.	Grantham.
Tufnell, E. Carleton, *Member of Council.*	
Twining, Thomas, *Vice-Pres.*	
Varley, Cornelius, F.R.M.S.	
Ware, James T., *Auditor.*	
Westbury, Lord	
Westminster, Marquis of	
Whatman, James, M.P.	Maidstone.
Whitwell, John, M.P.	Kendal.
York, Archbishop of	
Young, Frederick	
Zetland, Earl of	

THE ASPHALTS.

Dr. L. Meyn, of Halle, has recently published an account of this new and highly important material, which is recognised as the most complete and impartial hitherto given. The following is a translation of a part of the pamphlet:—

To prevent misunderstanding, he says, it may be as well to state, that when we speak of asphalt-stone, we mean the natural asphalt, or porous limestone, saturated with bitumen or mineral tar, which is capable of being worked to a tough, hard mastic—not the raw bitumen itself, which is frequently called asphalt by mineralogists, nor the various artificial compositions, which go by that name, but have widely different properties.

The use of the true asphalt is not mentioned in any technical treatises, except in the pamphlets issued by the asphalt companies, and the valuable manuals on building materials written by Bernhard Grübner, architect and professor of architecture at Berlin, and by Rudolph Gottgetren, architect, and professor at the Polytechnic School at Munich, and even in these works only three of 300 pages of the former, and seven of the 668 pages of the latter, deal with the subject, and, moreover, dwell more on the artificial than on the natural asphalt. Some confusion must also be caused in the minds of the readers by the authors regarding the raw bitumen (which is called "asphalt" sometimes by mineralogists) as identical with asphalt-stone. The subject will never be properly understood until the artificial mixtures of bitumen with other materials receive their proper name of "mastics," and that substance only which is prepared from natural bitumen and bituminous stones melted together is called asphalt mastic. We shall therefore follow the example of the distinguished engineer, Léon Malo, who prefaces his work on "Asphalt," in the "Annales des Ponts-et-Chaussées," 1861, by a classifiation of these different natural products. We differ, however, from him on several important points, and especially we consider him to be mistaken in including coal and bituminous slate among the asphalts.

Coal belongs, it is true, as does asphalt, to the small group of combustible minerals, but does not belong to the bituminous substances any more than peat or bituminous slate, which usually only becomes so by distillation. Coal and peat form a class by themselves, being produced by an accumulation of organisms, which still retain in part their external form and even their internal structure, by which feature they may be distinguished from those substances which, though resembling coal in many respects, have arisen from organic fluids.

We may dismiss at once, as a merely accidental resemblance, the fact that some kinds of coal—those more especially which are used for the manufacture of coke and gas—may be melted, as this so-called melting is, in fact, disintegration, and cannot be repeated.

It is, however, extremely difficult to distinguish between that kind of coal called jet, which is found in some of the recent geological formations, and some of the pure, hard, bituminous substances, on account of the absence of structural forms; but still cases like that at Bentheim are very rare, when it is doubtful if the substance to be worked is bitumen or coal, and then it may be generally decided by the geological position.

The analysis of the various asphalt minerals prove them to be oxidised forms of petroleum or naphtha. Their presence, therefore, pre-supposes that of petroleum, or, rather, they consist of petroleum which has absorbed a certain quantity of oxygen.

After these observations, the following classification of bitumens and bituminous stones will be intelligible. We need only mention that paraffin and the crystallised carbonates, though belonging to the same class, have not been included in the list, because of their comparative scarcity.

The pure bituminous substances are as follows:—

1. Naphtha, or rock oil.
2. Petroleum.
3. Mineral tar, or maltha.
4. Mineral pitch, or asphalt.

Naphtha (formerly called rock oil by apothecaries), an almost colourless fluid, with a bluish opal tint, and volatile at a temperature far below the boiling point of water, is evidently the source of all other bitumens, in all of which it may be detected in the first stages of distillation. It is very rarely found in its pure state, except in the regions about the Caspian Sea. Usually it occurs in the crevices and interstices of porous stone, into which it has been condensed after the heat of the earth's surface has distilled it from the rocks which contained it.

At first it was believed that naphtha was produced by the distillation of deeply-buried coals; but eventually the oil springs discovered underneath the coal formation led to the opinion that it was principally distilled from the animal organisms scattered through the rocks, in fact, the remains of countless ages of different animals. On this point, however, there are so many different opinions that it is unnecessary to enter further into it.

On being exposed to the air, naphtha undergoes a material change; it assumes a brown colour, with a green tinge, gains in specific gravity, is less liquid and less volatile at a low temperature, and, when evaporated, leaves a tough, pitchy residuum, containing a small proportion of fine, earthy matter. It is then called petroleum.

The various sources of petroleum need not be enumerated here, as they are well known. When it has been for long exposed to the air, it is converted into maltha, or tar, though it is very difficult to draw a line between these two substances.

Wherever a petroleum spring has emerged from the ground for any length of time, maltha or tar will be found near the surface, owing to the oxidisation of the oil from exposure to the air. The springs may, in fact, be traced by the existence of the tar. Tar is almost invariably found impregnating a sandy stratum, very rarely in a pure state. A spring of tar has been discovered however in the old volcanic region about Clermont Ferrand, in France, which is rich in naphtha and tar in the sandstone rocks. As a rule, however, the oxidisation of the petroleum has only been completed in the sand and loose sandstone, through the interstices of which the air can gain access to the oil.

Thus, at most of the sources of petroleum, tar may be found in the sand. At Hölle (in Ditmarschen), over an immense bed of petroleum there is a layer of light diluvial sand, saturated with tar, twenty feet deep, which may be cut like cheese. Also in the sand about the Hanoverian petroleum springs, in a part of the tertiary sandstone at Schwabweiler and Bechelbronn, in Alsace; at Seyssel, in the department of l'Ain; and at Bastennes, in the department of Landes (a region which bears a strong resemblance to the Lüneberg heath). The sand on the heath is bituminous, and, for some time, tar was extracted for commercial purposes in the following manner:—

The sand is washed or boiled in water; when the tar rises to the surface it is skimmed off, and heated again, to expel any remaining water. According to its degree of toughness, it is then either heated in an open cauldron, to drive out the volatile oil, or else distilled in retorts, in order to preserve the oil. The residuum is a hard, black, shining substance of unexampled toughness, which is the asphalt or mineral pitch, the most important ingredient in the manufacture of asphalt stone, being the vehicle by which it is dissolved into asphalt mastic.

The asphalt stone consists of limestone, saturated (in the same way as the sand) with tar, the character of which differs only from that found in sand in appearing somewhat tougher; this may arise, however, from the fact that in the sand the tar covers only the separable grains, whilst in the limestone the smallest interstices are so completely filled, and the two substances so completely united, that heat and water are alike powerless to separate them.

Nature has, however, rarely produced this substance, which is so valuable for industrial purposes. It is found in the greatest abundance and perfection in the Jurassic limestone in the Val de Travers, at Pyrimont, near Seyssel, on the Rhone, and the neighbouring localities, Volant and Chavaroche, where it is obtained by mining. In the same category may be included the bituminous limestone of the Alpine Lias mountains, near Seefield, in Tyrol, the tertiary freshwater limestone of Lobsan, in Alsace; also the yellowish-white Jurassic limestone on the Dalmatic island of Brazza, whose dolomitic banks are saturated with 7 to 8 per cent. of bitumen to a depth of 12 ft., so that it might be quarried.

The most important discovery of the kind in Europe is that at Hölle, near Heide, in Ditmarschen, of a bituminous limestone 1,000 ft. in extent, in which the bitumen is as closely united with the limestone as is the case in that of the Val de Travers or Seyssel, but contains, according to the opinion of the Paris Asphalt Company, too much pure petroleum for direct application (owing to its position under 120 ft. of diluvial soil). It is, however, hoped either that by exposure to the air part of the petroleum will be lost, and part so far oxidised as to produce a perfect asphalt stone, or that on further investigation some limestone may be found containing a larger proportion of tar and less petroleum, or that some means may be discovered of extracting a part of the petroleum.

From this tar, or maltha, and its combinations, we come at last to the asphalt of mineralogists, or pitch, which contains various different ingredients, some hard and brittle, others tough and soft, quite pure, or mixed with earthy matter. It is found in its purest form in the interstices of the older rocks, into which it has been distilled drop by drop, or somewhat less pure in clefts of the rock, as for example in the chalk formation near Munster. It is rarely found in such quantities as Klaproth describes in Avlona, in Albania, or as the pitch lake of Trinidad. The existence of asphalt in the Dead Sea is a fact for which we have to rely on the hearsay report of travellers, rather than on direct scientific observation. The tradition originated with the Greek and Roman writers, who asserted that the asphalt floated about islands on the Dead Sea; and in later ages the Biblical narrative of Sodom and Gomorrah has strengthened the impression. The American naturalists who have examined the locality find, however, that these descriptions do not hold good in the present day; that only in the long intervals between earthquakes asphalt occasionally oozes out of the ground and is washed ashore. This Oriental asphalt, or "Jew's pitch," though invaluable for the manufacture of certain varnishes, is too costly, as well as too brittle, for building purposes. The pitch lake at Trinidad is of more practical importance. On this island, situated opposite the mouth of the Orinoco, there may be seen in the midst of the most luxurious vegetation a lake of the pitch, which flows out like streams of lava into the sea, and forms promontories and reefs. On the edge of this lake, the asphalt is thoroughly hardened by oxidisation and the gradual evaporation of its oily ingredients under the rays of the burning sun; towards the middle, however, the sun still has power to soften it, and it can only be crossed on foot in the rainy season.

A considerable quantity of asphalt is exported from the island of Cuba, under the name of "Chapapote," or "Mexican asphalt," the sources of which are little known. The best Chapapote asphalt contains (like that of Trinidad) 27 per cent. of earthy matter, and the inferior kinds as much as 35 per cent. Under the same name, and from the same regions, a remarkably pure, tough, semi-fluid tar is sent over to Europe.

For all practical purposes, we are therefore restricted to a small number of sources, for we leave the bituminous slate out of the question, as in it the formation of the bitumen is not always completed.

Having examined the properties and classification of the natural bitumens, we proceed to the history of the asphalt as an article of industry.

We learn from the ancient authors that Babylon was partly built with asphalt, and from modern authors that an asphalt mortar was used for the walls of Nineveh. That used at Babylon was prepared with tar found near Is, on a tributary of the Euphrates.

Eirinus, a Greek physician, was the first to make known in Europe the advantages of asphalt as a building material, in 1712, and he also discovered the existence of tar in Alsace in 1737. When visiting the Val de Travers (the chief valley running up into the Jura from the lake of Neufchâtel) on an official mission from the Bernese Government, in 1711, he met a German adventurer, named Jost, who, with some of his countrymen, had blasted some of the soft, tough, combustible rocks on the sides of the valley, and, finding them worthless as fuel, were trying in vain to find a use for them. Eirinus, who was interested in the subject, examined the rocky sides of the valley, and found that the same soft oily rocks protruded everywhere; he also discovered a rich bed in the neighbourhood of Blois de Croix, and comprehended at once its probable use and value.

He applied to the King of Prussia (under whose protection Neufchâtel was at that time) for a monopoly of all asphalt beds which he might discover in the principality of Neufchâtel. After due and careful inquiry, the king granted the request, and this concession was the origin of the asphalt trade.

In 1712, Eirinus commenced his works and experiments, and was able to interest several sagacious and influential men in his undertaking, and to induce them to place various works under his direction to be executed in asphalt, the success of which brought the material into general notice and favour. He published his experiences and discoveries in various small pamphlets, which appeared in 1721, the title of one of which is, "Dissertation sur l'Asphalte, ou ancien Ciment naturel, découvert depuis quelques années au Val de Travers, dans le Comté de Neufchâtel, par le Sieur E. d'Eirinus, Professeur Grec et Docteur en Medecine; avec la manière de l'employer, tant sur la pierre que sur le bois." We cannot do better than quote his own words on the preparation of the Val de Travers asphalt:—

"The author, who, on his long and numerous journeys has had extensive opportunities of pursuing the study of minerals, has received from several reigning sovereigns, but especially from H.M. the King of Prussia, very favourable concessions for the working of any quarries he might discover in the domain of the said sovereigns; and having discovered in the Val de Travers, in the principality of Neufchatel, a bed of asphalt, quite equal in quality to that of Babylon or the Valley of Siddim, which is well known to the learned, he thinks it desirable to make its properties and advantages better known to the public in the following pages:—

"Being of a greasy, soft, clayey consistency, tougher and more adhesive than pitch, asphalt resists the influence of cold and water to such an extent as to be peculiarly suitable for covering all kinds of constructions; to protect wood and stone-work against decay, worms, and the ravages of time, for it renders it almost indestructible, even when exposed to wind, wet, and extreme variations of temperature, as has been practically proved in various parts of Burgundy, Neufchâtel, and Switzerland.

"The preparation of this cement is very easy. The stone must be slightly warmed till it can be coarsely powdered; a small quantity of pitch is added, to make it thinner and more soluble, then the whole is melted over a slow charcoal fire. The surface on which the asphalt is to be applied must be perfectly dry and slightly warmed, and rather more pitch must be added if used for wood than for stone, in which latter case the proportions are 10 lb. of asphalt to 1 lb. of pitch. If the cement is required to be more fluid, more pitch must be added. If rosin is used, the asphalt will be harder, and offer more resistance to the sun's rays, but the pitch makes it tougher. The asphalt may be smoothed afterwards with a warm iron. Great care must be taken that the surface on which it is to be spread is perfectly clean, otherwise defects will be found in the work, which are not due to the material but to the mode of application. If, owing to the frothing of the asphalt during the preparation, any bubbles should be formed, all unevennesses may be removed by rubbing a little cold tallow on the part, and then passing a hot iron bar once or twice over it."

Eirinus followed up these publications by official documents, in the years 1716 to 1719, in which he states that, between the years 1714 to 1716, in numerous cisterns and wells, the wood and stonework has been successfully joined and covered with asphalt; also, that a platform and a warehouse have been paved, to the perfect satisfaction of the owners. He also mentions that at Basle he joined together, with the asphalt cement, two pieces of solid rock, which were subsequently thrown from an upper story on to the street below without separating again, and he gives other instances of a similar kind.

These facts will not surprise any one acquainted with the works which have since been executed in the asphalt.

To what perfection Eirinus and his pupils carried the working of their new material, is shown by a notice of the engineer Henri Fournel, who mentions that in the house of a M. Coulin, in Couvet, one of the lovely villages of the Val de Travers, he found a flight of steps—which dates from this period—in which all the upper steps, which are of stone, are worn into holes; while the lower steps, which have been, of course, most used, being coated with asphalt, are almost entirely unimpaired.

Like other inventors, Eirinus was not to benefit by the discovery which restored to the world a building material that had been lost for 4,000 years. M. de la Sablonière, Treasurer of the Swiss Confederation, put himself in communication with him, in order to extend the undertaking, and on achieving his object he neglected the originator, allowed himself to be regarded as the inventor, and reaped the profits, obtaining, on the 21st February, 1720, a ten years' monopoly of the Val de Travers asphalt in France, and exemption from duties and tolls.

Buffon mentions, in his "Natural History," that the basin of the large fountain in the Jardin des Plantes was covered with asphalt, and he was fully satisfied of its durability, as it was still water-tight after a lapse of thirty-six years. As this work was executed in 1743, the Val de Travers asphalt must have been still in request; but gradually it seems to have fallen into disuse, for in the year 1735 Eirinus had left the Val de Travers, and settled in Alsace, where, living in retirement, he discovered the asphalt at Lobsan. The quarries of the Val de Travers fell into private hands, who worked them more and more exclusively for the oil which was distilled from the asphalt, of which Eirinus also had taught the medicinal and commercial value; and so it happened that, at the beginning of the present century, the invention and the inventor were equally forgotten.

In the year 1802, asphalt stone was discovered at Seyssel, near Geneva. In the sandstone formation, which extends throughout that part of the valley of the Rhone where it forms the boundary between France and Savoy, bitumen is found, scattered in "pots," as it were, according to the consistency of the sandstone strata, which are almost perpendicular, and rise in places to a height of 200 to 300 metres above the level of the river. In the beginning of the present century, the unrepaying process, which had been carried on for some time, of extracting the tar from the sandstone, was suddenly superseded by the discovery of a bed of limestone, saturated with ten per cent. of tar, which, though apparently occupying a limited area, seemed to promise a rich supply for industrial purposes. The idea was started anew of preparing mastic out of powdered bitumous limestone, mixed with five to ten per cent. of tar, and was given out as an original discovery, all the previous experiments in that material having fallen into oblivion. But instead of using it for the simpler purposes to which Eirinus had confined himself, the new discoverers were led away, by the adaptability of the asphalt, to promote its use for many purposes for which it was quite unfitted; hence the popularity which it first attained was succeeded by a reaction, and the Seyssel asphalt was eventually spoken of with as much contempt as it had been received with enthusiasm.

This mistaken application of the material led to a long series of failures, which ended with the complete ruin of the company, and the purchase of the quarries and works by Count Sassenay, in the year 1832, who had satisfied himself, by careful observation, that, under proper management, there was a great future in store for the asphalt, of which he must be looked upon as the second founder; his name therefore may be coupled with that of the Greek Doctor Eirinus.

The Count at once perceived that the cause of the failure of the works had been that the material was used for constructions for which it was unsuited, and which were executed at a distance, by unskilled workmen, whose mistakes were laid to the charge of the asphalt, and he bent all his energies to remedy these errors of management. He ascertained practically what were the purposes for which the asphalt could be best employed, and improved several of the processess, and, in consequence of his experience, he devoted himself exclusively to producing a continuous and homogeneous material, which was made in blocks, and also the tar necessary to melt it. He established an *atelier* for the instruction of workmen in the best methods of working and applying the asphalt, and no government works were executed except under the direction of these skilled artisans. He was rewarded for his care; in a few years the asphalt regained its former reputation; market places and public buildings were paved with it, and in all the French fortresses the stonework was protected against the damp by a coating of asphalt. The celebrated footpath of the Pont Royale, the fine pavement of the Place de la Concorde, at Paris, as well as many pavements at Lyons, and covering of the casemates and corridors of the Fort of Vincennes, date from that period.

At Seyssel, mineral tar was first substituted for common pitch (which Eirinus had used), an improvement brought about by the circumstance that tar was found in the same neighbourhood as the asphalt stone. Another improvement was the addition of some of the coarse sand found in the bed of the Rhone, which gave additional hardness and solidity to the asphalt mastic. An addition of one-tenth or even one-fifth of coarse sand, besides improving the consistency, rendered the material much cheaper, especially at a distance, where the costs of transport were such a serious item in the expense.

It was found also that, for public footpaths, a sprinkling of coarse sand on the surface, firmly melted-up with the asphalt, rendered it stronger, and enabled it to offer greater resistance to the constant wear of the traffic.

The asphalt was used in most of the large cities of Europe and the United States. In St. Petersburg it was used for the pavement of the terrace of the Imperial Palace.

It is of course impossible now to say if all these improvements are entirely due to Count Sassenay. We only know that, on the works coming under his control, the undertaking prospered at Seyssel.

The process of laying down the asphalt footpaths has undergone no material alteration since the days of Eirinus. By the courtesy of the Asphalt Company at Paris, the writer is enabled to give the following details as to the process.

The asphalt must be laid on an even foundation, without any hollows in which water could lodge; any attempt to lay the asphalt on sand, flags, or tiles, has failed, as the unevenesses caused it to be worn out more rapidly in some parts than in others. An even layer of concrete is the most economical and reliable foundation. The concrete must be perfectly dry before the asphalt is poured on, otherwise the steam generated by the superfluous moisture will produce bubbles and holes; also the concrete will not harden if it is covered too soon.

The mastic is sent from the works in blocks of about 25 kilos. They are broken up into pieces, about the size of the stones on macadamised roads, and melted in cauldrons with about half the total quantity of bitumen, which is to be added eventually (about five or six per cent. of the weight of the mastic). One quarter is kept to be added at discretion, if the mastic appears too dry, and the last quarter is added with any fresh supply of asphalt. The temperature is kept up to over 150°, and under 170° Celsius. When the mastic is thoroughly melted and stirred up, the molten mass in the cauldron is covered up and kept over the fire, and half of the sand is added first, without stirring, as it sinks to the bottom by its own weight. This is the only way in which the sand can be added without chilling the interior of the mastic. Then the second half of the sand is added in the same manner. At this point it may be seen if the mass is sufficiently bituminous, or if the remainder of the tar is required. When the whole mixture is ready, and has been brought up to the required temperature (which may be easily seen, by any water dropped on the surface being immediately carried off in steam, while the ladle can be plunged in and withdrawn without any particle adhering), it may be applied to the surface which is to be covered, stirred all the time lest the sand should all sink to the bottom.

The mastic is laid on with a wooden trowel, of peculiar form, which is first thoroughly warmed, lest the mastic should adhere to it. At the various joinings the asphalt must be poured on with large ladles, in order to unite the surfaces effectually, which are never properly joined without this precaution, too often neglected. A slight and rapid pressure is then applied to smooth the surface.

Too often the asphalt receives after this only a slight scattering of sand, it being thought that it serves only to roughen the asphalt. But this is not the chief purpose of this part of the process, as the sand is to supply the place of that which sinks down, and thus leaves the surface soft and liable to melt under the rays of the sun. The workmen should therefore scatter sand plentifully, and stamp it down quite equally on all parts. The footpaths at Paris are covered with a layer of asphalt, six inches in depth, and 3 kilos. of bitumen, with 30 kilos. of washed, dried, and sifted sand allowed to 46 kilos. of the mastic.

Formerly, the asphalt was mixed and prepared in cauldrons, with portable iron stoves, on the spot where it was to be laid down; this was found, however, to be an inconvenient obstruction to the street traffic, so the plan was adopted of preparing the asphalt in the works, and bringing it in the cauldrons into the street.

It is difficult to ascertain exactly how long an asphalt pavement, executed on the best principles, and with good materials, will last, but forty years' experience in Paris and Lyons points to about 20 to 25 years, if it is from six to eight inches thick.

In consequence of the immense demand for asphalt, similar works were successfully set on foot, in 1838, by the Brothers Dournay, at Bechelbronn, in Alsace, a locality which was well-known to abound in bitumen (as had been discovered by Eirinus), and where a bed of bituminous limestone was brought to light.

About this time, the long-forgotten asphalt-beds in the Val de Travers came before the notice of Count Sassenay, who had given over the works at Seyssel into the hands of a company. He speaks of them as follows:—"When my attention was first directed to the specimens of the asphalt of the Val de Travers, I could hardly believe that they were not taken from the best part of the Seyssel quarries, so complete was their similarity. I did not, however, venture to embark in any undertaking without making due inquiries. Accompanied by the able engineer, Henri Fournel, I investigated thoroughly the geological formation of the Val de Travers, and satisfied myself that it contained a very rich bed of asphalt-stone, similar to that of Seyssel, only of a finer texture, and containing 2 per cent. more bitumen, which is a valuable quality, as it saves the necessity for adding that amount of tar. The asphalt-limestone extends uninterruptedly along both sides of the valley, and on beholding the enormous masses which mark the course of the Reuss, to the right and to the left, one cannot conceive how such a supply could be exhausted."

Count Sassenay succeeded in purchasing the monopoly, and established a large company at Paris. Thus the three great asphalt companies of the Val de Travers, Seyssel, and Bechelbronn (or Lobsan) were instituted by French enterprise.

Notwithstanding the high estimation in which the asphalt was held, the municipal authorities in large and distant towns hesitated to pave all the footpaths with a material which, owing to the immense cost of transport, could not be otherwise than expensive, in spite of the competition between the three companies. The high price not only hindered the general adoption of the asphalt, but offered such a temptation to adulteration that many spurious imitations were brought out under that name, the failure of which impaired the reputation of the genuine article.

It has been found impossible to produce artificially the close union between the limestone and the tar, even if chalk or porous limestone is boiled up with pure mineral tar, and then treated like the natural asphalt stone, in which case a substance is obtained which resembles the latter in appearance, and even in smell, but is proved to be not nearly as durable. In the natural asphalt, the limestone has been evidently in the first instance saturated with petroleum, which, in the course of ages, has been oxidised in the interstices of the stone; hence the two substances are as closely united as is possible without chemical combination, and the sun or the cold only affects the very thinnest crust on the immediate surface.

With the extension of the railways, and consequent diminution of the cost of transport, the true asphalt was restored to its proper use, at least for large works, and enabled, to a certain extent, to drive the artificial imitations out of the field.

In the year 1843, a bed of asphalt-stone, similar to those of the Val de Travers and of Seyssel, was discovered at Limmer, near the town of Hanover; and Herr Hemming established similar works with such success that the Limmer asphalt was considered worthy to be classed with that of the above named localities; indeed, in the first London Exhibition superiority was assigned to the German asphalt over that of the older companies. The broad foot pavements of the streets of the town of Hanover bear witness to its excellence. The fact that the mountains which border the great German plain extending through the district of Hanover are rich in bitumen and mineral tar, gave great facility to the asphalt works at Limmer.

When, however, the granite or tile foot-pavements were gradually substituted for the asphalt, as, for example, at Berlin, it became necessary to seek some other means of employing the asphalt. The solution of the problem was found in the paving of the streets in large towns, a work requiring unlimited quantities of the material, which the railways now placed within reach.

The experiment was tried of laying down broken freestone on a bed of sand, and filling up the interstices with molten asphalt mastic. It proved unsuccessful, however, for when cold the mastic was too brittle for the purpose; and if the wheels of the carriages struck against and broke one of the corners of the stones, a hole was formed which gradually widened, and was very difficult to mend. In Lyons 10,000 cubic metres of roadway were covered with a layer of asphalt about two inches in depth, upon a substratum of concrete of about 4 inches, and this was found to answer admirably, but was so costly that in other towns the municipalities were obliged to content themselves with covering in that way the places where the most crowded thoroughfares crossed, and the spaces in front of public buildings, where it was important to deaden the noise of the traffic. In these cases it was found desirable to furrow the surface, to prevent accidents to the horses, which were never long enough on the asphalt to get used to the change from the rougher roads; but in Lyons, where the asphalt is more general, this precaution has been found unnecessary. At Vienna the great Aspern-bridge has been covered with a double layer of asphalt (from Seefeld, in Tyrol), the lower part more elastic, the upper harder. It was not considered necessary to furrow the surface, and there has not been any increase in the number of accidents to horses in consequence.

The Limmer asphalt seems particularly suitable for this purpose, being rather softer and more oily than that of Switzerland or Savoy. In the heat of the summer it receives the impression of the carriage wheels, and for this reason it has always been found necessary to mix with it some of the dryer asphalt of Vorwohle for the foot pavements.

A solid foundation is first prepared with mortar, which is covered with a layer of coarse asphalt two inches thick, and containing 10 per cent. of tar, and beaten down till it is quite hard; then a layer, one inch thick, of asphalt, consisting of 75 per cent. of mastic, 3 per cent. tar, and 22 per cent. of coarse sand.

A similar kind of composition was used in Hanover for the flooring of the cavalry stables, the saving in straw, cleanliness, and freedom from smell being found to be a great advantage.

But even this kind of road was so expensive that the municipal authorities were forced to look about for some other method, as none of the old pavements were at all efficient with the constantly increasing street traffic. In paved roads, the single stones were apt to be displaced, the edges chipped off, and the interstices widened, so that the dirt of the street could lodge in them and become the source of noxious miasma. The macadamised roads (adapted, it is said, in Paris, to prevent the erection of barricades) were still worse, causing a sea of mud in wet weather, and a cloud of dust when dry. Asphalt was thus the best resource, and at last they hit upon the right method of applying it, a method indicated by the nature and properties of the stone, which is so soft that in the quarries the hole for the blasting can be made with a carpenter's gimlet, and the asphalt can be cut into shavings with a pocket-knife. This property gives great trouble in working it during the summer, as the hammer frequently flattens the stone instead of breaking it, and in very hot weather even blasting is powerless unless done with nitro-glycerine; while in winter the blows of the hammer sound muffled, as if striking a soft block of gypsum.

From this peculiarity it was inferred that the asphalt was admirably qualified to be beaten down into a pavement; and this opinion was confirmed by the state of the roads and paths in the quarries of the Val de Travers itself, on which the small pieces falling from the carts were constantly pressed down and flattened by the cart-wheels passing and re-passing, till they at last formed a firm, solid, elastic surface, on which the horses could drag their loads with great ease, and which did not seem to be worn out by the traffic. The author noticed these roads in 1856, without knowing that this plan was so soon to be applied to the streets of towns. M. Henri Coulaine put this idea into practice in the department of the Maine et Loire, and described the result in the "Annales des Ponts-et-Chaussées."

(*To be continued.*)

CHANNEL PASSAGE.

The inventions intended to prevent sea-sickness by mechanical means have been very numerous. Chairs, couches, &c., have been hung in gimbals, and supported by ball-and-socket joints, or some similar contrivance. The earliest patent on the subject appears to be that of Pratt (1826) in which a spring mattrass was fixed on a "swinging frame." A later invention (De Manara, A.D. 1853) proposes to attach balloons to seats, in such a way as to keep them always horizontal. Another (Ritchie, A.D. 1866), describes a platform, resting on water in a tank, and having its edges attached to the edges of the tank by macintosh, or similar fabric. Differing from all the above was a plan, patented in 1866, by M. Simpson, in which the body of the patient is firmly fastened down to the ship itself, a method which has been found of occasional but not very great service. One scheme even bears some sort of resemblance to that of Mr. Bessemer. In 1854, L. Wertheimber patented some improvements in apparatus for preventing sea-sickness. The first of these consists of a movable platform, to which chairs or couches may be attached. A cylinder communicates with a steam boiler, and a platform is secured to the upper end of a piston rod in the cylinder. "Steam is admitted to the cylinder by a four-way cock, which may be opened and shut by a self-acting contrivance, so that when the ship sinks into the trough of the sea, steam is admitted beneath the piston, and the platform is caused to rise; on the contrary, when the vessel rises over the crest of the wave, steam is admitted above the piston and the platform descends." Thus a motion opposite to that of the vessel is obtained. Another arrangement "consists of three cylinders, one placed forward and two at the after part, connected with each other by pipes." The second part of the invention "consists of a platform or chair, &c., which is supported by a bracket attached to an upright shaft; this shaft passes through a hollow standard." The upper part of the shaft carries a rack in which gears a pinion, fitted with a handle, and "a rising and falling motion is given to the platform by moving the handle to and fro." Or the platform may be moved "by a perpendicular shaft or lever attached to a pinion gearing with a toothed rack." In the third modification the effect is attained "by interposing elastic bodies between the person and the deck." Older, however, than any of the foregoing is an invention mentioned in a curious old work, published in 1677, and named "Aero-Chalinos, or a Register for the Air." In it a sort of chamber is described, in which air might be rarefied or condensed, or otherwise changed for the use of invalids, so that they might have change of air without leaving home. Of this same chamber the writer says:—"Possibly, if the same might be made use of on board ship, it would (with the additional contrivance of a chair or bed, hung after the manner of a sea-compass) prevent that very troublesome affection whereto fresh men are subject, called sea-sickness, and consequently become very serviceable to such whose imployments engage them to undertake voyages into very remote parts, and there to reside far from their own countries."

Mr. Bessemer, writing to the *Times* in reply to an objector, says:—

"It may appear strange to the uninitiated, but it is nevertheless a fact, that the most successful of the several inventions which I have had the good fortune to make are just those which have been described as impracticable and worthless by the dogmatical assertions of anonymous writers. I have in my possession an old portfolio, which I filled many years ago with cuttings from the press, and which contain the sage arguments by which dozens of so-called scientific men and many interested writers, vied with each other in showing, by vehement declaration and specious arguments, that my steel process was impracticable and utterly valueless—in fact, the mere dream of a wild enthusiast, which the world at large were solemnly warned to have nothing to do with. Had these gentlemen been successful in their efforts to stay the progress of this invention, doubtless they would have profited by so doing; but the world would have lost more than ten millions sterling per annum, which my invention now saves.

"It is a curious coincidence that the hydraulic apparatus which, in my steel process, enables a boy to manipulate five tons of fluid metal, and govern and regulate the heavy mechanism at a distance of 60 feet from the apparatus, and pour out a fine stream, or let fall a seething flood of incandescent metal into the receiver, is the identical form of hydraulic apparatus which I am now using to control my ship saloon; and, after the introduction and employment for the last ten years of this peculiar mechanism in every country in Europe, it appears to my simple mind to be just one of those things on which I am able to form an opinion, and a fact on which I can rely.

"After this digression I will return to the task which has to be repeated at the birth of every new and important invention, and endeavour to convince those who cannot see, or will not accept, the facts that are clear to others.

"Your correspondent enumerates five distinct kinds of motion in a steam vessel which he considers necessary to provide against, but he is careful not to explain how completely the disagreeable, tremulous motion produced by the engines will be prevented by the complete isolation of the suspended saloon, the supports of which rest on massive beds of india-rubber, and thus prevent the sharp vibratory motion of the engines from being transmitted to the saloon, which will, in consequence, have all the ease and quiet of a C-spring carriage, as compared with a cart without springs, when rolling over the London stones. Neither has he pointed out the fact that the fearful thud with which the sea strikes the sides of the ship in a gale is directly transmitted to the couches of the passengers in all ordinary steam-vessels, and that these concussions cannot possibly be felt, nor the gurgling waters be heard, in a saloon wholly separated from the sides of the vessel by a distance of five feet. He is equally oblivious of the advantages afforded by a saloon of 20 feet in height, thoroughly ventilated by artificial means; nor does he think proper to notice the high speed of these ships, which will save half an hour of this disagreeable journey.

"But let us consider the so-called 'five well-defined movements' which 'Mechanicus' imagines to exist as sources of sea-sickness. Is he not aware that the combination of two separate motions at right angles to each other is capable of generating curves and twists innumerable? In the simplest form of pentograph there are two straight-line motions at right angles to each other; these motions acting in unison will describe every variety of curve and twist that the hand of man can trace, and, in like manner, the two simple motions of a ship—viz., her pitch, and the roll which is at right angles to it, will give rise to all imaginary combinations of motion, especially the sort of screwing or twisting motion so much felt at sea, and which is merely a combination of these two elementary ones. But take away from the pentograph its cross slide, and all its magic power ceases; it can no longer delineate a map or trace the intricate windings of a quaint signature; all this power has vanished, and one simple straight line is all that the instrument is now capable of forming. And so, in like manner, if we take away from the ship, or, rather, from the suspended part of it, one of its primary motions (the roll), we break the charm, and all its wonderful power of describing innumerable and most uncomfortable curves will cease, and there will remain only the one simple motion of pitching in a straight line.

"'Mechanicus' is entirely mistaken in supposing that my invention does not or cannot deal with the pitching motion of the ship, for the pitch is just as capable of being governed by the hydraulic apparatus as the roll; but in these particular Channel boats, it is the opinion of most eminent naval men—men who have commanded the largest steamships for years—that a ship of 350 ft. in length in the Channel, with a low freeboard, and moving at 20 miles per hour, will only pitch to a very small angle; and when we place a saloon of 50 ft. in length in the centre of such a vessel, it follows that the saloon being only one-seventh of the length of the vessel, the pitch at the extreme ends of the saloon will be only one-seventh of the pitch at bow and stern of the ship, and which motions are also greatly lessened by her peculiar construction and high speed; and, further, it must be remembered, that this extremely small amount of pitching motion at the ends of the saloon will occur at the extremely slow speed of one-seventh only of the speed at which the bow and stern end of the vessel pitches, and hence will be nearly inappreciable.

"As to the absolute bodily rise and fall of the ship, naval men are agreed that in large vessels this motion is extremely small, so small in fact that it may be entirely left out as an element of sea-sickness. What so often deceives non-professional men on this point is the ascent and descent of the ends and sides of the ship when she pitches and rolls simultaneously at a great angle.

"The fourth, or onward motion, pure and simple, which 'Mechanicus' has pressed into his service, will surely not make any one sea-sick. Were it so, pray, how do ladies manage to ride on horseback, or venture on a speed of twenty miles per hour in a railway carriage having an 'onward movement?' Then we have the fifth movement. This is supposed to be a purely crab-like motion. Only imagine a vessel of great length going forward at the rate of twenty miles per hour, and bodily jumping first to the right and then to the left of her course, so as to make people sea-sick. There simply is not, and cannot be, any such cross motion in a vessel moving at twenty miles per hour. The whole of the extremely complicated series of curves described by the bow of a steamer in rapid onward motion may be generated by the combined action of rolling and pitching, each at different distances, and at periods that do not accord; and should it be found necessary to neutralise both these motions by the hydraulic controlling apparatus, there is not the smallest difficulty in applying it to both these motions of the ship."

SCHOOL BOARD WORK FOR LONDON.

The population of London, as shown by the census taken on the 2nd April, 1871, was 3,265,005. The officers of the School Board, working in conjunction with the Registrar-General, ascertained that of these 681,107 were children between the ages of three and thirteen. Taking the next step in the process, it was found that of this number 97,307 were being educated at home, or in schools where the weekly fee exceeded ninepence, and were thus removed from the operation of the Act; and that an additional 9,101 were inmates of boarding-schools, reformatories, or asylums. This left 574,693 children for whom elementary schools were required, and of whom 398,679 were attending, and 176,014 were, for various causes all set forth in the bulky returns, not attending schools. Again, with respect to ages, 139,095 of the children requiring elementary schools were between the ages of three and five, and 435,598 between the ages of five and thirteen. Of the total of 176,014 who ought to be at school, but were returned as absent, it was found upon investigation that only 95,975 had valid excuses for stopping away; and the addition of the remaining 80,039 to the 398,679 already attending elementary schools within the meaning of the Act gave the London School Board 478,718 children, for whose "efficient" education they become responsible.

This position being determined, it next became necessary to ascertain what accommodation existing schools provided for the education of these children. A return obtained comprehending particulars of every school or department of a school at which elementary education is the principal part of the education there given, and at which the ordinary payments in respect of the instruction from each scholar does not exceed ninepence a week, showed that the metropolis contained 3,130 such institutions, providing in the aggregate accommodation for 370,960 scholars. One hundred and forty-five new schools, or enlargements of schools were projected, and when these were completed a total accommodation would be provided for 413,233 scholars. This was so far satisfactory that it appeared to show that, out of a population of upwards of three millions only a trifle over 65,000 children, some of them under the age of five, were left unprovided with schools. But when the test of efficiency came to be applied, the proportion was woefully increased. More than one-half of the existing schools (1,876) were condemned as being inefficient, reducing the accommodation by 63,907. These figures, as compared with the number of schools condemned, suggest, what is the fact, that the institutions found wanting were chiefly petty undertakings known to the Education Department as "adventure schools," and represented with greater or less accuracy by the Academy for Young Ladies at the East-end, the *locale* of which was a kitchen that also served the purposes of dining and bedroom, and the principal of which was fain to indicate her acquiescence with a document offered for her signature by affixing the primitive design known as a "mark." Deductions having been made in this direction, it resulted that there were in the metropolis 1,149 efficient schools, accommodating 312,925 scholars, and 250 schools partially efficient, accommodating 37,995 scholars, giving a total of 1,399 schools, providing education for 350,920 out of the 478,718 known to require it.

A further and final deduction had yet to be made, in order to arrive at the precise amount of school accommodation required for the given number of children. 478,718 children might require places at school, but it is not reasonable to suppose that every one of them would be in regular attendance from day to day. The Board, accordingly, with that well-directed energy which marks the whole of this important inquiry, procured a return from thirty of the largest schools in London, setting forth the absence of scholars day by day for a whole week. The aggregate return showed that on the average 5·09 of the number on the rolls were, from temporary causes, absent day by day. The Board, hoping that under the action of their bye-laws this proportion may be decreased, deducted five per cent. from the number of children who might attend school, in order to arrive at the numbers for whom accommodation would be absolutely necessary. On this basis of calculation, schools with a constituency of 478,718 children should have accommodation for the average attendance of 454,783, and there being existing accommodation for 350,920, it follows that the London School Board find themselves face to face with the necessity for building schools for 103,863 children.

Of the ten divisions which form the Metropolitan School District, the most necessitous is Tower Hamlets, which, requiring accommodation for 71,031 children, has provision for only 47,317. Lambeth wants school places for 76,962 children, and has provided 54,697; Hackney wants room for 56,906, and has provided for 34,851; Finsbury wants 58,049, and has 44,914; Southwark wants 35,230, and has 22,526; Greenwich wants 32,673, and has 28,884; Chelsea wants 30,204, and has 26,932; Marylebone wants 57,616, and has that number all but 3,140; Westminster is short of the total accommodation necessary by only 959; whilst the City actually has an excess of accommodation amounting to 1,418. The School Board have boldly decided at once to provide school accommodation for 100,600 children, and have apportioned that number amongst the ten divisions, in some cases, urged by special reasons, recommending accommodation in excess of the actual deficiency, and in others asking the district to be temporarily content with less than its full need. Thus Chelsea, which wants new schools for 3,272, will have schools built for 4,900; Finsbury, which wants 13,135, will get 10,600; Greenwich, which wants 3,789, will get 6,650; Hackney, which wants 22,055, will get 20,000; Lambeth, which wants 22,265, will get 18,450; Marylebone, which wants 3,140, will get 7,900; Southwark, which wants 12,704; will get 11,200; Tower Hamlets, which wants 23,962, will get 19,400; and Westminster, whose modest necessities would be met by provision for 959 scholars, will get the round thousand.

CORRESPONDENCE.

CHANNEL STEAMERS AND SEA SICKNESS.

Sir,—In one or more of the leading journals, it is stated that a Mr. Mackie has, three years ago, patented a system of tubular ship, which, it is thought, will offer better accommodation and more freedom from sea-sickness than the public now enjoy.

I desire to state to the public, through our *Journal*, that, in 1864, I designed a similar vessel, with two hulls instead of three, to lessen skin friction, and my system is almost identical with that of Mr. Mackie and Captain Dicey.

In corroboration, I beg to say that, in 1867, I was an exhibitor at the Conversazione of Civil Engineers, also at the Society of Arts, when a medal was offered for improved vessels for channel communication, and that my drawings have been hanging in the Polytechnic Institution many years, and are there still. Captain Dicey's scheme is so similar to mine that I have connected myself with his enterprise in the English Channel Steam Ship Company, and we hope to show the English public, on the Thames and on the sea, the result of our endeavours, which we intend to be as successful as our former experiments have been, and we also intend to have steady cabins, sofas and chairs, on and in which the public may luxuriate without the necessity of any apparatus to preserve their equilibrium.—I am, &c.,

Angelo Sedley.

92, New Bond-street, London.

ARTIFICIAL FUEL.

Sir,—As several suggestions have lately been made by correspondents to the *Journal* with regard to a substitute for coal, it will not perhaps be out of place for me to give some particulars respecting the utilisation of the refuse bark of the tan-yard for fuel in Italy.

The bark, taken in a wet state from the tan-pits, is kneaded by the feet, and compressed into circular moulds by boys, so as to form cakes or discs of about eight inches in diameter and one and-a-half thick, and which are dried on covered racks by simple exposure to the atmosphere.

These cakes are manufactured at most tan-yards in Northern Italy, and a boy, on the average, can make 1,000 per day.

The retail price in the principal towns varies from ten to twelve francs per thousand, and this fuel is largely used for economising wood, with which it is usually burnt.—I am, &c.

An Anglo-Italian.

EXHIBITIONS.

Vienna Exhibition.—Signor Natale Biffi, the enterprising *restaurateur* of the Galleria Vittorio Emmanuele at Milan, has just obtained the concession of 2,000 square metres of space at the Vienna Exhibition, where he intends opening an Italian restaurant, and visitors will thus have an opportunity of tasting the famous *Risotto alla Milanese*, *macheroni alla Napolitana*, and a variety of dishes peculiar to the Italian *cuisine*. The waitresses will be dressed in the picturesque costumes of Calabria, Tuscany, and Brianza.

The Vienna Exhibition and French Art.—A bold project is now under the consideration of some of the most eminent French artists in connection with the great International Exhibition, to be held next year at Vienna. It is proposed to attempt an exhibition—separate from the great one—of all the most remarkable works that have been produced by the French school during the past ten years, in order to set French art before Eastern Europe with all possible *éclat*. The success will greatly depend on the good will of the possessors of many of these works.

Lima Exhibition.—The three most important and special premiums awarded at the recent Lima Exhibition are to Doctor Don Manuel A. Fuentes, for the design of the building; to Don Demetrio Olavezoya, for the introduction of merino sheep into the country; and to Don Pedro Ruiz, for a famous clock shown, which is thus described:—"It was 50 feet 7 inches in height, and 49 feet 2 inches wide. It marks the weeks, the seasons, years, and centuries. It shows the course of the sun and moon, and the eclipses; hoists up and lowers daily the national flag, and presents pictures commemorative of the great events in the history of Peru. It strikes the hours and quarters of hours, and finally plays certain tunes at stated periods."

Art Exhibition at Versailles.—Versailles, the present seat of government, is about to have a grand exhibition of pictures and other works of art. The opportunity is a good one, and the Society of the Friends of Art of the Seine-et-Oise, who organise the exhibition, have issued a very liberal programme. Each invited artist is allowed to send as many works as he may please, and the quality of the works is left entirely to himself. Moreover, the exhibitors are not to be put to any expense whatever, even for package; the works are merely to be sent to the office of the *Moniteur des Arts*, in Paris, and the representative of the society will have them conveyed to Versailles and properly placed. The exhibition takes place in the Salle du Jeu de Paume, of historic celebrity. Considering that there, besides the 750 deputies, many of whom reside with their families at Versailles, a very large number of officials, a large military force, and a constant succession of visitors from all parts, the exhibition is likely to be eminently successful, especially when it is considered that the town is almost entirely destitute of any other attraction whatever in the winter season.

GENERAL NOTES.

Early History of the Steam Engine.—The Patent Office has lately purchased, and last week published, two deeds, dated respectively 1779 and 1799, relating to the erection by Boulton and Watt of steam engines at Gwennap, in Cornwall, and Werneth Colliery, near Oldham. They are interesting as giving details as to the terms on which the engines were to be erected and worked, and as to the cost of construction.

Manufacture of Sugar from Beetroot in Italy.—Professor Peyron, the well-known agricultural chemist, in his evidence before the "Inchiesta Industriale," now being held in Turin, states that, with regard to agricultural industries in Italy, few countries can be said to be more behindhand, and the manufacture of products derived from the productions of the soil is as yet in its infancy. The government have endeavoured to introduce the cultivation of various new plants, such as cotton, the esparto grass, &c., but without success, and of late a great effort has been made in Italy to encourage the growth of the sugar beet, and to teach the farmers carefully the general treatment of the land for the cultivation of this root, so as to produce heavy crops, rich in sugar. Professor Peyron expresses his opinion that Italy will never become a sugar-producing country, as the juicy root, although rich in sugar, is not easily crystallised, and that other crops can be grown with far more profit than the beetroot. A series of experiments made in Tuscany, Naples, and Lombardy, by himself and Signor Peria, gave in some cases a production of 12½ per cent. of sugar, and, on the average, from 10 to 10½ per cent.

Memorial Portrait of Sir James C. Ross.—A memorial portrait of the late Rear-Admiral Sir James Clark Ross, D.C.L., F.R.S., has recently been placed in the Painted Hall of the Royal Hospital, Greenwich, by subscription from several naval officers and eminent men of science, as a mark of his great achievements in geographical discovery, and in the advancement of science in both Polar regions. Sir James C. Ross served in every Arctic expedition under Sir Edward Parry and his uncle Sir John Ross; he passed nine winters and sixteen summers in the Arctic regions. Among his great achievements he planted the British flag over the position of the north magnetic pole, and it was his glory to attain the highest latitude in both hemispheres ever reached by man, in the north when he served with Parry, and in the south when he commanded the Antarctic expedition, and accomplished the most extensive, most important, and most perilous survey ever undertaken. The discovery of Victoria Land on the Antarctic continent could only have been accomplished by an officer so long inured to Polar navigation as Sir James Ross. His magnetic survey over that portion of the southern hemisphere has been one of the most valuable contributions in this country to science, and, by permission of the Lords Commissioners of the Admiralty, this portrait is now placed as a worthy pendant to that of the illustrious navigator, Captain James Cook.

Meat Supply of Buenos Ayres.—Official reports lately published show that sheep boiling down is becoming as much a staple industry in Buenos Ayres as pork packing at Cincinnati. A couple of years ago there were but two or three "graserias," or boiling-down establishments in the Republic, now there are nearly 100, which can boil down daily about 60,000 sheep. There are also 15 "saladeros," where horned cattle and mares can also be killed to the number of 14,000 or 15,000 head daily. Supposing the graserias were to work 300 days in the year, they could boil down 17½ million sheep, which would be about one-fourth of the entire number in the province; the number now killed is probably from 8 to 10 millions yearly. The shipments of tallow in 1871 represented 5,000,000 dollars, and of sheep skins 2,000,000, or about £1,500,000. "If," observes the *Buenos Ayres Standard*, of September 30th, "we could convert the graserias into mutton-packing establishments, as in Australia, for export to England, the gain to the country would be, of course, much greater. We could kill and pack 10 million sheep yearly without overthinning our flocks, which at two dollars per head would give four millions sterling per annum. And there seems no reason why we should not do so, for, however poor the beef of Buenos Ayres may be, the mutton is excellent, and it seems a pity to boil down the sheep for tallow."

The Iron Mines of Elba.—During the month of July, 1872, the quantity of iron ore exported from the island of Elba amounted to 24,556 tons, of which 3,286 tons were shipped for Italy, to be melted at the iron works of Follonica and Cecina, the former being one of the most important in the kingdom; 18,570 tons to France, and 2,700 to other countries. Of 199 vessels that were laden with ore during this month, 4 were French, 4 English, 1 Austrian, the remainder being Italian.

New Kind of Gunpowder.—A novel description of gunpowder, possessing extraordinary projectile power, is said to have been recently adopted by the Prussian Artillery. It is composed of a certain proportion of nitre and sawdust, and in this state can be kept in store without fear of explosion. To render this composition explosive it is necessary to add a sufficient quantity of sulphuric acid to make it cohere, and when dried it is ready for use. This composition has certainly the advantage of cheapness, combined with extreme simplicity in its manufacture, and is said to leave but little residue after being fired.

Scholastic Museum, Model School, &c.—A new establishment is about to spring up in Paris, under the auspices of M. Say, the Prefect of the Seine, to include a model school, and a gymnasium, and a museum of globes, atlases, maps, topographical charts, reading and arithmetical tablets, school books, together with models of school furniture and material of all kinds, in short, a permanent exhibition of objects used for instruction, whether literary, scientific, or artistic. Such an establishment cannot fail to be useful, and cannot be very costly. The place chosen for it is a house and a plot of ground belonging to the government, situated on the Boulevard Mornand, and just in the rear of the library of the arsenal.

Peruvian Antiquities. — M. de Bunsen, Chargé d'Affaires in Peru, has sent to the Berlin Museum a curious and valuable collection of Peruvian pottery and other articles, which are all the more valuable from the fact that the ancient civilization of South America was previously but poorly represented in the Ethnological Section of the Museum. Amongst the collection are several kinds of urns, some of early date, while others are the work of natives who had been converted to Christianity. The mummies are very remarkable. Three of them are completely clothed, and accompanied with the objects which are almost always found in Peruvian tombs, such as the bag for food, the drinking-cup, and the loom and its accessories placed in women's graves. In one case, the mummy of a female has in its arms a clay model of an infant. The various textile stuffs in which the mummies are enveloped are extremely rare, there being but few examples in our museums.

Trans-Andine Telegraphs.—The last Buenos Ayres papers received contain an interesting official report on the trans-Andine telegraph. The length from Buenos Ayres to Valparaiso is 1,238 miles, of which 1,058 are in Argentine and 180 in Chilian territory. The Argentine government pays a subsidy of 30,000 dollars on the section from Villa Maria to the top of the Andes, 680 miles, and the Chilian government a subvention of 8,000 dollars on the section of 60 miles that had to be made from the Andes to connect with the telegraphs on the Pacific side. On the Argentine side were used 1,800 tons of materials, the cargo of nine vessels from Europe, the Villa Maria section to the Andes taking 1,300 metal posts and 280 tons of wire, the land-carriage of which, from Rosario, was as much as the first cost. On the Chilian side are 3,600 metal posts and 184 tons of wire. There are two snow cables, for a stretch of 30 miles over the top of the Andes, besides a wire line on posts, and this was a difficult work. These cables, which had to be brought over the Andes piecemeal on the backs of mules, were commenced to be laid on May 15th, 1871, but snow-storms soon stopped progress, until September 6th, when the arduous task was resumed, and completed on Feb. 6th, 1872. Each cable has a conductor of seven copper wires, and in laying the cables a trench for each had to be dug two feet wide through the worst part of the Cordilleras, from Ojos de Anga, on the Chilian, to the Inas-bridge on the Argentine side. The Chilian government is anxious to hasten telegraphic communication with Europe, and engages to increase the subsidy to 20,000 dollars a year when the Brazilian cable is laid. It further offers 20,000 dollars a year to anyone who will lay a cable along the coast to Peru, as in that way they would soon reach Panama, which is already connected with

North America and Europe. Then the readers of the morning papers in America will be able to learn at the breakfast-table all that occurred the previous day at Paris, London, Madrid, Berlin, New York, Melbourne, Calcutta, and Yokohama.

Fuel Economy.—Peat in Italy.—The peat deposits in Italy cover an area of upwards of 40,000 hectares (in round numbers 100,000 acres), and average in thickness from five to six metres, although in some places, as in the Roman Campagna, deposits 25 metres, or 34 yards, in thickness are to be met with. Up to the present time, from the impossibility of compressing the peat to a greater density than from 200 to 300 kilogrammes per cubic metre, it has been impossible for this fuel to compete with foreign coal in Italy. Signor Giovanni Mozo, after a series of patient and careful experiments, has succeeded in making machinery by which peat coal of a density of 1,000 kilogrammes, about one ton, per cubic metre can be produced, and sold at from 16 to 18 francs (12s. to 14s.) per ton. Experiments on the Lombard railways show the value of Signor Mozo's invention, which, with the present high price of coal, cannot fail to be a most important one for Italy, tending to free her from the immense tribute (40,000,000 francs yearly) that she pays to other nations for fuel, and to enable her to develop her natural resources.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

THE LIBRARY.

The following works have been presented to the Library:—

Phormium Tenax as a Fibrous Plant. Edited by James Hector, M.D., F.R.S.

Report of the Commissioners appointed to inquire into the preparation of the Phormium fibre or New Zealand Flax, and also further papers relating to the same.

The Metric Calculator. By Richard Rickard. Presented by the author.

Retail Traders and the Co-operative Stores (a pamphlet). By Jeremiah Head. Presented by the author.

Twentieth Annual Report to the Council of the City of Manchester, on the Working of the Public Free Libraries, 1871-2.

Light Railways (a pamphlet). By Henry S. Ellis. Presented by the author.

Census of Victoria, 1871. Part 3, Ages of the People.

Statistics of the Colony of Victoria, for the year 1871. Part 4, Law, Crime, &c.

Commision de la Flora Forestal Española, Resumen de los trabojos verificados, por la misma durante los años de, 1869 y 1870. Presented by his Excellency Don José Merino Ballesteros.

A Collection of Publications of the Sociedad Economica of Madrid. Presented by his Excellency Don José Merino Ballesteros.

ORDINARY MEETINGS.

The following are the dates of the Wednesday evening meetings, the chair being taken at eight o'clock:—

1872.	November......	—	—	—	27	
,,	December......	4	11	18	—	
1873.	January	—	—	15	22	29
,,	February	5	12	19	26	
,,	March	5	12	19	26	
,,	April..........	2	—	16	23	30
,,	May	7	14	21	28	

For the meetings previous to Christmas, the following arrangements have been made:—

November 27.—"On Technical Education, and the Means of Promoting it." By Thomas Webster, Esq., Q.C., F.R.S. On this evening the chair will be taken by John Hinde Palmer, Esq., M.P., Q.C.

December 4.—"On the Manufacture of Horse-nails by Machinery." By J. A. Huggett, Esq.

December 11.—"On Galvanic Batteries." By the Rev. H. Highton.

December 18.—"On Russia, her Industries, Commerce, and Means of Communication." By Leone Levi, Esq., Professor of Mercantile Law, King's College, London, and one of the Deputies to the International Statistical Congress at St. Petersburg.

CANTOR LECTURES.

The first course of Cantor Lectures for the ensuing Session will be on "The Practical Applications of Optics to the Arts, Manufactures, and to Medicine," by C. Meymott Tidy, M.B., Joint Lecturer on Chemistry, and Professor of Medical Jurisprudence at the London Hospital, and will consist of five Lectures, to be delivered on the following Monday evenings, at eight o'clock:—

Lecture I.—Monday, November 25th, 1872.

The Law of the Intensity of Light in its Application to Photometry—Lighthouse Illumination.

Lecture II.—Monday, December 2nd, 1872.

Lighthouse Illumination *(continued)*—Applications of Reflection—Lenses and their varieties—Their Application to Medical Purposes, &c.

Lecture III.—Monday, December 9th, 1872.

Applications of Optics in the Arts, illustrated in the Science of Photography.

Lecture IV.—Monday, December 16th, 1872.

Polarised Light, and its Practical Applications.

Lecture V.—Monday, December 23rd, 1872.

Spectrum Analysis as Applied to Manufactures, illustrated in the Bessemer process, and to Medicine in the Detection of Blood.

A second course will be given during the Session, by the Rev. Arthur Rigg, M.A., "On the Energies of Gravity, Electricity, Vitality, Affinity, Light, and Heat, especially with reference to the Measurement and Utilisation of them.'

MEETINGS FOR THE ENSUING WEEK.

Mon......**SOCIETY OF ARTS, 8** Cantor Lecture. Dr. Tidy, "On Practical Applications of Optics to the Arts, Manufactures, and Commerce."
Actuaries, 7. Mr. Sprague, on "Reversionary Life Interests as Securities for Loans."
Social Science Association, 8. Rev. E. Abbott, on "The Proposed Examination of First-grade Schools by the Universities."
Royal Geographical Society, 8½. 1. Major H. H. Godwin-Austen, "Survey of the Garo Hills and Ascent of Mount Hylas." 2 Account of the Looshai Country from the Reports of the Surveyors.
Institute of Surveyors, 8. Mr. Arundel Rogers, "On Mines and Minerals."

Tues ...Civil Engineers, 8. Mr. William Anderson, "On the Aba-el-Watif Sugar Factory, Upper Egypt."
London Institution, 4. Professor Rutherford, "The Nutrition of the Body."

Wed. .. **SOCIETY OF ARTS, 8.** Mr. Thomas Webster, Q.C., F.R.S., "On Technical Education and the Means of Promoting it."
Society of Telegraph Engineers, 8. Mr. W. H. Preece, on "Lightning.'

Fri ......Architectural Association, 7½.

JOURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, NOVEMBER 29, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

SECOND ORDINARY MEETING.

Wednesday, November 27th, 1872, J. Hinde Palmer, Esq., M.P., Q.C., in the chair.

The following Candidates were proposed for election as Members of the Society:—

Allison, F. F., 127, Leighton-road, N.W.
Baker, George C., 24, Offerton-road, Clapham, S.W.
Bodkin, Frederick Edwin, Merton-lane, Highgate, N.
Browell, Capt. Langton, R.N., J.P., Freshfield, Millbrook, near Southampton.
Carrington, John Bodman, 13, Regent-street, S.W.
Clement, Robert Pardy, Brighton-villa, Prospect-hall, Walthamstow, E.
Cocks, Stroud Lincoln, 58, Harold-house, Finchley-road, N.W.
Couch, Arthur, 172, Wapping High-street, E.
Greenhough, D. W., 1, Suffolk-villa, Breakspeare's-road, Upper Lewisham, S.E.
Halstead, Henry Richard, 3, Rose Bank, Manningham, Bradford.
Head, John, The Orwell Works, Ipswich.
Johnson, Frederick J., Lincoln-house, Broad-green, Croydon.
Jones, David, 27, Mincing-lane, E.C.
Lord, David Lintott, 29, Somerleyton-road, East Brixton, S.W.
Kennedy, Lieut.-Col., J.P., Bombay and Baroda Railway Company, 45, Finsbury-circus, E.C.
Mylne, Robert, F.R.S., C.E., 21, Whitehall-place, S.W.
Ogle, Richard, Broad Oak-park, Worsley, near Manchester, and 2 Pall-mall, Manchester.
Sarson, Henry, 71, New North-road, N.
Saunders, John, Armley-house, High-street, Bromley, Middlesex.
Sefton, David Heywood, Land Mortgage Bank of India, 17, Change-alley, Cornhill, E.C.
Tayler, Henry, 44, Finsbury-circus, E.C.
Triggs, Reuben, 18, Clarewood-terrace, East Brixton, S.W.
Whitaker, John, Hill-side, Primrose-hill-road, N.W.

The Paper read was—

ON TECHNICAL EDUCATION AND THE MEANS OF PROMOTING IT.

By Thomas Webster, Q.C., F.R.S.

Technical education constitutes a branch of the general question of the education of the people peculiarly within the chartered objects of this ancient Society, and to which its attention has from time to time been directed. The meaning of the term, the subject to which it relates, the position of those more peculiarly affected, and the means of promoting it, have given, and will continue to give, rise to much discussion. The commencement of the 119th session of this Society appears to present a convenient opportunity of renewing a discussion on the subject of the conference at the close of the last session, in the hope that a step in advance may be taken and maintained, that some distinct progress may be made in that which has been aptly described "as having for its aim to dignify industry, to fructify capital, and to bring the means of living into harmony with the true ends of life."

Although I can hardly hope to add much to what has been already said on this subject, some service to the cause may be rendered by drawing attention to the more salient points upon which a large amount of common assent exists.

Technical education must be understood as having reference not only to a special kind of instruction, but to the requirements of a particular class of the community.

Its necessity has been forced upon us by the conditions in which we are placed, as to which, in the opening address of the present session, the Chairman said:—"Our country is passing through another phase of its history, a period of change which cannot be but deeply interesting, and ought to be full of hope for the future. Manufactures in which this country stood for many years predominant and almost alone, are now being abundantly produced by other nations. Coal and iron, the raw materials of industry and wealth, are rising in price at home, while they are being more abundantly produced abroad. Educated skill is acknowledged to be an important element in commercial success and national character. It behoves us not to rest in past success, but that our members should do their utmost to help forward every class of society, and to unite them in the one common object of social improvement."*

It cannot be doubted that thoughtful men have been much struck by the contrast which exists between some continental nations and this country as to general and special instruction. The cause of this has given rise to much speculation. The following opinion of Dr. Yeats is deserving of consideration:—"I incline to think that the early attention paid to general and to technical instruction by the Swiss, the Dutch, and the Germans, was a result of circumstances over which they had little or no control, rather than a matter of foresight and deliberate choice. The desire to provide liberally for numberless orphans, the victims of war, led the rulers of those nations to think deeply on the subject of education. The best men devoted themselves to it, and made it of necessity a question of national concern. It progressed wonderfully after the interest excited by the philanthropic labours of Pestalozzi, at Stanz; Franke, at Halle; Von Turk, at Potsdam; and Von Fellenberg, at Hofwic. One enthusiast succeeded another; endless experiments were tried, for the pupils were passive, and public opinion was favourable. At length the axiom, 'Man is a being to be educated, and becomes human only in proportion to the culture bestowed upon him,' was generally received, and soon acted upon. Pedagogy rose to the rank of a science, and men like

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* The Chairman's address, 25th November, 1872.

Wilhelm von Humboldt became ministers of education."*

Admirable as, according to the testimony of all who have examined into the matter, is the general and primary education in many foreign countries, and much to be imitated by us, doubts may be entertained as to whether their strictly called trade schools afford the best solution of the difficulty, and supply the existing want. The admonition that unless cheap and efficient practical instruction in the principles of science, and their application to the industrial arts, be immediately and abundantly provided for workmen and workwomen, the better classes of productions will be monopolised or materially interfered with by foreign countries, and that to this country will be left the production of the cheaper and coarser goods and wares—a position due to capital, machinery, and energy of labour—cannot be disregarded. Mr. Brassey, in his "Work and Wages," inclines to the opinion that these characteristics may suffice for the maintenance of our position in the markets of the world; but this ought not to content us. Our position is widely different in many respects from Continental countries, and from the United States. We have a large number of existing educational establishments of the highest character, adapted to the requirements of one portion of the community; we shall have shortly, thanks to the untiring energy of patriotism, a universal system of primary education adapted to another portion of the community, hitherto neglected. We have manufacturing establishments of the highest character, which hitherto have had the command in most of the markets of the world. The question is, how can this be maintained.

The expression of some politicians, in vogue a short time ago, in reference to a kindred subject, of "levelling up and levelling down," will illustrate what I wish to convey as respects the educational establishments for the two portions of the community. The great middle-class, constantly recruited from the upper and lower classes, require the adaptation of those establishments to facilitate that operation. Deeply sensible as I am, from actual experience, of the deficiencies of our older and nobler institutions in this respect, and of the anxiety now existing to adapt them, as far as possible, to the requirements of the times, I look with great hope to the common schools of the kingdom as the true foundation upon which to raise the superstructure of technical education.

The evidence of Mr. A. Field,† as to the United States, corroborates this view. He says:—"I think the difference between the way in which the American workmen will turn out an article that is wanted, and the way that an English workman will turn out an article that is wanted, is to be described in this way. The Englishman has not the ductility of mind, and the readiness of apprehension for a new thing that is required; he is unwilling to change the methods which he has been used to, and if he does change them, he makes demands of price by trade rules which actually oppose the change of the article, or certainly attach to it something in the shape of a fine, or an extra demand beyond a fair price for the making of an article. An American readily produces a new article. He understands everything you say to him as well as a man from a college in England would. He helps the employer by his own acuteness and intelligence, and, in consequence, he readily attains to any new knowledge, greatly assisting his employer by thoroughly understanding what is the change that is needed, and helping him on the road towards it. On the one hand, I have a man who willingly assists me on the road I am going, knowing some things which I do not know myself; and, on the other hand, I have a man who stops me on the road, who puts his own ignorance in the way of my knowledge, exhausting me by the efforts I am forced to make to get past him while he stands before me in the middle of the path. Having been fighting the battles of English products in my own trade during a very long residence abroad, I have had gradually forced upon my conviction what the difficulties are that we are meeting with. This last year, having made an extensive tour in the United States of 7,000 miles by land, not so much for my immediate business purposes as for the sake of obtaining general information connected with the comparison of the manufactures of the two countries, as well as upon other social subjects, I have come to this complete opinion, that the cause of the whole difference between us is to be found in the education of the workmen on the two sides of the water. On one side, in fact, there is an almost total absence of education, and that is the main difference. There should be an improvement in the primary education of the English workman, and also given to the working men. The scientific education and the primary education are but parts of one whole. We must have the whole building in order to get what we want. I think, as a matter of fact, that what is most wanted is primary education, or rather a general liberal education, beginning at the bottom. I think if we could get that we should find that those parts of the edifice which come at the top would be arrived at more easily; but we should have those parts of the edifice too. And I do not conceive that we should be doing a work of supererogation, and what would not really help us in the right direction, should we at once promote the scientific education of all those who were ready to receive it. The American workman has received considerable scientific education; he has it chiefly by his own study. He has received, to begin with, a liberal education, something quite different from what we call primary education in this country, an education that puts him on a level with persons in a higher position than what we call the lower middle class, on a level, indeed, with almost the upper middle class. And with his mind so trained, he readily applies himself to acquire scientific education."

The history of this movement must not be wholly passed over in silence. "The immediate interest in the subject," as stated by Dr. Yeats,* "grew out of, among other matters, the reports of the British jurors at the time of the Great International Exhibition in Paris, 1867, and correspondence arising therefrom, such as Dr. Lyon Playfair's letter addressed to Lord Taunton, chairman of the Schools Inquiry Commission; the letters of the British jurors, and of men of eminence in science; the reports of working men, the memorials of the chambers of commerce, the questions addressed by the Vice-President of the Council of Education to the chambers; the answers returned from Birmingham, Nottingham, Staffordshire, Kendal, &c.; the particular evidence of Messrs. Young, of Bathgate; Bragg, of Birmingham; Ripley and Behrens, of Bradford; and again of Dr. Lyon Playfair; the evidence adduced before Mr. Samuelson's Committee of the House of Commons; and the excellent report on the importance of the introduction of technical education into this country, with the courses of study pursued in the technical schools of Germany, France, Belgium, Switzerland, &c., by Mr. Robert Gill, manufacturer, and member of the South of Scotland Chamber of Commerce."

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* Paper read to the Social Science Association, February 19, 1872.

† Before the Committee on Scientific Instruction, 25th June, 1868.

* See paper read before Social Science Association, 19th February 1872.

One of the first steps in connection with this subject was an inquiry by a Committee of this Society, in the years 1853-7, and the issue of two reports. The next step of importance actually taken was the appointment of the Committee of the Society of Arts on Technical Education, 26th February, 1868.

The report of that Committee leads to the following conclusions:—1. That the basis of all sound technical instruction is science taught efficiently in its application to the various employments of life. 2. That such instruction is essentially distinct from manual skill or handicraft, such as required for and only to be obtained in the workshop, which, as a rule, should be given in connection with institutions for general education. 3. That the term "technical" should not receive a wide and comprehensive meaning, such as has been occasionally assigned to it, so as to include almost every department of acquired knowledge. The limitation to be placed on this term may be further illustrated by a consideration of matters to which it does not apply, as, for instance, to the discovery of the properties of matter, attraction, cohesion and repulsion, of the laws of the physical and natural sciences, astronomy, mechanics, physics, electricity, magnetism, heat, light, &c.

The term "technical," in a wide and extensive meaning, might be applied to almost every department of knowledge. Thus we hear of technical terms, of speaking technically, and, as observed in the report of the Committee of this Society on technical education, those words, in their most general sense, include all manner of instruction required by the workman for his craft, by the manufacturer for his business, by the professional man for his practice. In these terms might be included those most admirable of all instructions, athletics, gymnastics, and school drill. That report limits its application to the strict and original meaning of the original Greek word, which, according to Richardson, relates to making, forming, or fabricating by the industry of man. In this restricted sense the term will be used here—a restriction which may be further illustrated by reference to the contrast which is drawn between art and nature, in which, according to the motto of the Smeatonian Society of Engineers, we overcome by "art" those things in which we are overcome by "nature."

The vast field of the industrial arts is thus laid open before us, and technical education is limited to instruction in matters bearing some special reference thereto; in other words, to the application of science proper to practical things.

Here again, however, some limitation may be necessary, and may aid us in making what is included more intelligible, by considering some matters not included.

Between discovery and invention a wide distinction exists; the former relating to the disclosure of the properties of matter and the laws by which it is governed, as of attraction, cohesion, repulsion, electricity, gravity, heat, light, magnetism; the latter to the application of those laws.

Technical education, as above defined, is based on instruction in the application of such knowledge; it starts, so to speak, with that which was created or made for man, not with what has been created or made by man.

Air, light, and matter are such as made by the Creator. No skill or labour of man can alter their properties, but such skill or labour can adapt and apply them to the uses of his fellow creatures. In this consists invention, and in the knowledge thereof consists technical education.

A further distinction exists between the fine and industrial arts. The products of intellectual labour embodied in a book, a design, a picture, a poem, or a sculpture, is the embodiment of the particular mind. No two minds would produce the same thing; the distinction between faces in the human race is not more remarkable than the distinction of mind—no two are identical. But inventions, or the creations of man in the industrial arts, may be identical, being all founded on laws or properties of matter as impressed by the Creator. In considering technical education, all reference to the fine arts is excluded; instruction may direct, intensify, or improve natural gifts, such as find scope for their exercise in the fine arts; but progress in the industrial arts, to which alone technical education has reference, depends mainly upon the results of training.

Thus, then, we are brought face to face with the subjects of technical education, which, as has been already observed, may be defined to be instruction in the application of the laws of nature and of natural agents to the requirements of mankind in the industrial arts. Assuming the foregoing definition or exposition of technical education, the question arises as to the means of promoting it. At this point it becomes important to consider the agencies in existence or available for the purpose. First and foremost, then, is primary education, that is, instruction in reading, writing, and numeration, with linear or plane drawing, as introductory to geometry.

At this point of the education of the people I would take my stand. Speaking from no small experience of the years wasted in studies for which no mental capacity exists, I would counsel educationists to consider whether some separation or classification of minds, in respect of their capabilities, is not practicable. I do not mean to suggest that at an early stage, say after the acquirement of the first rudiments of education next after primary education, it may be possible to ascertain what the particular mind is best fitted for, but I contend that by a very simple process it may be ascertained for what the mind is *not* fitted. For instance, some minds would never rise beyond mensuration in plain figures, or the conception of an area, comprehended between lines, that is to say, of space, in two dimensions. Minds so limited may become excellent accountants or surveyors, but can never become mathematicians. The faculty of passing, as it has been expressed, from squares to cubes, is a faculty of the highest order. At this stage of education the natural sciences come in; many of those who could never become mathematicians, may become observers, botanists, geologists, physiologists. The faculty of observation is innate, in the nature of an instinct to be improved, developed, but not to be given or created by culture. The necessity of technical education for the people is forcing attention to the deficiencies in the general education of those to whom competition in prizes is the incentive to labour, and who cannot have the same incentive to labour as the mass of the people.

It is, says Dr. Quain,[*] apparently not considered that there are faculties of the mind of a high order besides those by the exercise of which distinction is obtained in the favoured studies of our schools and colleges. It is not considered that many young people, though they have little aptitude for those favoured studies, might acquire in other pursuits the best results of education—knowledge and mental power—while some might attain even to distinction. Were the scheme of instruction in early life less "narrow," did it include subjects which require for their cultivation faculties other than those employed in even the most successful study of grammar, and classical languages, and ancient philosophy, no small proportion of that large number who are everywhere stated to be listless and indisposed to mental labour, would, in all likelihood, be saved intellectually, as Faraday was—would find, as he did, "an anchor" in some branch of natural science.

The "anchor" which Dr. Quain supposes would be found by some process of natural selection by the few who are free to choose any path in life, will, by force of circumstances, be found for those who take to technical instruction as the education for their position in life.

This instruction will afford to the children of the poorest the stimulus which prizes supply to the highest; not that the former should be excluded from prizes, but in the continuous system of education which, it may be hoped, lies in the future, and which is the natural supplement to the fiat that every child born into the world shall receive the elements of primary education, it is not too much to hope—to adopt an expression of an eminent philosopher—that an education begun in the gutter may end in our universities.

Whatever causes may have been in operation, it cannot be denied that the conviction at which we have now arrived as to the necessity of technical education has been forced upon us. The question may be asked how it has come to pass that technical instruction, which has so long existed and flourished on the Continent, has been neglected by us, to whom it is equally important. The follow-answer to this question has been given by Dr. Yeats:[†]—"We have suffered less on our own soil, and directly, from the horrors of war than they, and therefore, perhaps, have been less humble and painstaking. During their protracted struggle for liberty, we subsidised their troops, and thus contracted much of a load of debt the interest of which is weighing us to the earth, while they are comparatively free from such incumbrance. To maintain our credit we had to make money to discover and utilise the properties of matter, while our neighbours have been well and wisely addressing themselves to the development and application of the powers of the mind."

Without dissenting from the views expressed by such an authority, I am inclined to think that the true reason of this neglect is to be found in the fact that hitherto we have done well enough without this instruction.

Mr. Brassey, in his book on "Work and Wages," has furnished interesting statistics as to the relative prices of labour in this and foreign countries, as to the amount of work done, and as to the cost of its production, arriving at the conclusion that the lower rate of wages is more than compensated by the improved machinery, skill, and energy of the operative. This may be true as regards some of the industrial arts; but it should be remembered that we derived many of our manufactures wholly from foreign parts, and that France and Germany still enjoy, almost to the exclusion of this country, some manufactures, as, for instance, silk velvets, by reason of the preparation, spinning, and working of silk being still a domestic and hand manufacture, not yet brought under the dominion of capital and machinery, a result which would probably be followed by the transference of that manufacture to this country for a limited period, until the adoption by the foreigner of similar appliances.

Mr. Samuelson, who has given special attention to this subject, thus speaks of the question of foreign competition:[*]—"I think that the importance of the question of foreign competition, as affecting the policy of a Patent-law, has been somewhat underrated. In the year 1867 I visited Switzerland, and I was surprised to find how successfully our inventions in spinning machinery are copied there, the result being that our trade in spinning machinery, so far as certain neutral markets are concerned, more especially the South of Germany and North of Italy, has been transferred almost entirely to the Swiss."

The superiority of the Swiss, especially in certain descriptions of handicraft, as jewellery and watches, has been often the subject of remark, as illustrative of the results of the admirable system of elementary and technical instruction existing in that country. Similar results are referred to as due to the admirable system of teaching in Saxony.

Differences of opinion exist as to the effect which their generally superior education has on production, but it can hardly be doubted that the experience so clearly expressed by Mr. A. Field as to the character of American workmen will find a counterpart in Continental workshops.

The change which has taken place in the position of the industrial arts in this country during the last century cannot be denied, and ought never to be lost sight of. During that period domestic manufacture has given place to the absorbing and overwhelming influences of capital and machinery. The country has become one great workshop, labour-saving machines and mechanical appliances, chemistry and electricity, have created a world unknown to the last generation, and who can say what will be the outcome of the future?

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[*] See "On Some Defects in General Education." By Richard Quain, F.R.S., President of the Royal College of Surgeons for 1869. pp. 74-5.

[†] Paper read 19th February, 1872, before the Social Science Association, on "Aspects and Prospects of Technical Education."

[*] Evidence before Select Committee of the House of Commons on the Patent Laws, 18th April, 1872.

Neither the culture of the soil nor the rearing of cattle—in a word, the manufacture of food—has escaped the change, and the field of employment for the unskilled is becoming daily contracted in its dimensions.

The natural course of events, then, indicating the requirements of the future, the question arises, what can be done in anticipation of such requirements by a suitable system of instruction—how can our institutions be best supplemented or added to for the purpose?

The system of trade-workshops adopted in some Continental countries, to which reference is so frequently made, does not appear to meet the emergency. Indeed, such workshops already exist in the great manufacturing establishments of this country. It is the almost unanimous opinion of experienced persons that manual skill or handicraft can be acquired only in the actual workshop and working of those establishments.

Suggestions for the establishment of schools or universities devoted to the special subject of advancement of science and technical instruction, have not met with a favourable reception. The better system would appear to be to take advantage of the educational establishments already existing, so as to render them, as far as practicable, available for the education of the people, by suitable lectures and evening classes.

The concurrent testimony of thoughtful and experienced persons points to the facility with which the youthful mind of both sexes grasps at information as to the world in which we live. Why should not the universities, colleges, and schools be adapted to this? Why should not the child who has received a primary education in the common schools of the nation have the opportunity afforded for what has been termed secondary education, that is, instruction in the properties of substances, in the first principles of physics, mechanics, and the other natural sciences, before passing on to the tertiary stage of technical education, namely, that to be acquired in actual practice?

A wise distinction has been drawn between technical knowledge and manual skill or handicraft. The latter may exist independently of and without the former. Skill in manipulation is matter of birthright; it may undoubtedly be improved, but it will not be acquired by practice. As to this, the high authority of Sir Joseph Whitworth may be cited:—"My opinion is not favourable to model workshops. It is better to leave the people to pick up the knowledge where they can, in places of real business. Youths may learn the simple use of tools in almost any village, from the carpenter or the smith. I would not have a youth make machinery in a school or a college."* This opinion is not condemnatory of workshops and laboratories attached to schools and colleges, as King's College and University College in London, and Owens College in Manchester. They are essential to the illustration of principles and to that instruction which may be regarded as secondary and tertiary. These views are perfectly consistent with the classification of mind to which reference has been made. There is no necessary connection between manual skill and mental culture.

Having, then, by an exhaustive process, arrived at what technical education is not, and as to certain means which are available and suitable for its promotion, a few words may be added as to the principles upon which it should be founded. Upon reading, writing, and numeration, it will be unnecessary to say a word. I adopt the word numeration rather than arithmetic because I know, from the experience of others, as well as my own, that much time is unnecessarily wasted at an early stage in teaching, or trying to teach, portions of that subject which the mind is wholly incapable of appreciating, applying, or using in future life.

From the first step in numeration, that is, addition, subtraction, division, vulgar fractions, and decimals, I would pass to plane drawing and geometry, some of the simpler propositions of which may be taught with great advantage before entering on Euclid or any complete system of geometry. From plane drawing and geometry the youth should pass to elementary mechanism, chemistry, physics, and the other natural sciences. At this stage the principles of selection should be made, and technical education, that is, instruction in the elementary knowledge of particular trades begin. Last of all would come the education of the special trade or workshop, which no teaching can supply the place of.

The existing educational establishments may take part in such a division of instruction.

First, the Universities. Instruction at these ancient seats of education was, till recently, purely theoretical; that is to say, mechanics, for instance, were taught with reference to an imaginary, and without reference to an actual, state of things.

The late Canon Moseley,* one of the founders of the Applied Science Department at King's College, London, and the originator of the Bristol Trade School, insists on the importance of teaching industrial science to the industrial classes, rather than mere science which is not applicable to any useful industry, and illustrates it by the teaching, as existing in his time, at Cambridge. The laws of motion were then taught without reference to friction, all bodies being supposed to be perfectly smooth—an imaginary state of things, applicable to no industry whatever; whereas industrial science is that kind of science which takes into account all the conditions of the industry to which the science is applied. The theory necessary for this is geometry of the most elementary character, which might be dealt with by scale and compasses without any theoretical knowledge.

Another illustration may be derived from the theory of "work," and of the work done by heat, subjects within the reach of competent capacity, without any theoretical or mathematical teaching, but which, till lately, found no place in the teaching of our universities.

Similar illustrations may be drawn from hydrostatics, chemistry, electricity, magnetism, and the other natural sciences. The extension of lectures now given on these subjects at existing educational establishments to the people, would be the first step in the right direction for "technical education."

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* Evidence before Select Committee of House of Commons on Scientific Instruction, 7th May, 1868.

* See evidence before Select Committee on Scientific Instruction, 28th May, 1860.

One difficulty is in the want of suitable teachers. Teaching is a gift, an art, an instinct. Its power may be improved, but cannot be acquired. It was said of one of the most successful schoolmasters of my school days, "he taught so well because he knew so little." He had the capacity of imbuing the boys with what he knew. Here, then, is the first difficulty to be encountered and dealt with—an adequate supply of suitable teachers.

The following evidence of Dr. Frankland before Mr. B. Samuelson's Committee on Scientific Instruction is especially deserving of attention:—"There is a great deficiency of teachers in science schools, and in order to meet that deficiency the government now gives payment upon results to teachers who have not passed the teachers' examination, but have simply taken a first or second grade as pupils, and that is obviously a matter of momentary convenience only. It would be very undesirable that this scientific instruction should be stopped for the want of teachers altogether. I would prefer rather that it should be carried on with comparatively inferior teachers. The attempt to carry it on with inferior teachers would be liable to lead to discouragement on the part of those taught; but still, taking that evil into consideration, I think the advantage of awakening a desire for science teaching in the country would more than overbalance it; by bringing the boys and workmen into contact with scientific teaching at all, which has hitherto, been quite exceptional, there would be a considerable gain. There would now be a greater number of persons who would offer to teach than there would otherwise have been. The present schools are sufficient, or about sufficient, for the supply of the actual demand for instruction in chemistry, judging from the number attending those schools at the present time. That is not at all a healthy state of things—the fact of the demand being so small. You may contrive the best possible institutions for imparting instruction in science, but if nobody, or only a few, come to avail themselves of it, your labour is in vain. I feel that the growth of this desire must be somewhat slow, and hence it is that I say the institutions now existing would probably be quite sufficient if they were amplified in the direction of technical and scientific instruction. Thereby the country would be benefited in a material sense. I cannot conceive that it would be possible for us to maintain our position as a manufacturing country, unless something of the kind, in a very marked degree, takes place, and that before long. Apart from any moral or general considerations, I think that, in a mere economical point of view, instruction in my special branch should be more generally diffused. We know that the two great chemical inventions of this country during the last 20 years have been made by men who have been specially trained in chemistry, I mean the invention of the manufacture of paraffin from coal, by Mr. Young, who was trained in the laboratory of Professor Graham, the present Master of the Mint; and, secondly, the invention of the manufacture of the aniline colours from coal-tar. This invention was made in the first place by Mr. Perkin, who was a trained student in the College of Chemistry. Those are the only two great chemical inventions that have been made in this country during the past 20 years, and they have very greatly increased the manufacturing income of the country. They have started two most important branches of industry, which have already attained to colossal proportions. I have recently had occasion to go through a large number of chemical manufactories in Lancashire, which I had not visited for the past eleven years, and I was very much struck to find that the processes which were in use at that time were still employed, and in exactly the same form, that, in fact, those branches of manufacture had stood almost absolutely still; the only new invention that I found was beginning to be used was one for the recovery of sulphur from masses of alkali waste. This invention, which is important both in economical and sanitary respects, was made by a young German chemist, trained in the Polytechnic School of Cassel, I believe, but, at all events, having received a scientific training in Germany. Therefore, I think that science-training, imparted to those who are likely to become managers of chemical works, or proprietors of chemical works, is of the very highest importance to the nation. As to purchasing the inventions of foreigners, I do not think that purchased inventions can, as a rule, be effectively carried out in a manufactory where the manager is not himself a well-trained man, capable of introducing a new branch of manufacture, and, consequently, that the mere buying of a patent right will not take the place effectively of the inventive spirit in proprietors or managers of chemical works. A scientific invention must be scientifically applied, or else it will be almost certain to fail—at all events, commercially. It is well known that one of the great obstacles to successful invention on the part of men of science who are outside manufactures, consists in their possibility of getting their processes fairly carried out in the chemical manufactories. If they themselves turn manufacturers, there is little difficulty; but at present there are no points of contact between the purely scientific man and the purely mechanical workman in the manufactory. There are many attempts, but they generally turn out failures—so much so, that if a new patent is taken out nobody believes in it, and with reason, because the probability is that it is worthless. Many of those attempts are prosecuted in the teeth of scientific principles; there is a great waste of thought and a great waste of time in this country in that direction. Many people who are not without ability set themselves to solve a problem which is obviously impossible under the conditions. I insist upon the necessity of a general knowledge of the principles of chemistry preceding the application of those principles. I should not attempt to teach the practice of any art or trade, in either a laboratory or elsewhere, in connection with such a college, but I should give special courses of instruction upon those particular branches of science which bear upon the technical pursuits of students afterwards. In the case of brewers, for instance, it would be very desirable to develop, in the instruction of those men, what has been discovered with regard to fermentation, the conditions under which it takes place, and the modifications which it undergoes from various causes, things which would be almost useless to general students, or, at all events, would lead to too much detail in general instruction in science, but which would be invaluable to men who were going into that particular trade. These are the directions in which applied science would be most valuable to technical students. As to both the mechanics and chemistry of brewing, I should scarcely think that it would be desirable to go into the actual practice of the manufacture; that would be very much more quickly and efficiently learned in a brewery, to which I should presume the student would go on completing his instruction in the college. Supposing there are ten or twelve different systems of machinery as applied to brewing, I consider it desirable that the pupil should be made acquainted with those different systems, also with those systems which have turned out to be failures; in fact, any knowledge which can be imparted with greater effect in lecture-rooms than in manufactories ought to be so imparted. The pupils who enter my college generally come almost totally unprepared; they are quite unacquainted with the elements of science and with the modes of thought, I might almost say, which are necessary in beginning the study of science. Coming to me at 16 or 17 years of age, their general education has been tolerably good as to classics, and in a few cases as to mathematics it is tolerable; but the cases where it is good are rare. A fusion of the various scientific schools in the metropolis which are supported by the government would be productive of a very considerable advantage; it would not only give to the united institution a more complete staff of professors, but it would enable the students to pursue their studies with less loss of time, for the present students of the College of Chemistry have to go about a mile to the Museum of Practical Geology in Jermyn-street, to hear lectures on physics and on other branches of science; that is a considerable loss of time. It would be much better if their instruction could all be imparted in one building. But the other point, namely, the establishment of a more complete staff of professors, would be the main advantage that would be gained by this fusion.

"The classes in connection with the Science and Art Department, on the whole, have exercised a decidedly beneficial influence on the scientific instruction of the country; a large number of men have issued from the School of Mines, who have proceeded to different parts of the country, and who have formed centres around which a good deal of collateral science has subsequently been developed. The evidence afforded in the examination which is now just passed, shows that a great deal of useful instruction is given in those provincial classes."

The evidence before Mr. B. Samuelson's committee contains much valuable information in connection with this subject which cannot be referred to on the present occasion. I cannot, however, omit to call your attention to the evidence of the late Mr. John Platt, to the effect that some knowledge of actual work in the workshop should precede or be contemporaneous with technical teaching, and that the great difficulty is to find competent teachers, notwithstanding what South Kensington has done.

The Bristol Trade School is naturally referred to as a model. Its history and success, as stated by its founder, the late Canon Moseley, one of the pioneers in the education of the people, is most instructive, and deserves the special attention of all interested in this question.

And here I would refer to the labours of the Science and Art Department of the Council of Education, which has done, and is doing, a great work, as the recent report shows. With reference to the elementary instruction to adults and the children of the middle classes, it has not reached the younger portion of the artisan or the children of the weekly wage class. The report of Capt. Donnelly to Mr. Samuelson's committee calls especial attention to this subject.

Its teaching is thus described by Mr. Coomber:—"We teach chemistry, organic and inorganic, theoretical and applied mechanics, and experimental physics, including electricity, magnetism, and heat; we do not teach acoustics and light, inasmuch as our pupils have no use for them. We also teach descriptive geometry, by which I mean the description of planes and solids, and apply it to the construction of machinery and building, and mathematics. We have not done that subject so thoroughly as we shall do it in the future, inasmuch as our teaching adapts itself to the examinations of the Science and Art Department, and it is only just now that those examinations are beginning to take a really practical character; previously they had been merely initiative."

The character of technical instruction will vary with the locality, and to the careful appreciation of and action on this the success of the Bristol Trade School was mainly due.

There exist in the great centres of industry, men now occupying the position of engineers, managers, and foremen of establishments, well qualified to become teachers and instructors in their respective arts. On this point I can speak with confidence. Professional experience has, from time to time, made me acquainted with men who are essentially "experts" in their particular art, who, as witnesses, have shown their capacity and talent for teaching, by the power of giving evidence in litigated cases. This source of supply has not been considered, but I believe a large number of already-trained teachers might be found, who, from their known character in the particular locality, would at once command a class, even without the certificate of the Council of Education, or of any other department.

The payment of such persons out of public funds in the first instance, might be matter of arrangement, but I believe that payment by results would, in general, be sufficient as a supplement to payments by the pupils themselves.

For the proper development of such a system technical examinations, or examinations in technology are essential.

And here I would venture to ask what has been done in furtherance of the object of the meeting held in this room in July last, presided over by Prince Arthur, and in which the Lord Chancellor Hatherley and other eminent persons took part?

At that meeting an important suggestion was made as to the part which the City guilds might take in the movement. Their duties as to apprentices are still most beneficially exercised, and I gladly take this opportunity of calling attention to the suggestions then made by members of those guilds as to the funds at their disposal for affording most material assistance.

The instruction of their apprentices is, to some extent, under their control, and the members of these old institutions may be reminded that their duties in the education of their youth are not discharged by handing them over to masters who may be indifferent to their advancement. The complaint before Mr. Samuelson's Committee of the want of instruction generally of apprentices is well deserving the attention of these integral elements of the corporation of this great city.

Reference should be made to the recent minute of the Science and Art Department, whereby persons are allowed to become teachers in evening classes up and down the country, who have passed the May examination, but have not passed any special teachers' examination, or received any special certificate for teaching. This has been highly approved by persons of competent authority as a step in the right direction. The success of a man as a teacher—as remarked by Mr. Coomber* —does not depend on the number of certificates he gets, but upon his work. If he makes his work tell, he gets pupils, and if he does not, all the certificates in the world will not bring him any.

This, so to speak, free-trade in teaching appears deserving the attention of our educational authorities, and, if accompanied by a system of examinations in technology, and by payment by results, may become a mighty engine in the technical education of the people.

The following extract from the evidence of Mr. Buckmaster† is specially deserving of consideration in connection with the subject. He says:—"I think we ought, if possible, to give more attention to the teaching power of those engaged in giving instruction, for it is not always the man who has passed the best examination in science that is the most successful teacher, and if he should fail in teaching, from want of ability to communicate his knowledge, it is exceedingly difficult to re-organise a class when it has once been discontinued. It has occurred to me that we might in some way attach more importance to the man being able to communicate what he knows, by granting him a teacher's certificate independently of his having passed an examination in science. I think, before a man undertook the instruction of a class, he should give a lesson in the subject which he proposes to teach before some person who is competent to form a judgment on his teaching power and manipulation, because experiments frequently form a very important part of the instruction." Again, "teachers should go to some model school, for the purpose of learning to teach and experiment. There would be no necessity for that in the case of men who had already passed an examination as elementary teachers, because there you have a guarantee, but with the others you have no guarantee.

"If it were understood that men would be examined as to their power of teaching before receiving payments, they would make it part of their business to become good teachers, and you would have more efficiency. Although there might be a falling off for a time, I think that in the long run there would be a recovery which would compensate for it, and there would also be an enthusiasm upon the part of pupils, which no man can create unless he knows how teach."

The testimony of Professor Clifton, supported by others of high authority, leads to the conclusion that the instruction in arithmetic is generally of the most elementary and imperfect kind. Adequate instruction in the whole of arithmetic involves what is beyond many minds, and confirms the opinion that far too much is attempted. Indeed, algebra and higher geometry should take the place of a large portion of the teaching of arithmetic, all which, however, is wholly unnecessary as a foundation for technical education.

The same high authority confirms my own opinion, formed on long experience at the University of Cambridge more than thirty years ago, viz., that it is not expedient to attempt technical instruction by the ordinary teachers or professors. It was my good fortune in early life to hear the lectures of the late Professor Farish, now almost forgotten, and of whose system I am not aware of existing record.* He possessed the rare qualification of a combination of the highest mathematical attainments with practical science. His lectures were an exposition of principles, illustrated by their practical application in the arts and manufactures of the country. With the aid of a skilled assistant, operations and processes were carried on before your eyes by means of models of actual machines, constructed out of elements adapted for the purpose, on a comprehensive system of mechanical construction.

Lectures at the universities will, of necessity and most properly, be mainly directed to the mathematical theory—not, indeed, to the exclusion of experiments, but to the exclusion of that technical knowledge which is essential to technical education. It is, I conceive, essential to their special functions in education that the course should be directed to instruction in the mathematical, physical, and natural sciences, leaving the applications of these sciences to subjects purely trading or professional in other hands. They should, of course, possess collections of apparatus and laboratories of every description, in which, under the aid of skilled professors, students might pursue the applications of principles, but professions or trades, as such, cannot be taught or learnt then with effect.†

The art of lecturing, so as to secure the attention and attendance of an adequate audience, is a rare gift, which, though it cannot be acquired, may be much improved by practice.

The Society for the Diffusion of Useful Knowledge published a "Manual of Lectures for Mechanics' Institutes," also a series of "Sectional Diagrams of Machinery," and took the initiative in providing a series of models for lecturers, constructed somewhat on the system adopted by Professor Farish, already referred to; but the encouragement was not adequate to justify the risk on the part of a society having no public funds, and depending on the subscriptions of a few eminent men, and self-supporting. The authorities of the Science and Art Department would do well to follow out some such system in aid of lecturers in the provinces.

The neglect of drawing, at the earliest stage of the use of a pencil by a child, may be regarded as a great defect in our system of teaching, which our educational authorities have done much to remove.

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* Evidence, 28th May, 1868, before Committee on Scientific Instruction.

† *Ibid*, 3rd July, 1868.

* Any person who could supply this would render essential service to teaching.

† See evidence of Professor Clifton upon Committee on Scientific Instruction, 15th May, 1868.

What reason can be suggested why a child should not commence geometrical and mechanical drawing contemporaneously with learning to write? Indeed, so soon as it has the power of handling a pencil, the discipline of learning to draw would be quite equal to the discipline of learning to write. The want of this simple first elementary knowledge is declared by competent authority to be a great barrier to the success of artisan students.

The Select Committee of the House of Commons on Scientific Instruction recommend in their report that instruction in drawing should be given in elementary schools. The disregard of such elementary instruction as a branch of general education is surprising. Drawing is a universal language; it is easier of acquirement than writing. By the use of a ruler, pencil, and compasses, a child may become self-educated, and acquire a handicraft of essential service in after life.

The exclusion of drawing and geometry from the subjects of examination by the Council of this Society on the recent revision of the subjects of local examination, is, in my opinion, greatly to be deplored. Encouragement in this acquirement might thus be given to those who can never attain mediocrity either in reading, writing, or arithmetic; and who can tell what may be the aid to development thereby afforded to the natural born talent of an artist?

I look upon linear drawing and geometry as the very foundation of instruction, and as affording, at a more advanced stage, the means of separating and classifying minds into orders or classes, so as to utilise each to the utmost, according to the powers with which it is endowed.

In the material world, the subdivision of labour is carried to the utmost practicable limit, but it does not appear to have entered into the consideration and practice of educationalists that the mental world admits of a similar subdivision.

Experience as regards free-hand and mechanical drawing may serve to illustrate my meaning. It is said to be difficult to draw the line of division between art and science in the fine arts. The knowledge of the human figure, that is, of the bones and the muscles, is said to be pure science, but the drawing them is matter of art, which may be executed with great effect without any knowledge of geometry, which is, however, essential to a master in art. The practice of the Science and Art Department further illustrates this, in which, according to the evidence of Mr. Cole,* a certificate for the highest grade of our art-teachers comprehends an ability to teach practical geometry so far as drawing is concerned, but it is optional that a person so qualified should take a special certificate for mechanical drawing, which includes drawing machines, as well as drawing for carpentry and building. More children in parish schools, according to the same high authority, take the earliest certificates in geometrical drawing than in what is called free-hand drawing; the making a triangle or an ellipse mechanically is easier than drawing it with a free hand. The same authority, after illustrating by specimens from our art schools the course of instruction at M. Schneider's school at Creuzot, of free-hand drawing, that is, without measurement or instructions for drawing, and mechanical drawing, concludes as follows:—"The fact is, that a man who is no artist may very soon acquire the power of doing drawing which is done by measurement, and which does not involve dexterity of hand; he will grind away for a year or two to be able to do that; but the moment you come to something that implies an instinct in art, the number of those who have that aptitude is very much reduced."

"The child is father of the man." Why should not the detection of this aptitude or inaptitude be made at the earliest stage of education? One school was referred to by the same authority as existing in this country in which this was done, that is, beginning with A, B, C, and going on with reading, writing, and arithmetic; why, I would ask, should not such elementary instruction in drawing go on contemporaneously or simultaneously with the ordinary elementary instruction?

The establishment and maintenance of museums of inventions, or of the industrial arts, in the principal towns, would contribute much to the cause of technical education. The feeling in favour of such museums is shown by their existence in an imperfect form in many of our principal towns, and by the spasmodic attempts from time to time made for their establishment.

One main cause of the failure, or imperfect accomplishment of these well-designed attempts has been the want of system and connection with the education of the country. This subject has received little attention, but is thus spoken of by Mr. Wright:—"The only part of the report of the Schools Enquiry Commission which has not been favourably received in Birmingham is, that the Commissioners do not recommend any portion of the funds to be applied to mere elementary teaching. Generally, the inhabitants are in favour of some portion of it being applied to elementary education. As far as I can gather, I should say that we are generally in favour of having a museum on an efficient and comprehensive scale. We think that it would be of great use, and we think that if the government were to supply us with the latest and most approved scientific instruments, and send some of the ablest professors as lecturers, to stimulate our people, and if they would also employ some one in connection with the metal trades to give information with regard to new discoveries on the Continent and in different parts of the world, that would be of the greatest possible use. Such lectures very much help the trade of Birmingham, and not only would help the trade of Birmingham, but they would be a national good. For instance, if an eminent teacher like Dr. Percy were sent down to give a series of lectures on the laws of combustion, or on metallurgy generally, we think it would be very useful."

The Patent-office Museum at South Kensington of the Commissioners of Patents, founded on models principally collected by or the property of Mr. Bennet Woodcroft, may be pointed to as a type of the establishments which are required. This museum is not only wholly inadequate for the purpose, but it is starved amidst abundant funds available for the purpose. Interesting and instructive machines and models are withheld for want of adequate room, though surrounded with unoccupied space available and suitable for the purpose. Funds are withheld for the carriage of machines which mark an epoch in the progress of the nation, as, for instance, of a

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* Before Select Committee on Scientific Instruction, 30th April, 1868.

Newcomen steam engine, constructed by Smeaton in 1766, and nine years prior to Watt, for the Carron Company, and which, at the instance of Sir Francis Pettit Smith, the curator of the museum, was presented by the Carron Company for preservation in the museum of the Commissioners of Patents.

The starved and neglected state of this museum has been the subject of frequent observation. Its history was recounted before the Royal Commission on Patents; it was the subject of inquiry in 1864, by the Select Committee of the House of Commons, presided over by Mr. Dillwyn, and recommended as a legitimate application of the surplus of the fees levied on inventors; and again in 1871 and 1872, by the Committee presided over by Mr. Samuelson, when it transpired that the so-called reading-room was actually not screened off from the public part of the museum, and denied the warmth necessary, not only for the comfort, but the existence of the readers in severe weather, and this in the face of an accumulated surplus, during the last twenty years, of nearly a million of the monies of inventors, and of an annual surplus of £60,000 a year available for the purpose.

The existence of such a state of things is almost incredible—urgent requirements, ample funds, and nothing done.

Inventors, like teachers, the greatest benefactors of mankind, if not a despised class, have received but little recognition of services or funds. The apathy, not to say indifference and opposition, of those who are placed above the necessities of life, can only be successfully overcome by the exertions of a Society like this. Its voice has been raised effectively on many occasions, and must not be silenced until some paternal government has not only recognised, but shown its recognition by acting on the axiom, that technical education is essential to industrial progress.

The Earl Granville, at the annual celebration of the 101st year of the existence of this Society, at the Crystal Palace (the suspension of which celebration, in common with many others, I deeply regret) compared this Society to the Zouaves, as ready to go into action without knowing how they were to get out of it—as a body full of resource. The noble Earl then pointed to a museum of industrial arts as naturally arising out of the Exhibition of 1851, of which it must never be forgotten that this Society was the parent.

The spirit by which those observations were animated still subsists amongst us, With the view of deriving some practical conclusion from the foregoing, I would suggest as follows:—

1. Aid, assistance, and encouragement, by apparatus, drawings, and money to experts, in any department of the industrial arts, to become lecturers and teachers in the locality in which they are placed.
2. Local examinations in technology, certificates and money prizes for proficiency, and payments on results.
3. The establishment and maintenance of museums of industrial arts, for the education of the people in technical knowledge.
4. Authority to municipal corporations and local boards to expend money raised by rates in supplementing the foregoing objects.

The experience of many present will suggest other experiments in furtherance of the foregoing objects. The Society of Arts cannot discharge itself of the duties and responsibility of its position in connection with technical education until something effective has been done; and so soon as the country has been aroused on the subject, volunteers in the work will not be wanting.

The voice of the earnest men who, in the same session, obtained a grant of twenty millions for the extinction of slavery and the first grant for national education, has been responded to by the nation, in the declaration of the Legislature that every child born into the world is entitled to, and shall receive, primary education; but the technical education essential to its advancement has yet to be secured by wise practical measures, fostered by this Society.

DISCUSSION.

Dr. Yeats said the question of general culture had often been discussed, but that of special culture, or technical education, seldom, or not so often, at any rate, as its importance warranted. One bearing of technical education was this, that it raised the whole working power of the nation. It had been said that it would be a great triumph to the political economist if he could convert every consumer into a producer, and that the next great triumph would be to increase each producer's producing power. The advocate of technical education, however, would go considerably beyond this. Every parent knew what a difference it made in the management of a family when each one was fully interested in his or her own occupation, and the same principle might be carried into the workshop. Any proprietor or manager of a factory could say what a difference it made in the condition of those under his control, mental, moral, and physical, when they were directly interested in what they were about, as compared with men who were only instruments, watchers of instruments, watchers of machinery, and who, under the system of minute division of labour, had no legitimate occupation for the whole of their being. They might have their eyes constantly occupied, but neither their heads, hands, or hearts were fully employed. Advocates of technical education were not merely promoting the means of gaining a livelihood, but, far more than that, they were endeavouring to aid the workman in really living—mentally, morally, and physically—and he knew of no greater want in the present age. In fact, the danger of neglecting it became more apparent every day. Capitalists were becoming the possessors of machinery which superseded the men who, 20 or 30 years ago, had to make and keep in order the instruments with which they wrought, and in making their tools they made themselves. The machinist of the last generation had to keep his own tools sharpened and tempered, but now, in modern establishments, all that was done for him, and, as a consequence, the men being set simply to watch pieces of machinery, became indifferent to it, and, as human beings, they greatly deteriorated. Only recently the foreman of a large concern told him it was wonderful the difference between the men of the present day and those of thirty years ago; only a short time previously, a man had come to him saying that a beautiful lathe, worth £400 or £500, was spoiled and broken, but, on investigation, it appeared that the man had been put to work at this lathe from one exactly similar in principle, but differing slightly in detail, and having forgotten or omitted to put one of the leading wheels in gear, he fancied the lathe was out of order. The old system of apprenticeship was being set aside, and there was no substitute for it, which he considered was a great pity, especially as there was an immense amount of work to be done, if men only knew how to set about it. For instance, on every railway there was an immense waste of force in the generation of steam, in the transmission of the steam to the point where it was utilised, in the loss of heat from the waste steam, and in the imperfect construction of the engines; besides all which, there was an immense amount of dead weight carried, amounting to something like two or three tons for every passenger. If some or all of these things were altered, great reduction in fares might be effected, but not without. These things were all well known, but no one knew how to remedy them, nor where to go for information as to what had been attempted, what had failed, what it was no use attempting, and in what direction efforts might most usefully be directed. And he saw no possibility of improvement until establishments were set on foot in which the first principles were thoroughly taught. Years ago he read a list of premiums offered by the Society of Arts for desiderata in nearly every branch of manufacture, but he was not aware that many of them had been applied for. Scores of times he had heard the desirability of a good substitute for the present pen and ink pointed out—something which should be available at all times, and in any climate, but as yet nothing had come of it. During the siege of Paris, a number of French *savans* were called together to deliberate as to some means of overcoming the difficulties under which the population were labouring, especially in the matter of food and fuel; but eminent as some of these men were in various branches of research, they had to confess their incompetence to deal with the simplest and most practical points, never having turned their attention to them. Now that was just what was wanted, especially in England, without waiting for the pressure of a siege. Facilities were required for the diffusion of knowledge already gained, but of which the great mass of working men were in total ignorance. The Patent-office had been referred to, but it seemed to him to be treated by inventors very much as the Court of Chancery was by owners of real property—a place to be avoided if possible. Any one with money might patent anything, but he only was successful who had the power of purchasing all before him, unless, indeed, he were strong and unprincipled enough to override everything and everybody.

Mr. Campin, alluding to a reference in the paper to the City guilds, said he was sorry to find they were not doing as much as they might to aid technical education. Five years ago, in the Guildhall, he got a resolution passed, recommending the then Lord Mayor to take the matter into consideration; and similar resolutions had been passed since, but hitherto nothing had come of it, though hopes were entertained that something might be done by the present Lord Mayor. His predecessor called together a number of representatives from the various guilds, and various meetings were held at the Mansion-house, but he believed no definite conclusion was come to, though something might be done with Gresham College, which had about £10,000 a-year at its disposal; and if the Mercers' Company, who had the management of it, and who were represented at the recent Conference on this subject in the summer, would take the matter in hand, and turn the College into an institution for technical education—perhaps in a different locality—he thought it would be a great benefit to the community. He did not agree with Mr. Webster, that reliance should be placed in the old universities and colleges taking this matter up, but inclined to the opinion expressed by Mr. Scott Russell, that in such places classics and mathematics would overshadow and dwarf the teaching of the natural sciences.

Mr. Mast thought one principal point had been to a great extent overlooked, viz., the importance of having good teachers. His native country afforded a good example of what might be done to overcome difficulties. It was desired some years ago to establish a school for technical education in Gothenburg, there being then no available establishment in Germany; the future teachers sent to the Ecole Polytechnique, in Paris, where, being—men who had received a university education—were supported by their own government, they learned those branches of science which it was desired to teach in Germany. As soon as they had acquired a thorough knowledge of these, the government established a school on the model of the Polytechnique at Stuttgard, and this was the focus of technical education in Germany. In connection with this was established a system extending to the very lowest grade, so that every child, from the lowest to the highest, might partake of its advantages. Instead of connecting this school with the University of Tübingen, the government thought it better to give it the station of a university, so that its professors ranked equally with those of Tübingen. One of the arrangements was that each department was divided into two grades, upper and lower, and provision was made for educating teachers. This was of prime importance—for until teachers were raised in public estimation and received better pay, systems of examination and everything else would be of very little use. It seemed to him that beginning with examinations was commencing at the wrong end; some knowledge ought to be put into the children's heads before they were examined. And he must say that, in his opinion, the middle classes required assistance of this kind as much, if not more, than the lower. It was absurd for employers of labour to be less educated than the men under them, yet it was really this class of persons—managers and so on—which, he believed, was most backward in technical education, when they were compared with persons holding the same positions abroad.

Mr. W. Botly, from his personal knowledge of manufactures, was able to corroborate what had been so well said by Dr. Yeats as to the difference between the mechanics of the present day and their predecessors. In the cutlery trade it was formerly the practice for one man to conduct the entire manufacture; forge the blade, file it, harden and temper it, grind it, glaze and polish it, and finally fit it to the handle; now every process was a separate branch, and no man could do anything but that to which he had been accustomed.

Mr. Edward Hall begged leave to direct attention to the importance of enlisting the co-operation of trades unions in the matter of technical education. It was well known that these bodies intended to keep up the standard of wages, and that, of course, involved the necessity of keeping up the standard of work. Hence they ought to be most active promoters of the education of other members in their various crafts. At any rate, in connection with each trade there ought to be a system of education, or, at least, a museum containing specimens of everything relating to the knowledge of the craft. Another important means of technical education would be, he believed, visits to works in progress. He had initiated something of this sort a few years ago in connection with engineering and building works in which he was most interested, and from the success which had attended his efforts he was convinced that much more might be done in the same way.

Major Donnelly, R.E., in answer to the question of Mr. Webster as to what the Society of Arts was doing in this matter, said that arrangements were being made for examinations to be held next May in four or five different branches of industry—in the manufacture of paper, of cotton, of silk, of steel, and in carriage-building. The Society would provide funds for the examinations, but of course it must depend mainly on the different industries interested as to what development these examinations would take, for unless they came forward and gave prizes, it could not be expected that any great number of persons would offer themselves for examination. He was much obliged for the suggestion of Gresham College as a source from which funds might be derived, and any further suggestions of the same kind would be very acceptable. He could not see the force of the objection that they were beginning at the wrong end, considering that there were so many organisations now at work throughout the country by means of which technical instruction could be attained. With regard to drawing, the Science and Art Department did attempt, and in some degree successfully, to introduce it into elementary schools, though he hoped more would yet be done in the same direction. He believed the main point to be aimed at was to induce different guilds and trading companies to place money at the disposal of the Society for the purpose of rewarding successful students, for by that means an immense, immediate, and practical stimulus would be given to technical instruction, and there was no need to wait for any large system being introduced before setting to work.

Dr. Ellis said there were three principal points which should be kept in view in considering this matter. First that every man who had distinguished himself, possessed a natural talent, which talent could not be created, though it might be discovered and cultivated. Therefore setting young people to work at anything for which they had no aptitude, was as bad as teaching music to a person whose organs of hearing were defective, and involved an enormous waste both of time and money. Secondly, that children should not be set to study matters for which they had neither taste nor capacity. Thirdly, it was of great importance to discover in what direction a child's talent lay, and this could always be done by the watchful eye, often in the hours of recreation. After all, as had been well said, one of the greatest difficulties was to find persons with a capacity for teaching.

Professor Tennant remarked that the action now being taken by the City companies in this matter was merely a revival, for one of them had been fighting this battle for the last 20 years, though they were only now accomplishing the object they had in view. The Turners' Company, of which he was a member, had taken a prominent part recently in recognising technical education. The Museum of Patents having been mentioned, he might say that, on visiting it recently with some friends from the country, they had occasion to lament the absence of any catalogue giving a description of the articles exhibited; and with regard to museums generally, he had been much struck only that morning, on visiting the British Museum, with the fact that its great educational advantages were so little appreciated by the public. In the mineral department he counted twenty people, though it would hold 500 without inconvenience; whilst in another portion of the building, equally commodious, there were only fifteen. Yet there was no difficulty in gaining access. Some years ago the Society for Promoting Christian Knowledge took a prominent part in promoting technical education by publishing a series of maps. They were, however, very little known, and had recently been given up. It so happened, however, that, having shown them to the late Mr. Stephenson, he was so pleased with them that he left the Society £2,000, which considerably more than covered their cost. A small case, which he had placed on the table, illustrated another branch of the subject, viz., the importance of a knowledge of mineralogy. During the last twenty years many things had been thrown away which were commercially of the greatest value. The first description of the gold-fields of Australia was given in this room some twenty-two years ago, and only four years since the first description of the diamond fields of South Africa. Interested persons said that diamonds did not exist there, that when they were found they were of no value; and the most recent paragraph going the round was that no more were to be found. Well, in the case on the table was a specimen of a South African diamond in the matrix; by its side was a photograph of the diggings, taken within the last four months, where there were 60,000 people at work, and some of the diamonds discovered were worth £10,000 a piece. The person who took the photograph, moreover, stated that he had found diamonds existing for a distance of 200 miles; he still continued to find them, and there was every probability that they extended for 200 miles further.

The Secretary said, in reference to the action of the City companies in this matter, he was sure the meeting would be pleased to learn that the Clothworkers' Company had, in appreciation of the work the Society was now entering upon, intimated their intention of contributing to the funds of the Society ten guineas annually.

Mr. George Martin said the art of teaching was a most important subject. Having been for the last 25 years engaged in teaching teachers, he had had some considerable experience in the matter. He should be very pleased if the Society would take up this question, in however small a way, though, unfortunately, the art of teaching was seldom to be acquired, being generally born with the teacher, as poetry was with the poet. At the same time, an indifferent teacher might be much improved, and he should like attention to be called to the fact that the London and other school boards entirely ignored the art of teaching, depending entirely upon the certificate of the master or mistress. However, in many cases a man or woman who obtained the highest certificate proved themselves the very worst of teachers. The art of teaching, therefore, should be more considered, encouraged, and studied, and government should make appointments according to the result of examination, and not according to the certificate of the master. It was a great pity that so many men and women, willing and able to engage in this work, should be kept out of employment, and only certificated persons engaged.

The Chairman said it was impossible to overrate the importance of the subject, and all must feel greatly indebted to Mr. Webster for the very clear manner in which he had dealt with it, as well as to those gentlemen who had taken part in the discussion. It occurred to him during the discussion, as it always did when this subject was mooted, that two of the great difficulties in the way of success were, first of all obtaining a sufficient amount of funds, and the next a sufficient number of skilled and qualified teachers. One of the most valuable suggestions was that just made, that more attention should be directed to those who had an aptitude for teaching than to those who were greatly qualified by means of the scientific knowledge which they possessed. Mr. Martin, however, was not quite correct with reference to the course adopted by the Science and Art Department of the Privy Council. In the case of elementary schools, it was no doubt true that certificated teachers only were taken for public instruction, but in the last report for 1872 he found it mentioned that the payments to teachers in connection with the Science and Art Department on results, which was the great test of success of teaching for instruction of artisan classes during 1871, amounted to £18,830. It was obvious therefore that the course taken in that direction had been in accordance with what no doubt was the opinion of all present. In the present state of affairs it seemed that the Privy Council was the principal body to which everyone looked for the promotion of the education of the people. He could not help thinking however that that body had, to use a common expression, far two many irons in the fire. Both the cattle plague and numerous other things were referred to this body, and there seemed a tendency to cast upon it all sorts of additional duties. He believed therefore that the time was come when there ought to be in England a minister of public instruction, as was the case in France and elsewhere. Looking to the immense importance of education, and the various fields into which it ramefied, not merely the mental but technical education in various branches, and even going higher still, it was certainly time that there was a responsible minister, such as he had referred to. However, in the absence of such a minister, it was right to state that the Privy Council was doing a great deal to promote teaching in science and art, for not only had they raised the large sum of nearly £19,000 for results in teaching artisans, but they had at present under their control 908 schools in the science department, educating 38,000 students. Of course that was nothing at all in proportion to what the country required, but these matters were supported by public grants, and everyone knew the difficulty in these days of economy in getting large sums of money voted for anything like new purposes. At the same time, though Parliament ought to be the proper guardian of the public purse, when a subject of this great national importance, which would amply repay any expenditure incurred, came before it, he thought it was not wise economy, or prudent parsimony, to grudge a vote for such purposes. In 1871 only £175,000 was voted for this object, which might seem a large sum, but, in proportion to what was required, it was by far two small. £77,000 of that was expended in schools of science and art in connection with the Privy Council, leaving the margin to be expended for other purposes, such as the Kensington Museum. He had only mentioned as yet the number of students in the science department, but allied to that was the art department, which was also of considerable importance, and he found that for 1871 there were 212,000 students under that department, the amount of fees paid being upwards of £23,000. It was quite true, as had been said by Mr. Webster, that the scheme of technical education might become a branch of the elementary education of the country, and he did not see how the schools could be maintained unless they were put, to some extent, on the same footing as the elementary education of the country, viz., that there should be School Boards or some local bodies to superintend them, with the power of imposing rates for their support. It was not, perhaps, borne in mind that in the Elementary Education Act of 1870, there was a clause enabling School Boards to contribute to the maintenance of industrial schools whenever necessary. If these technical schools were so important a branch of elementary education, and this were one of the means by which they could be supported, it would be most desirable to embody in any amendment of the Act, a clause and a similar description, enabling School Boards throughout the country to contribute to the maintenance of schools for technical education. In the meantime, however, they were almost dependent on voluntary effort, which had already been found in the case of elementary education to be anything but sufficient. A system of rating had been found necessary, and no doubt the same thing would have to be done for technical education. The Society of Arts had done, and was doing, much in this direction, and this was, of course, voluntary; and so, to a great extent, was that which was done by the Privy Council. He was glad also to find that some of the wealthy corporations in the City of London were feeling the necessity of applying a part of their funds to similar purposes. In the report of the Privy Council on this subject, the Plasterers' Company was mentioned as having given prizes to successful competitors in the arts connected with the embellishment of buildings, and the Paper Stainers had done the same, and also the Coachmakers' Company. The Society of Arts, therefore, had already stimulated some of these bodies to do something in a way which was in reality only a return to the original design of their originators. Another valuable observation of Mr. Webster's was that museums exhibiting inventions and models of machinery were of importance as an educational means; and so they were, if properly managed, but he must say that the Patent Museum at South Kensington was a disgrace to the country, and to those, whoever they were, who were responsible for its condition, for it was practically useless. Allusion had already been made to the want of a catalogue, but even if that were supplied it would be almost impossible to get at and examine anything you wanted, owing to the way in which the various models were huddled together. The American Patent Museum formed a striking contrast to this, being one of the most splendid establishments in the country. Now, it so happened that the Commissioners of Patents—the Lord Chancellor, the Master of the Rolls, and the two law officers of the Crown for the time being—had year by year, from 1859 down to 1872, drawn attention to the defective state of the Patent Museum, and the necessity for improving it. In fact, the report for 1872 quoted a paragraph from that of 1859, stating the objects and uses of such a museum, and saying that the Committee were in possession of a large number of valuable models which remained in their cases simply because room could not be found for them at South Kensington. It was, therefore, evident that Parliament, in voting the civil service estimates, ought to allot a sum of money for the purpose of placing this institution in a proper condition, especially when it appeared that the aggregate surplus of fees paid by inventors over the expenses of the Patent-office amounted, from 1859 to the end of 1871, to nearly a million sterling, that for 1871 alone being upwards of £70,000. Yet, in face of this, he read in the newspapers of that date that the Attorney-General told a deputation from Liverpool, which recently waited upon him, that he and the other officers of the Patent Department had applied to the Chancellor of the Exchequer for a sum of about £120 for the purpose of the Museum, and even that was refused. He did not say that there was no reason for the refusal, red tape or otherwise, but it certainly looked rather extraordinary. He concluded by proposing a vote of thanks to Mr. Webster for his valuable paper.

The vote having been passed,

Mr. Webster, in reply, said there was every reason to hope that the universities were beginning to recognise the natural sciences at their true value. Trinity College, Cambridge, for instance, had recently elected two fellows for their attainments in this branch of knowlowdge. He agreed with Mr. Mast, that beginning technical education with examinations was not the proper and natural method, and in a new country he should advocate beginning with instruction; but they must take into account exisiting circumstances, and he believed that a good system of examinations would in this country, and at the present day, really encourage and advance technical education. He also agreed that the trades' unions might greatly aid in the work, if they would adopt the principle that a man should be paid according to his skill, and on no other system.

Mr. Hyde Clarke writes:—"As time did not allow a fuller discussion of the important subject, I beg to offer a few observations with regard to the history of this subject. The invention of technical education in France was greatly owing to the wants of the revolutionary wars, which prompted the formation of the Polytechnic Institutions and the establishment of other measures. The public efforts for technical education can scarcely be limited to 1853, as already in 1836 it was fully recognised in the agitation and the Parliamentary Report on which were founded the schools of design, as the preliminary step to the full course of instruction afterwards resumed in 1853. Technical education alone is not sufficient to account for the competition of the Swiss, because this must be attributed partly to the employment in watchmaking and other trades; and the arguments of Dr. Yeats are applicable to those countries in which technical education is most developed as well as to England. The same defective application of heat and construction of locomotives, alleged in England, is identically to be recognised in Switzerland, Germany, Belgium, and France, while it is to be observed that the locomotive system was developed in England originally, and it has continued to be the chief seat of railway development. Without in any degree underrating technical education, the necessity of which cannot be too strongly advocated, it is necessary to point out that some of the consequences must be attributed to other causes. Consumption must, indeed, be regarded as much as production, and in this respect it is the deficiencies of commercial education which tend to retard the progress of our trade in foreign countries. Some of our competitors bestow more attention than we do on the adaptation of manufactures to the requirements of the local consumers, and others reach the trading classes by making themselves acquainted with the language of the people, a matter too much neglected among ourselves."

The Rev. Arthur Rigg writes as follows:—"If in addition to opinions expressed this evening, in reference to 'Technical Education and the Means of Promoting it,' facts resulting from actual work in the cause, extending from 1839 to 1869, are likely to be of interest, I will supply a few. What was being done in 1850 is very clearly and truthfully expressed in a letter to the *Chester Courant*, where I saw it for the first time. This, however, is too long for quotation here. The date of the letter is September, 1850. Recalling the views and experiences of the past, I may state—

"1. That school workshops in lieu of a manufactory do not succeed.

"2. That, supplementary to school instruction, they are as useful, and perhaps more useful than museums and physical laboratories.

"3. That models of apparatus, and experiments as such, and ending there, are delusions; they do not carry with them intellectual development.

"4. That of the numerous models and apparatus made at Chester for school instruction in technics, England has had little—much has been sent to Australia and America.

"5. That there is much truth in the somewhat apparent anomaly to which Mr. Webster alludes, in writing of one of his schoolmasters, 'He taught so well because he knew so little.'

"6. Surely the time has arrived when men of action should operate and opinions be silent. The importance of technical instruction was with me a fact, not an opinion, more than thirty years ago. Alas! very little indeed has been the progress. If the next thirty years do not see a much more rapid development than the previous thirty, some generations must pass away before England has that which can properly be called technical instruction in her schools."

There were exhibited by Professor Tennant some interesting specimens of diamonds from the Cape of Good Hope, as well as some photographs of the diamond fields there.

A rich naphtha spring has been discovered in the province of Caserto, near Naples, and is now being worked by a Milanese firm.

M. Marechal, the well-known glass-painter, late of Metz, whose productions have attracted attention at several international exhibitions, has removed his establishment to Bar-le-Duc.

It is proposed to utilise the tramways in the early hours of the morning, before the passenger traffic begins, by running on the lines suitable scavenger waggons, by which the dirt and refuse of the streets could be carried away to a distance.

The General Council of the Seine have recently rejected a project submitted to them by the prefect, for uniting the lines of the east, north, and south by a short suburban line by Neuilly, St. Denis, and Pantin; and they recommend, in preference, a more comprehensive scheme of M. Lesage for a complete encircling line.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

THE EXHIBITION OF 1873.

The first meeting of the Committee for Silk and Velvet was held on Friday, the 22nd inst., Sir Daniel Cooper, Bart., in the chair. The following resolutions were carried unanimously:—"That it be recommended to her Majesty's Commissioners to make a rule that every object of new silk manufacture offered for Exhibition should have the names of the manufacturer and of the place of manufacture attached to it." "That combinations of other materials with silk in the manufacture of piece goods be admitted with silk manufactured goods."

The first meeting of the Committee on Steel was held on Monday afternoon, at Stanhope-lodge, Kensington-gore.

It was resolved that the materials known in the trade as "homogeneous metal" possess properties which are accepted as characteristic of steel, and should therefore be included in an Exhibition which embraces all varieties of steel; but that malleable cast iron will be more appropriately included in the Exhibition of Cast-Iron, in 1879.

The Committee recommended that her Majesty's Commissioners should take such steps as might be necessary to secure the exhibition of all classes of articles that consist of steel united to cast-iron, either by welding or otherwise.

The Committee agreed to advise her Majesty's Commissioners to invite, from the War Department, a loan of all specimens of steel used for military purposes. The Committee also suggested a complete representation of the various processes of manufacturing needles, fish-hooks, and steel pens, and they recommended that invitations should be sent to the most eminent manufacturers in the country to lend models and drawings illustrating generally the manufacture of steel goods.

The first meeting of the Committee for Carriages was held on Saturday last, when it was announced that the Coachmakers' Company had appointed a special committee to assist her Majesty's Commissioners in procuring a good representation of carriages. There were present at the meeting, the Duke of Beaufort, Lord Francis Gordon Lennox, Mr. J. V. Hooper, Mr. J. W. Peters, and Mr. T. C. Starey. Major-General Scott, C.B., Mr. Cole, C.B., and Captain Clayton, R.E., attended the Committee.

A meeting of the Committee of Advice and Selection for the class of Cooking, to be represented next year, was held on Tuesday, at Stanhope-lodge, Kensington-gore, the Hon. F. Leveson-Gower in the chair. The Committee resolved that cooking for agricultural labourers, artisans, upper and lower middle classes, as well as that most suitable for the army and navy, for paupers, and for prisoners, should be represented as far as possible. It was also resolved to communicate with some of the principal makers of kitchen ranges, stoves, and apparatus, with a view of ascertaining whether they will exhibit apparatus in action. The Committee recommended also that an attempt should be made to represent the various modes of cooking as practised by the French poor.

The first meeting of the Committee on Surgical Instruments took place on Tuesday afternoon, at Stanhope-lodge, Kensington-gore. Amongst those present were

Mr. Cæsar H. Hawkins, F.R.S.; Mr. Prescott G. Hewett, Mr. J. Hilton, F.R.S.; Mr. R. Quain, F.R.S.; Mr. W. White Cooper, Mr. J. Luke, F.R.S.; Mr. T. W. Nunn, Mr. E. Saunders, Dr. G. T. Gream, Dr. W. S. Playfair, and Dr. H. J. Domville, C.B. After discussing the objects and arrangements of the exhibition, the Committee proposed that, as an interesting addition to modern collections, the Royal College of Surgeons, and other public bodies or private collectors, should be requested to lend ancient surgical instruments and appliances, and that the Italian government should be requested to lend those recently recovered from the ruins of Pompeii. In addition to other business the Committee recommended that publicity should be given to the class by means of communications to the medical journals; and individual members of the Committee undertook to request instrument makers to give early information of their intention to exhibit specimens of their instruments in the Exhibition of 1873.

The first meeting of the Committee on Recent Scientific Inventions and Discoveries, was held on Wednesday afternoon, at Stanhope-lodge, Kensington-gore. Among those present were Major-General H. D. Harness, C.B.; Dr. C. W. Siemens, F.R.S.; Dr. E. Frankland, F.R.S.; Dr. D. S. Price, Mr. J. Ramsbottom, Mr. C. F. Beyer, Major Donnelly, R.E., and Major Frank Bolton. It was considered that the class should consist of objects, the excellence of which are considered by the Committee of Selection to be so great as to render it undesirable that their introduction to the public should be delayed until the proper year for their exhibition as an industrial manufacture. The Committee suggested, as special subjects for exhibition in the class, all new modes of preserving stone or of rendering wood incombustible, or of purifying water, or of copying forms in wood or metal by machinery, &c. The applications for admission, it is arranged, must be sent in before the 31st of January, 1873, and the goods delivered on the 12th of March, 1873.

The Melbourne correspondent of the *Times* has the following:—"I informed your readers that a public subscription was being made to secure the representation of the colony at the Exhibition of 1873. The government has promised to place on the Estimates the sum of £4,000 for that purpose, but in the meantime it is necessary to go on and enter into arrangements for a permanent building at Kensington with Victoria and Queensland. Hence the private subscription, which is fairly taken up, but people are rather averse from doing what they conceive to be the duty of government."

EXHIBITIONS.

Vienna Exhibition.—The commission of the Chamber of Commerce of Paris, charged with the duty of examining the industrial products offered for the exhibition, has completed the first act of its labours, and is now engaged in planning out its space. As in the fine art, so in the industrial sections, the applications far exceed the space to be allotted, but the commission is acting with the full hope that the National Assembly will vote a sufficient sum for the erection of supplementary galleries, for, says an organ of the commission, "in the presence of the unprecedented efforts which are being made by other countries, it is of the utmost importance that French industry should assume all the importance that belongs to it, and thus assure the superiority of her exhibition." These words are wise, and moreover they are applicable to other countries besides France, who will certainly make an admirable show in both the divisions of art and industry. The commission sits at the Hotel Cluny, and applications for space for works of art are received till the first of December.

American Exhibitors at Vienna.—Some of the American exhibitors are complaining because Congress refused a grant towards the defraying their expenses. There is even some talk of renewing the appeal unsuccessfully made to Congress last year for funds. Most of the papers, however, express the opinion that the exhibitors, who may expect the chief profit, may also fairly be called on to defray all the expenses of transporting their goods to Europe, and the general opinion seems to be that they will find it well worth their while to do so, and that in consequence America will be tolerably well represented.

Competitive Exhibition of Bronze Work.—Perhaps there is no class of ornamental art in which the French enjoy such unquestioned pre-eminence as in the production of bronzes, and especially such as are suitable for interior decoration. The bronze founder, fitter, and chaser are three of the highest class of workmen in Paris, and the bronzists take great pains to encourage and improve their art. Amongst other means to this end, there is an annual competition for prizes, which takes place in the winter; that for the present year is just announced to open on the first day of December. On the present occasion, the prizes are for chasing only; they consist of two prizes, named after the donor M. Crozatier, each of the value of £20, for a drawing of figures and one of ornament, and of two Villernsen prizes, of £12 each, for the best examples of figure and ornamental chasing. This interesting exhibition has usually been held in one of the galleries of the Conservatoire des Arts-et-Métiers. It is a purely workman's exhibition, and, although of course very limited, is perhaps one of the most thoroughly practical and valuable of the many competitions and exhibitions that take place in Paris. It should be added that it is due entirely to the initiative of the artistic bronze manufactures of the city.

Versailles Exhibition.—Although the historic Jeu de Paume is literally encumbered with the mass of works of art sent for exhibition, the Society des Amis des Arts, under whose direction the undertaking has been organised, determined that there should be no further delay, and opened the gallery on Sunday last to the members of the society and a number of invited guests. The works received amount to more than seven hundred in number, being about half as many as there were at the last Paris *salon;* but what is far more important than quantity, the collection includes a large number of excellent works, and the exhibition will doubtless attract large numbers of visitors. The presence of many famous examples of painting and sculpture, shut up for years in private collections, adds to the value of the present exhibition; the "Ariadne" of M. Millet may be mentioned as a prominent object of interest.

THE ASPHALTS.

(*Continued from page* 16.)

The first specimen of this kind of road was laid down between Bordeaux and Rouen, in the neighbourhood of the town of Saumur. A layer of broken stones, such as those used for a macadamised road, was laid down, and over that asphalt broken up small, to the depth of one and a-half inches, which would appear, to anyone well acquainted with the nature of the material, to be an eminently practical method. Experience was, however, to show otherwise. At first the new streets seemed to be a complete success, for the asphalt soon became firm and solid; the stones were crushed down and the malleable asphalt filled up the interstices. The surface yielded to the pressure of the carriage-wheels without cracking, the impression made by each horse or carriage being effaced by the succeeding one, aud it did not appear to be affected by summer or winter, least of all by wet, and the softest parts of the road were found most durable. On the strength of this favourable experience, many roads and bridges were covered in the same way, near Saumur, Angers, Tours, and Briare, and on the great bridge over the Loire at Saumur it was found that the two arches which were covered with asphalte were water-tight, whilst the 17 others let the water through, although carefully covered with hydraulic mortar.

In time, however, the drawbacks of this system became apparent. The crushed granite of the macadam substratum, mixed up with the asphalt, destroyed its continuity, and by preventing it from forming an unbroken surface allowed it to be permeated with dirt and water. This method could not be therefore said to be satisfactory. The final solution of the problem is due to the engineer, M. A. Merian, of Basle, who conceived the idea of laying down powdered asphalt in a warmed state on the street, and applying a strong pressure, so as to form at once an impermeable elastic surface. He tried the experiment on a part of the high road between Serrieres and Travers, with such success that, in spite of the insufficient foundation on which it was laid, that part of the road has remained unimpaired to this day.

The French engineers soon followed the example of M. Merian, and although they cannot dispute the right of the Swiss to the first invention, yet they may claim for France the honour of having taken the lead in every useful application of asphalt.

In the same year, M. Darcey, Inspector-General of the Ponts-et-Chaussées, published a treatise on the different descriptions of street pavements in London and Paris, in which he advocated the plan of laying the cold asphalt down on the macadam foundation. Under his direction several of the boulevards at Paris were thus paved; but soon the drawbacks to which we have alluded were perceived, and M. Darcey acknowledged the superiority of the compressed hot asphalt powder, which has a tendency to cohere, whilst in the case of the cold-broken asphalt, considerable resistance is offered to the union of the abraded particles. In Paris, the hot compressed asphalt was first tried in the Rue Bergère, near the Conservatoire de Musique, and its success decided the authorities to pave the Place du Palais Royal in the same way, and subsequently many streets in different parts of Paris, in none of which has the pavement yet had to be renewed. The following is the process of preparing the asphalt pavement, as described by M. Léon Malo:—

"The asphalt stone is brought direct from the quarries, and broken up into small pieces about the size of those used for macadamised roads, it is then heated over a stove, in a drum-shaped iron vessel with feet, till it crumbles into powder; and in order that the powder may not lose its heat, the whole apparatus is conveyed on to the street where it is to be applied. Then a foundation of 'béton' is laid, about four inches deep, which may, however, be thicker or thinner, according to the nature of the soil."

On some ground, a road which has been macadamised, for example, the substratum of concrete may even be dispensed with entirely, whilst on a loose soil it may be made as thick as six inches. When the béton has hardened, and been cleaned, it should be smoothed to the proper curve. The arch of the roadway ought not to be greater than is absolutely necessary to drain off the rain-water, in order that the horses may not slip on the incline at the side. The powdered asphalt is then spread over the surface, to a depth of sixteen to twenty inches (according to the amount of traffic it is to bear), and stamped down; a roller of 2,500 to 3,000 kilogrammes weight is then drawn over it, to make the pressure perfectly even. Two hours later the road is ready, and may be opened to carts and carriages. M. Léon Malo's remarks apply exclusively to the Seyssel asphalt, as, at that time, the other companies had not yet embarked in this undertaking, and it was not till 1856 that an amalgamation took place, under the name of "Compagnie Générale des Asphaltes," from the manuscript report of which, in 1869, the writer has gathered the following facts:—

The company is now in entire possession of the Seyssel works and quarries, and has a capital of three and a-half millions of francs. The works have been erected at Pyrimont, where the Geneva Railway Company has established a special station. Every year about 400,000 cwt. of the mastic and 150,000 cwts. of powder are prepared, and 150 workmen employed. Since that time, however, these figures will doubtless have been much increased, the asphalt roads being more in request. In 1852, 800 metres of road were laid down in Paris; in 1856, 8,000 metres; in 1866, nearly 100,000; and in 1869, 280,000 metres, all principally in the quarters between the Rue de Rivoli and the boulevards, from the Madeleine to the Rue Poissonnière.

But even though the Compagnie Générale des Asphaltes took the initiative in extending the use of asphalt for street pavement, yet it seems as if it would have to leave the field to the Val de Travers Company, as the stone from that quarry is superior for the hot compressed roads to that of Seyssel, which contains only 6 to 8 per 100 of bitumen, whilst that of the Val de Travers contains from 11 to 12 per 100, and hence is tougher.

The bituminous fresh-water limestone of Lobsan does not seem to possess enough solidity to be kneaded into a continuous mass without the addition of any other ingredient.

The asphalt stone of Limmer and of Vorwohle also do not appear suitable for this mode of application, the former being too oily and the latter too dry for the necessary toughness to be obtained without melting.

The writer was shown roads paved with the Limmer stone and with the three kinds of asphalt—the compressed asphalt, the asphalt-macadam, and the asphalt-mastic; of these only the mastic road could be said to be thoroughly successful. Under these circumstances it was only natural that the general attention should be turned to the Val de Travers, and on the 15th December, 1870, the government of the canton of Neufchatel granted the concession of these quarries to an English company, entitled the "Neufchâtel Bituminous Rock Company," which devoted itself exclusively to the paving of streets and roads, supplying various local companies with materials for the purpose. Such companies have been formed in Great Britain and Ireland, which requires annually 200,000 to 2,000,000 cwts; one in North America, with a consumption of 40,000 to 2,000,000 cwts., in South America, with an annual consumption of 40,000 to 600,000; for Austria, Hungary, and Roumania, respectively, with a similar consumption of 40,000 to 600,000 cwts. Similar contracts have been made for Russia, Italy, Holland, Belgium, and Germany.

As a great deal has been said about the danger to the horses on the asphalt roads, it may be as well to give the experience in France in this respect, which applies equally to the three kinds of asphalt roads.

At Lyons, which has long had mastic roads, a number of cavalry horses fell on a street of compressed asphalt. This accident arose from the circumstance that the asphalt had been laid on an old macadam road, and had therefore that considerable arch which is unnecessary and dangerous for the asphalt road. The cavalry riding in a long line, those horses near the side of the road slipped on the steep incline.

At Marseilles, where the asphalt roads from the harbour to the town were made with a very gentle curve, there has been no increase in the number of accidents, though the traffic is enormous. A very slight arch of the road is quite sufficient to allow the rain to run off from such a smooth surface.

It is also not advisable to lay the asphalt on any street with a gradient greater than 1 in 60, though in London some streets having a gradient of 1 in 57, and even to 1 in 46, have been covered with asphalt without any apparent danger. It is of course extremely difficult to get any accurate information about the number of accidents on the streets, general vague impressions being worthless; but in Paris the number of horses which were observed to fall in the Rue Neuve des Capucines, during two months were as follows:—In the former, which was paved with sandstone, in blocks, from Fontainebleau, one horse in 1,308 fell; on the latter, which was covered with asphalt, one in 1,409, so that the balance was in favour of the asphalt.

In snow or frost asphalt is not so slippery as granite, being in itself warmer, and also more easily warmed by the slightest rays of the sun; hence, the ice is more slow in forming, and quicker in melting, than on granite.

It has been proved that the greatest number of accidents to horses happen when the asphalt is not cleaned, for the surface is never muddy or greasy, except with foreign matter, and this ought to be constantly washed off with water, which is plentifully laid on in Paris, and to some degree in London. At any points where this cannot be done, a slight sprinkling of coarse sand will prevent the horses slipping. This is, of course, only a temporary remedy, but valuable in case of emergency. It is one of the great advantages of asphalt, however, that it is so easily and cheaply cleaned.

Considerable alarm has been excited as to the danger of the asphalt taking fire in case of a conflagration. We think, however, that these objections may be met by narrating the following circumstances:—

During the Commune in Paris, in 1871, the fires commenced by incendiaries were never known to have been spread by means of the asphalt pavements. In London, experiments were made on this point by heaping wood on the Val de Travers pavement and setting fire to it. When the fire was at its fiercest, the burning embers were raked away, and only a few feeble flames were seen to issue from the pavement, and they went out directly of their own accord.

In the stables of the Paris Omnibus Company the corn-loft is immediately over the stables, and in order to protect the corn against the effluvium from the stables the floor of the loft was covered with a thick layer of the asphalt, and in five different conflagrations this floor arrested the course of the flames until help could be procured.

It has also been found that a wooden floor covered with asphalt was entirely protected against a fire which was lighted on the asphalt; for although this material develops a volatile bitumen, which is inflammable, and another part of the bitumen escapes as gas, and burns accordingly, yet the mass of lime and coke which remains is sufficient to protect the wood completely against the flames.

During a conflagration in the works at Seyssel (owing to the bursting of a kettle of boiling tar), the asphalt floor turned the course of the fire, and when the wooden beams and walls were burnt and the asphalt ceiling came down with a crash, it entirely extinguished the flames beneath.

Finally, the conclusions that have been arrived at by the experience in London are:—

1. That the prime cost of the asphalt road is the same as that of a granite pavement.

2. That, with the present prices, the annual cost of maintenance is a trifle greater than the granite.

3. That, at the end of seven to ten years a granite pavement is worn out, whilst the asphalt is still in perfectly good condition.

4. That the asphalt, when taken up, may be always used again for the same purpose or for mastic.

The experience in Paris shows:—

1. The asphalt costs, in the first instance, one-third less than the stone pavement.

2. That the annual cost of maintenance is three-quarters less than that of a macadamised road.

From these facts it will not be difficult for any municipal authorities to deduce the great advantages of the asphalt pavement.

"In the destruction of some ancient fortifications, supposed to have been Roman, near Pyrimont, about forty years ago, the stones appeared to have been similarly cemented, and so great was its tenacity, that the works were with great difficulty pulled down, and not without the use of gunpowder. This circumstance led to a singular and important discovery, for the fact of which, as follows, we are indebted to a gentleman named Perrigny, a native of that neighbourhood. During the removal of the above ancient remains, it was observed that the cement bore a great resemblance to the asphaltic mass or mountain in the park of Pyrimont, about five miles north of Seyssel. This led several persons present to think of making a similar application of it. Amongst others was a relative of M. Perrigny, whose dwelling on the banks of the Rhone was so very damp that the lower part could not be appropriated to any use whatever. This person considered that its application might succeed in keeping out the wet, every other remedy that he had tried having failed. The experiment was accordingly made, and succeeded beyond his most sanguine expectations. This circumstance, among other early trials of its properties, speedily led to its very general adoption in that vicinity, where the working of this material has become of great importance, and where the presence of the bituminous asphalt is so great as to appear almost inexhaustible; and although but recently worked to any great extent, yet its properties as a cement appear to have been long known. It already constitutes the chief wealth of the country, which was previously half wild."*

CHANNEL PASSAGE.

Mr. Bessemer's letter to the *Times*, on this subject, has called out further correspondence. In the paper of Saturday last there are two letters, one from Admiral Elliot, advocating the ship designed by Captain Dicey in opposition to the Bessemer-Reed plan; and the second from Colonel Strange, also discussing the comparative merits of the two inventions. The matter contained in Admiral Elliot's letter is mainly personal. Colonel Strange endeavours to show that there are no advantages gained by Captain Dicey's plan which are not included in that of Mr. Bessemer, except in so far as that the former improvements refer to the whole vessel, the latter only, or in chief part, to the saloon. In summing-up his conclusions, Colonel Strange says:—

"The point at issue between the two rival schemes is reduced to a very narrow compass. Both Captain Dicey and Mr. Bessemer agree in regarding the rolling action of ships as that against which direct special provision alone need be made. Captain Dicey provide against it by his twin-ship principle, which secures the advantages of abnormal breadth of beam without, as he believes, any of that loss of speed which the same breadth obtained in the usual way would occasion; while Mr. Bessemer seeks the same object by means of a swinging central saloon, whose secondary oscillations, generated by pressure of wind, shifting of load, and of centre of suspension, are controlled by a hydraulic apparatus of peculiar construction. Both agree also in employing only indirect means, such as length, high speed, and conformation of bow, to diminish pitching. Experience will show which inventor has approximated most closely to a solution of this interesting problem. My belief is that Mr. Bessemer will practically annihilate rolling, and that Captain Dicey will reduce it to an important, but not to so great, an extent. Against this, however, he may justly claim that such immunity from rolling as he confers on his ship will be enjoyed equally by every one on board of her, while only the favoured occupants of Mr. Bessemer's saloon will be spared the dread sufferings we know so well. But what will be the net result in either case? I believe diminution and alleviation only—not prevention of sea-sickness. Mental elements are concerned as much, and in many cases more, than those mechanical conditions which alone can be dealt with by engineers and naval architects. It will be interesting to learn which will be most relished by the inner man—the natural but much diminished motion of the Dicey ship, or the sort of non-natural motion of the Bessemer. Most people who have had, however little, experience of the ultra-natural motion now so fully secured by Channel steamers, will probably like to try the non-natural for a change."

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* Extract from page 2 of the pamphlet written by F. W. Simms, C.E., on "The Asphaltic Mastic or Cement of Seyssel." 1858.

On Tuesday a letter from Mr. Reed was published. In this he points out what he considers the faults of the Dicey ship:—"First, where one of the primary objects is to secure small draught of water, and therefore lightness of structure, the plan in question renders a very unusual weight of hull necessary, because it gives the ship four sides instead of two, and introduces a heavy superstructure for the purpose of yoking the two half ships effectually together; secondly, unless the superstructure is extremely well designed and very strongly built, it will not keep the two half ships together in a heavy storm, and their separation would be fatal to both; thirdly, there is great reason to suppose that two half ships of equal size and large proportions, placed thirty feet apart, and yoked together, however propelled, would be circumstanced very unfavourably for high speed, because of the interference with each other of the waves of displacement in retreating from the inner bows. Fourthly, there is also much reason, and some experience, to suppose that such a vessel, propelled by an interior wheel, would be under very great additional disadvantages as regards the obtaining of extreme speed—such vessels have, in fact, failed from want of speed; and, fifthly, the Dicey ship, being made (by the separation of the twin portions) of very unusual breadth from stem to stern, is peculiarly unadapted for entering the narrow harbours of Calais and Folkestone in bad weather. I will only further add that the experiment which Admiral Elliot promises with a twin Dicey steamer no bigger altogether than a 'Citizen' boat, will throw little or no light upon any one of the above questions; and the very fact that such a vessel is being prepared for the purpose of proving to the public that the Dicey ship is right, when great size and speed are to be realised, strongly inclines me to believe that its advocates have neither considered nor understood the real difficulties that will oppose their success and frustrate their good intentions. In seeking to reduce rolling they have looked past other equally important conditions."

Thence the writer passes on to describe his own ship. The present discomforts of the passage, he says, are almost wholly due to the small size of the vessels now in use, a size necessary if they are to be turned round in the existing harbours. This drawback will be avoided by the new double-ended ship. The many serious difficulties offered by the construction of such a vessel have, Mr. Reed thinks, been overcome in the new ship.

New structural arrangements have been necessitated in order to support the Bessemer saloon, the extra weight, however of which "is, in fact, not great." The duplicate sets of paddles are admitted to be an evil, but this is made up for by extra steam power. Besides, they have their compensating advantages, especially that of securing the ship against total disablement by engine accidents.

As to the low freeboard, Mr. Reed maintains that this is not a disadvantage in short seas like those of the Channel, however mischievous it might be in long rolling seas. Even if it were, he says, the low freeboard can easily be got rid of by prolonging the upper deck and the sides to the extremities—an inexpensive addition. The great advantage of the low freeboard is stated as follows:—"Although the ship is 350 feet long in the water, she is only 250 long above the water, where she is exposed to the wind; so that not only shall we escape the risk, which other long ships will be exposed to, of being blown across the harbour entrance in a gale, but we shall positively be better off than smaller vessels in this respect, because, while we shall have a comparatively small surface exposed to the wind, we shall have a greatly lengthened surface immersed in the water to resist the leeway resulting from the wind's action." On the whole, Mr. Reed thinks that the ship will be a success for the peculiar purpose for which she is intended:—"For my part, I do not put her forward as a perfect remedy for sea-sickness in all cases, although I think she will be found a sufficient remedy in the Straits of Dover. Her advantages seem to me to be that she will be large enough herself to escape all but very small movements as regards lifting bodily and pitching. The moderate pitching which she would otherwise experience will be diminished by the low ends, and what remains of it will scarcely be felt at all in the central saloon. The rolling of the ship, which is the only remaining movement of importance, will be perfectly neutralised by Mr. Bessemer's hydraulic arrangements. In other respects the ship will be fast, capacious, well-furnished, and well-ventilated."

THE EDUCATION OF WOMEN.

The first annual meeting of the National Union for Improving the Education of Women of all Classes was held on Tuesday afternoon last, at the Rooms of the Society; Lord Lyttelton (in the absence of Lord Napier and Ettrick, who had first been announced, but who was prevented, by domestic trouble, from attending) presided. The Chairman alluded to the circumstance which had called the Union into existence, and spoke of the work it has already commenced. He also announced that the first school company scheme would be opened in January, at Durham-house, Chelsea, the object being the establishment of good and reasonably cheap education for the class above that which was provided for by the Elementary Education Act. Mr. C. S. Roundell moved the adoption of the report, the election of the Princess Louise, Marchioness of Lorne, as president, and a long list of distinguished persons as vice-presidents, and members of the central committee for the ensuing year. He stated that some misconceptions were prevalent about the wealth of Dulwich College. Hereafter, he said, their wealth would no doubt be very great, but at the present time they were paying out between £4,000 and £5,000 for pensions to the old corporation. Mr. W. D. Christie, C.B., seconded the resolution, and advocated the extension of the subject matter of women's education to the same limits as the education of men. The Rev. Canon Barry moved the second resolution—"That this meeting, feeling the inadequacy of the supply of good schools for girls, pledges itself to promote the establishment of such schools, and also to aid all measures for extending to women the means of higher education beyond the school period of life." This was seconded by Miss Davies, who spoke of the experience specially derived from her connection with Girton College. She hoped that women would soon be really qualified for the work of teaching, and that at the same time that work would receive the appreciation it deserved. She concluding by giving some information respecting Girton College, at Hitchin, and stated that the new college, it was hoped, would be ready for occupation by next Midsummer. Mr. Payne moved the third resolution:—"That this meeting, feeling the necessity of thorough training for teachers, and of some recognised test of their efficiency, pledges itself to promote measures for the attainment of these objects." The speaker produced, to the amusement of his audience, a number of replies to an advertisement for high-class female teacher. These, he said, served to show how real was the want of a higher education. The Rev. W. Arthur seconded the resolution. A vote of thanks to the chairman, moved by Mrs. Grey, chairwoman of the Central Committee, concluded the proceedings. Lord Lyttelton, in responding, said if Parliament next session knocked on the head the Endowed School Commission, as it was not improbable it might do, he should be most happy to give more attention than he had been hitherto able to do to the affairs of the Union.

CORRESPONDENCE.

CHANNEL PASSAGE.

Sir,—In your *Journal* last week, Mr. Sedley says that he has seen it stated that I have patented a system of tubular ship, and claims that system as his. Of the dissimilarity between his and my plans, there is no doubt. Of the value of Mr. Sedley's plans —for there are several, with several different dates, hanging on the walls of the Polytechnic—I have such an opinion that I am heartily glad he considers Captain Dicey's more consonant with his own than mine, and that he has, therefore, associated himself with the twin-ship principle—a plan considered by myself ten years ago, and rejected as having fatal constructive defects. Steps are being taken to put my system into practice, and I mean to abide by hard and tangible facts, and not upon imaginative data.

I have spent three years of time, and a very considerable sum of money, in experiments, in order to satisfy myself I had a right and true thing to put before the public—one that would be commercially profitable, and not a mare's nest. If Mr. Sedley had worked as sincerely as I have for public appreciation, his ideas would have been so well known that his attempted cry of plagiarism would have been ignored.

If the Society of Arts will give me one night in their sessional meetings, as I have asked, the members will have the full opportunity of seeing how thoroughly different in every principle and in every detail my vessel is from Mr. Sedley's, or any other plan yet put before the world.—I am, &c.,

S. J. Mackie.

3, Delahay-street, Great George-street, Westminster.
25th November, 1872.

P.S.—The new model of my latest design for my Channel Passage steamers, to one-quarter inch scale, will be at my office, as above, on Monday and following days of next week, and open to the inspection of any members of the Society who will favour me with a visit.

OBITUARY.

Sir John Bowring.—In the Chairman's address of last week were mentioned the names of those eminent men whose loss the Society has had to deplore during the past year. Almost before this address was in print we have another name to add to the list. Sir John Bowring died on Saturday last, November 23rd. His is one of those names which links our own generation to the one just past, which carries us back to the days of Bentham and James Mill. Among that set which, a generation ago, was chiefly known as represented by the *Westminster Review*, Sir John Bowring occupied a foremost place. Indeed, he was for some time editor of the *Review*, and, to a great extent, its guiding spirit. But this was only one among the various employments of Sir John. He was emphatically a many-sided man. Poet, philosopher, politician, diplomatist—he aspired to excellence in all, and if he did not in every line attain the first place, in all he surpassed mediocrity, in most he achieved a decided success. Born in 1792, it was in 1835 that he commenced his political life, but his literary career began some years before. He published a volume of translations from the Russian in 1821, and this was followed by several other works, chiefly translations of poetry. In 1825 he became Editor of the *Westminster Review*. After his return to Parliament he devoted himself more especially to politics, and this led to his employment abroad, notably in China, to which country he was sent on diplomatic missions on several occasions. His last employment of this sort was in 1861, when he was sent to Italy on a commission. From that time till his death he continued his literary labours—labours which, though partly interrupted by his political work, were never wholly discontinued. Even within the last year he had contributed to some of our magazines. He became a member of the Society in 1859, and in the year of his election read a paper on "China, and its Relations to British Commerce." This paper will be found in the *Journal*, vol. viii., p. 19. Besides this, he at all times took a general interest in the work of the Society.

GENERAL NOTES.

Pneumatic Channel Postal Dispatch.—A proposal has been brought forward by Mr. Edward Martin, to lay down a pneumatic tube, like those used in connection with postal telegraphs, across the channel from Shakspeare's Cliff to Cape Grisnez. The tube is to be of small diameter, and the messages to be photographed on films of collodion, in the same way as those sent into Paris by pigeons during the siege. The idea is a very ingenious one; but we are not aware that there is any likelihood of its being carried out.

Mildew in Cotton Goods.—This subject was discussed at a special meeting of the Manchester Chamber of Commerce last week. The president, Mr. Hugh Mason, suggested the appointment of a committee to go into the whole question as to sizing, steaming, and ill-ventilated ships. Another member made suggestions to the effect that a committee should be appointed with instructions to report upon the question, and that buyers should be recommended to require from manufacturers a written contract that no deleterious ingredients were contained in the sizing, leaving the manufacturers full liberty to use whatever amount of sizing they thought proper. An opinion was also expressed that 99 per cent. of the mildew resulted from chemical admixtures in the size. The question having been discussed at great length, the directors of the chamber were requested to take up the consideration of the cause of mildew, and report to the members at an early period.

Tramways in New York.—The continued prevalence of the horse disease in New York city has, to a great degree, rendered useless the ordinary means of public transportation. Many of the cars and stage lines have ceased running altogether, and others send out a reduced number of vehicles. Under these circumstances, various projects are discussed for affording a means of conveyance between distant points of the city. A line of cheap steamers plying on either side of the island, and touching at convenient streets, is suggested, the plan to be similar to that of the penny boats on the Thames. Especially has fresh attention been directed to a motive power for street trams, and the city authorities have passed an ordinance allowing the use of engines on certain roads for a limited period. Under this authority, the Remington steam street car, from Ilion, New York, is soon to be put to work on one of the New York lines. As the line selected is one presenting especial difficulties in the way of grades, curves, &c., it is expected that the powers of the steamer will be fully tested.

There will be an Exhibition of Science and Art in Bombay in February.

EXAMINATIONS, 1873.

The attention of candidates is drawn to an error in paragraph 55 of the Programme. After the words "accidence," the words "and in passages" should be inserted.

THE LIBRARY.

The following works have been presented to the Library:—

Gibraltar's Value, by "Fras."

The Policy of Restrictive Measures, or Quarantine as applied to Cholera and Cattle Plague, by Geo. Foggo.

On Improvements in Locomotive Engines, by Appliances for the use of Heated Air in combination with Steam, by Richard Eaton. Presented by the Author.

La Mosaïque de Lillebonne. Extrait des Publications de la Société Havraise d'Etudes diverses. Presented by Chas. Roesler.

Catalogues of Works of Art, &c., exhibited at the opening of the New Library and Museum of the Corporation of London, November, 1872. Presented by J. Anderson Rose.

A Description and List of the Lighthouses of the World, by A. G. Findlay. Presented by the Author.

A German Class-book for Beginners, by Chas. Fischer-Fischart. Presented by Messrs. Oliver and Boyd.

The Strength of Materials and Structures, by John Anderson, C.E., LL.D. Presented by the Author.

The following have been presented by the American Statistical Association:—

Annual Reports on Education in the State of Massachussetts and Boston.

Reports on the Statistics of Labour, Board of Health, Productions of Industry, State Charities, Census 1865, Fire and Marine Insurance, and Life Insurance of the State of Massachussetts.

Fire Department of Boston.

Agriculture of Massachussetts, by C. L. Flint.

ORDINARY MEETINGS.

The following are the dates of the Wednesday evening meetings, the chair being taken at eight o'clock:—

1872.	December	4	11	18	—	
1873.	January	—	—	15	22	29
,,	February	5	12	19	26	
,,	March	5	12	19	26	
,,	April	2	—	16	23	30
,,	May	7	14	21	28	

For the meetings previous to Christmas, the following arrangements have been made:—

December 4.—"On the Manufacture of Horse-nails by Machinery." By J. A. Huggett, Esq. On this evening the chair will be taken by F. J. Bramwell, Esq.

December 11.—"On Galvanic Batteries." By the Rev. H. Highton.

December 18.—"On Russia, her Industries, Commerce, and Means of Communication." By Leone Levi, Esq., Professor of Mercantile Law, King's College, London, and one of the Deputies to the International Statistical Congress at St. Petersburg.

CANTOR LECTURES.

The first course of Cantor Lectures for the ensuing Session will be on "The Practical Applications of Optics to the Arts, Manufactures, and to Medicine," by C. Meymott Tidy, M.B., Joint Lecturer on Chemistry, and Professor of Medical Jurisprudence at the London Hospital, and will consist of five Lectures, to be delivered on the following evenings, at eight o'clock:—

Lecture II.—Tuesday, December 3rd, 1872.

Lighthouse Illumination *(continued)*—Applications of Reflection—Lenses and their varieties—Their Application to Medical Purposes, &c.

Lecture III.—Monday, December 9th, 1872.

Applications of Optics in the Arts, illustrated in the Science of Photography.

Lecture IV.—Monday, December 16th, 1872.

Polarised Light, and its Practical Applications.

Lecture V.—Monday, December 23rd, 1872.

Spectrum Analysis as Applied to Manufactures, illustrated in the Bessemer process, and to Medicine in the Detection of Blood.

Members are requested to take notice that the next Lecture by Dr. Meymott Tidy will take place on TUESDAY evening, the 2nd December, instead of Monday, as originally announced.

MEETINGS FOR THE ENSUING WEEK.

Mon.....Entomological, 7.
British Architects, 8. Mr. B. Fletcher, "On Arbitrations."
Medical, 8.
Asiatic, 3.
Victoria Institute, 8.
Social Science Association, 8. Mr. Frederic Hill, "On that part of the Report which deals with the Re-construction of the County Courts."
Society of Engineers, 7½. Mr. W. H. Fox, "Continuous Railway Brakes."
Victoria Institute, 8. Mr. Charles Brooke, on "Force and Energy."

Tues....**SOCIETY OF ARTS, 8** Cantor Lecture. Dr. Tidy, "Practical Applications of Optics to the Arts, Manufactures, and to Medicine."
Civil Engineers, 8. Discussion upon Mr. Anderson's Paper "On the Aba-el-Wakf Sugar Factory."
Pathological, 8.
Anthropological, 8.
Biblical Archæology, 8½. Mr. Geo. Smith, "On a Cuneiform Inscription containing the Chaldean Account of the Deluge."

Wed....**SOCIETY OF ARTS 8.** Mr. J. A. Huggett, "On the Manufacture of Horse Nails by Machinery."
Geological, 8. 1. Mr. Henry Hicks, "On the Tremadoc Rocks in the neighbourhood of St. David's, South Wales, and their fossil contents." 2. Rev. O. Fisher, "On the Phosphatic Nodules of the Cretaceous Rock of Cambridgeshire." 3. Mr. W. Johnson Sollas, "On the Ventriculitidæ of the Cambridge Upper Greensand." Communicated by the Rev. T. G. Bonney. 4. Mr. D. Mackintosh, "Observations on the more remarkable Boulders of the North-west of England and the Welsh borders."
Microscopical, 8.
Pharmaceutical, 8.
Obstetrical, 8.
London Institution, 7. Mr. F. Field, "On the Paraffin Industry."

Thurs...Royal, 8½.
Antiquaries, 8½.
Linnæan, 8. 1. Mr. Thomas Allis, "On the skeleton of the *Apteryx*." 2. Rev. O. P. Cambridge, "On New and Rare British Spiders."
Chemical, 8. Mr. C. Rammelsberg, "On the Reducing Power of Phosphorous and Hypophosphorous Acids and their Salts," and "On Hypophosphates." 2. Mr. A. H. Church, "New Analysis of some Mineral Arseniates and Phoshates."
Royal Society Club, 6.

Fri......Geologists' Association, 8. 1. Mr. D. C. Davies, "On Coal Seams in the Permian at Ifton, Shropshire, with Remarks on the Supposed Glacial Climate of the Permian Period.' 2. Mr. Caleb Evans, "Note on a Well Section at Finchley."
Philological, 8¼.
Archæological Institute, 4.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,046. VOL. XXI.

FRIDAY, DECEMBER 6, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ECONOMIC USE OF COAL FOR DOMESTIC PURPOSES.

With reference to the sum of £500 placed at the disposal of the Council through Sir William Bodkin, by a gentleman who does not wish his name to appear, for promoting, by means of prizes or otherwise, economy in the use of coal for domestic purposes, the Council have decided to offer the following prizes:—

1. For a new and improved system of grate suitable to existing chimneys as generally constructed, which shall, with the least amount of coal, answer best for warming and ventilating a room.—*The Society's Gold Medal and Fifty Pounds.*

2. For a new and improved system of grate, suitable to existing chimneys as generally constructed, which shall with the least amount of coal, best answer for cooking food, combined with warming and ventilating the room.—*The Society's Gold Medal and Fifty Pounds.*

3. For the best new and improved system of apparatus which shall, by means of gas, most efficiently and economically warm and ventilate a room.—*The Society's Gold Medal and Fifty Pounds.*

4. For the best new and improved system of apparatus which shall, by means of gas, be best adapted for cooking, combined with warming and ventilating the room.—*The Society's Gold Medal and Fifty Pounds.*

5. For any new and improved system or arrangement not included in the foregoing, which shall efficiently and economically meet domestic requirements.—*The Society's Gold Medal and Fifty Pounds.*

The Council reserve to themselves the right of withholding all or any of the above prizes, as the judges appointed by them may determine.

The competing articles must be delivered not later than the 1st of December, 1873, with a view to their being tested, and subsequently shown in the London International Exhibition of 1874.

Further particulars as to place of delivery and other arrangements will be published as soon as they are finally settled.

PRIZE FOR STEEL.

The Council have resolved to offer its Gold Medal to that manufacturer who shall produce and send to the London International Exhibition of 1873 the best specimens of steel, suitable for affording increased security in the construction of locomotive and marine engines and boilers, and for other engineering purposes.

The conditions of the competition and further particulars will be published subsequently.

NOTICE TO MEMBERS.—INDIAN VIEWS.

An exhibition of views of Indian temples, idols, and illustrations of every-day life, by means of photographs, taken by Captain Lyon during his residence in India, shown by means of the magic lantern, will take place before the members of the Society on Friday evening, the 13th instant, at eight o'clock.

Captain Lyons sends the following explanatory statement:—

"Now that, thanks to the opening of the Suez Canal, India is every day becoming more accessible to the tourist, as the yearly-increasing number fully testifies, the moment seems appropriate to try and give the general public some idea of what is passing there every day, as I saw it myself, and thus endeavour to put those who are forced to stay at home as nearly as possible on a par with those more fortunate ones who are free to roam wherever their inclination leads them. It is a curious fact that, notwithstanding there is hardly a family in England who has not a near relative in some way connected with India, still the interest generally entertained both for the people and the country is much smaller than what is felt for any other of our possessions. It is also observable that though many of our fellow-countrymen are now settled as tea-planters on the slopes of the Himalayas, and as coffee-planters on the slopes of the Neilgherries, still none ever talk or think of the country as their home, as those settled in Australia or any other of our colonies so invariably do, but their whole desire seems to be to get together as quickly as possible a little money to enable them to return to England. Six years ago, in a lecture which he gave to this Society, Mr. Fergusson accused a large audience of ignorance regarding India, and using the words "Vimana Mundapa," &c., doubted whether any of those he was addressing knew what he was talking about, nor did he endeavour to enlighten them, but abandoned the attempt as hopeless, as he felt the task could not be accomplished, even in forty lectures, without an amount of definition and illustration impossible to contemplate. Nevertheless, this attempt I am about to make in the illustrations I propose to exhibit on Friday, the 13th, in the Society's Rooms, with verbal explanations, and I fearlessly undertake that not one shall leave the room without understanding the meaning of all the words Mr. Ferguson used, as well as many others besides. Again, let me ask how many in this country have ever made the acquaintance of the god Ganesa, though in some parts of India representations of him are as common as milestones on an English high road. To him also I propose to introduce you, and, at the same time, explain why, according to the Hindoos, he is so handsome both in form and face. It may seem like putting the cart before the horse to show you a god before the people who worship that god; but, being in India, we must do as the Hindoos do, and, without doubt, such would be the course adopted by a true Brahmin. I do not propose to enter into a long and dry discussion on the Indian people, where they come from, &c., but my object being to try and create some interest in my audience for India, I shall endeavour to convey the information I have to impart in as amusing and cheery a manner as I can; and I promise most faithfully not to describe the whole of the 330,000,000 deities which are said to be worshipped there, more especially as, even at only one minute to each god, it would take 600 years to complete the list. I will ask you first to come with me to Madras, and will show you the steamer you will arrive in, the boat, if the surf is high, in which you will be asked to land; the carriages from which you can select one to convey you to your hotel; the streets as you would see them if you were there; and the natives squatting at the corners of the streets exactly as I saw them; the picota, or machine which is used to inundate the paddy, or rice fields, to grow the rice which so many of us eat here at home. I will introduce you to the native jugglers, justly renowned throughout the world; and I will show you also those extraordinary beings, the snake charmers, whom I have seen handle a wild cobra in a manner to make one's blood run cold, when it is remembered that two hours is about the limit one can expect to live after a bite from one of those fearful reptiles. Leaving the town of Madras, we will go to Trichinopoly, and visit the two celebrated temples on the island of Seringum, and we will look at Mundapa and Teppa Kolaes, and find out what they are, and what they are for. We will go to Madura, the Rome of the Hindus, and see a mundapum which cost one million sterling, and we will see there the golden lotus tank, which the Brahmins say is fed by the waters of the Ganges, which passes 1,000 miles under the sea for that purpose. Continuing our journey south, we will stop at Streevelliputtur, and see the finest Juggernaut car in the south, and accompany the god on his yearly peregrination. Again, further south, there is a little bijou of a monolith, which is nearly, if not quite, the most beautiful in the whole of India, and which, if you like to believe it, I can positively assure you, on the authority of a Brahmin high priest, was excavated and carved in the short space of twelve hours. Thence, with a peep at Cupid, at Tinnevelly, we hurry on to Ramisseram, the most sacred temple in India, some say even more so than Benares. Concerning its sanctity, a poem has been written, called the Ramayana, which fills an enormous volume, but less than five minutes will give you the pith of it; explain to you all about Adam's bridge; and then we will visit these most marvellous corridors, 4,000 feet in length, and with a long-drawn perspective and an effect of light and shade that the world itself cannot excel, if it can equal. Here the Hindu pilgrim finishes his pilgrimage, which he began in Scinde, three thousand miles away. The hardships he undergoes while travelling on foot from north to south of India, those only acquainted with the country can realise, to say nothing of the penances to which he condemns himself, such as prostrating himself full length at the end of every mile and remaining for several minutes with his face buried in the dust, having an iron cage riveted round his neck before he starts, and only to be removed on his arrival at this sacred spot. Here is rest at last; he has performed his pilgrimage; he has conquered all difficulties; he has gained his goal; he looks forward to worldly blessings and immediate beatitude after death, and he forgets all he has undergone in the remembrance that he has earned the right to be permitted to wander and repose in these sacred precincts. Here we will leave him, and turning northwards and following the coast, stop for one moment at Avadea Covill, which, though one of the smallest, is one of the most wonderfully carved temples in India, its chief peculiarity being that the stone forming the pillars is so hard that no chisel can be found to cut it in these degenerate days. Our next halt will be Tanjore, with its magnificent tower, 300 feet in height, and the celebrated stone bull of Shiva, weighing 80 tons, which a pilgrim brought in his pocket 500 miles. Still further north, and close to Madras, we shall find Mahavellipore, or, as it is commonly called, the Seven Pagodas. It is doubtful if the world can produce anything more remarkable than the monoliths here to be found; and the more we examine them and the whole place the greater is our astonishment; while, at the same time, we are lost in conjecture as to the motive or purpose for which such an amount of labour and time has been spent in forming these marvellous structures, for no record exists as to when or by whom they were executed. Not one among the many works begun has been finished, and all seem to have been undertaken at once by some enthusiastic rajah, or by people under some strong religious impulse, and all stopped simultaneously, either by his death or some other catastrophe.

Time will, I fear, not permit us to go further, and so I must defer to another opportunity a visit to the Neilgherries, or Blue Mountains, with its beautiful cascades and pretty scenery. The Deeria Dowlat, built by Tippoo Sahib, and owned and occupied by the late Duke of Wellington, said by all to resemble, and by many to surpass, the Alhambra. These, as well as the exquisitely carved temples of Mysore, and all the other wonderful mosques and other monuments in Bombay, I hope to be permitted to show you on some future occasion, if, as I trust, I shall be successful on Friday in creating sufficient interest in India and her temples and people to make what I shall then show instil in all a desire to see more.

At the last meeting of the College of Preceptors a scheme was approved of for a course of lectures on the Theory and Practice of Education. The details of the course were not decided on, but it is to be tried as an experiment for the years 1873 and 1874. There are to be examinations connected with the lectures, and, if possible, the students will have opportunities of attending schools in order to gain practical experience.

PROCEEDINGS OF THE SOCIETY.

THIRD ORDINARY MEETING.

Wednesday, December 4th, 1872, the Rev. Arthur Rigg in the chair.

The following Candidates were proposed for election as Members of the Society:—

Avery, Alderman Thomas, J.P., Church-rd., Edgbaston, Birmingham.
Baker, Richard, 9, Mincing-lane, E.C.
Barnard, Philip Augustus, 131, Regent-street, W.
Booth, James, the Grange, Ovenden, near Halifax.
Bowman, Frederic Hungerford, F.R.A.S., F.G.S., West Mount, Halifax.
Brewer, William Henry, M.A., 27, Grace's-road, Camberwell, S.E.
Chadwick, James, High-bank, Prestwich, near Manchester.
Culver, Edward, 25 and 26, Spencer-street, Goswell-road, E.C.
Dettelbach, Sigismund Maurice, Lime-street-chambers, Lime-street, E.C.
Dove, H. J., 39, Bruton-street, W.
Eck, Justus, Riga-villa, the Grove, Clapham-road, S.W.
Frölich, Theodor, 2, Park-villa, Lonsdale-road, Barnes, S.W.
Gibb, George, 19, Pembridge-square, Bayswater, W.
Hancock, C. F., jun., B.A., Hendon-hall, Middlesex.
Layton, Edward John, 2, Suffolk-lane, Cannon-st., E.C.
Le Mair, François, Osborne-lodge, Bexley-heath, Kent.
Nash, Wallis, 2, Suffolk-lane, Cannon-street, E.C.
Roche, Alfred Robert, 31, Palmerston-buildings, Old Broad-street, E.C.
Synge, Colonel Millington H., R.E., Alverscliffe, Alverstoke, Hants.
Wedekind, Hermann, 3, Great Tower-street, E.C.
West, Arthur Anderson, C.E., 62, Choumert-road, Peckham, S.E.
Whitley, John, West-house, Halifax.
Whitley, Nathan, Park-road, Halifax.

The following candidates were balloted for and duly elected members of this Society.

Adams, William, Bow and Bromley Institute, E.
Ball, Edmund C., 73, Strand, W.C.
Bayley, James Alfred, 28, Canonbury-square, N.
Brayshay, William Hutton, West-view, Ickley, Yorkshire.
Cromfield, John Coley, 38, Russell-square, Brighton.
Carson, Rev. William, Kildwick, Leeds.
Chant, J. R., 1, Ludgate-hill, E.C.
Coker, Frederick, 32, Cheapside, E.C.
Cumings, Alphious Charles, 4, Victoria-road, Kilburn, N.W.
Davies, D. Griffith, Bridge, Cardigan.
De la Penha, Eugene, 19, Sackville-street, W.
De Wette, Augustus, 7, Catherine-court, E.C., and Cross Deep, Twickenham.
Dodson, Arthur John, Penrhyn-lodge, Cambridge-park, Twickenham.
Foy, Rev. William Henry, Barningham-Norwood, Holt, Norfolk.
Fry, George, 99, Ethelburga-house, 70, Bishopsgate-street-within, E.C.
Fursey, Samuel Dunn, 9, Buckingham-rd., Shoreham.
Gadsby, Alfred, Lancaster-house, 39, Finchley New-road, N.W.
Galloway, George Bell Errington, West Ferry-road, Millwall, E.
Geach, Robert Gichard, Cragg's-wood, Rawdon, Bradford.
Gower, Lord Ronald Sutherland Leveson, M.P., Stafford-house, St. James's, S.W.
Guest, John, 63, Leadenhall-street, E.C.
Haltpenney, G. W., Lower Shadwell, E.
Harding, Major Charles, F.R.G.S., 52, Springfield-road, St. John's-wood, N.W.
Haworth, Richard, Manchester.
Hempleman, Frederick Sebaud, 5, Whalebone-terrace, Stratford.
Henderson, James, 1, St. John's-gardens, Notting-hill, W.
Hernaman, John, Salvador-house, Bishopsgate, E.C.
Ingledew, Joseph, 191, Bishopsgate-street Without, E.C.
Isaac, Albert, 27, Somerford-grove, Stoke Newington, N.
Johnston, David W., Dalriada, Belfast.
King, Nathaniel, 2, East-street, Worthing.
King-Harman, Captain W. H., R.A., Royal Artillery Institution, Woolwich, S.E.
Lanyon, Captain William Owen, A.D.C., Craigton, Kingston, Post-office, Jamaica.
Lees, Colonel Nassau, LL.D., Conservative Club, S.W.
Leishman, John B., 26, Kensington-gardens-square, W.
Lutscher, Peter, 8, Austin-friars, E.C.
Lyell, Robert, 30, Brunswick-gardens, Campden-hill, W.
Marks, Murray, 395, Oxford-street, W.
Macleay, Alexander Donald, Carlton Club, S.W.
Meakin, John Forster, 84, Baker-street, W.
Morgan, George Victor, 39, Blackheath-hill, Kent.
Nicholson, Henry, 3, Montague-place, Russell-square, W.C.
Oswin, Frederick, 2, Weymouth-street, Portland-place, W.
Page, Charles Albert, 38, Leadenhall-street, E.C.
Parry, Edward, 290, Camden-road, N.
Parsons, J. R., 95, Wigmore-street, Cavendish-square, W.
Partington, Edward, Woolfold, Bury, Lancashire.
Phelps, F. W., 8, Albion-grove, Barnsbury, N.
Prothero, Alfred John, 45, Great Marlborough-street, W.
Randle, Howard, Buxton College, Forest-lane, West Ham, E.
Ratcliff, Daniel R., Mossley-hill, Liverpool.
Rau, Theodor, 148, Buckingham-palace-road, S.W.
Renny, Rev. James, M.A., Ph.D., Barnet.
Rose, Henry, 8, Porchester-square, W.
Sadler, F. A. Turnford-hall, Cheshunt, Herts.
Schacht, Theodor, Wismar-house, Lee-terrace, S.E.
Seymour, W. Digby, Q.C., LL.D., 2, Dr. Johnson's-buildings, Temple, E.C.
Shelford, William, 7, Westminster-chambers, Victoria-street, S.W.
Skelton, Thomas Alfred, 37, Essex-street, Strand, W.C. and Southampton.
Smith, Reginald Masters, Queen's Bench Office, Temple, E.C.
Stewart, Charles P., 92, Lancaster-gate, W.
Thomson, Walter, Beheea, East Indian Railway, Bengal.
Vandersee, Henry, Clifton-lodge, Elgin-crescent, Notting-hill, W.
Wagstaff, James Poole, Highbury-lodge, Islington, N., and Manor-park, Potton, Bedfordshire.
Whitehead, W. H., Ontario-lodge, 10, Kilburn-priory, N.W.
Williams, Edward, 23, Birchin-lane, E.C.
Windover, C. S., 32 and 33, Long-acre, W.C., and Sandford-hall, Huntingdon.
Wylie, Andrew, Prinlaws, Leslie, Fifeshire, N.B.
Zimdars, Conrad Edward, 28, Red Lion-square, W.C.

And as Honorary Corresponding Members.

Echegaray, His Excellency Don José, K.G.C., St. M.

and St. L., Minister of Education, Public Works, Agriculture, Industry and Commerce, Calle de Olozaga, No. 13, Madrid.
Fontanals, The Most Illustrious Don Antonio M., Director-General of Statistics, Agriculture, Industry, and Commerce, Calle de Alcalá, No. 7, Madrid.
Martos, His Excellency Don Cristino, K.G.C.M., LL.D., &c., Minister for Foreign Affairs, Calle de Serrano, No. 20, Madrid.
Merelo, His Excellency Don Manuel, K.G.C.I.C., &c., Under-Secretary of the Minister of Foreign Affairs, Calle del Barquillo, No. 13, Madrid.
Ritz, Dr. Wilhelm Carl, 12, Römer-strasse, Bremen.

The Paper read was—

MANUFACTURE OF HORSE-NAILS BY MACHINERY.

By J. A. Huggett, Esq.

It will be in your recollection that the orator of ancient history, when desirous of displaying the utmost of his powers, selected for his theme the subject on which there was the least interest, and on which there could be but little to discourse, that his genius might thereby display itself in his ability to fascinate and interest his audience on a subject that possessed no power of its own to fix the attention. Now, should any one have reached this room this evening impressed with the idea that any such motive has influenced the author of the paper on "Horse-Nails," I beg at the outset to disclaim all powers that may be attained by profound learning or brilliant eloquence. Not, indeed, that I have no desire to make the subject of this paper interesting, and, if possible, to elevate it; but, after throwing out my feeble efforts, I candidly confess that I cannot rise above my subject, and I have never before found horse-nails so tough and unyielding. It might be interesting to give some brief history of horse-nails, by way of introduction; but these shapeless-looking articles, of late years having their origin in some outside villages of the black country, and then passing a short and neglected career in streets and gutters, never rising above a stable floor, and, finally, after a month's hard toil and severe knocking about, deposited for their final rest on the old iron heap—where can we find the chronicles of such an obscure and uneventful history? And if history be silent, we can hardly turn to poetry or art for information; and yet was there ever a picture-gallery opened where the blacksmith and his forge has not found a place? And not only in modern paintings, but also in ancient art we find the smith and his forge, as well as even his method of shoeing; and, indeed, there can be no doubt that, amongst his many other excellent qualities, the village blacksmith of Longfellow possessed industry enough to make the nails he could obtain by no other means; and whatever music Handel's harmonious blacksmith might have made, it may be accepted as a fact, though not recorded, that he also made his own horse-nails; the truth being that until recently the trade in horse-nails scarcely existed, those who used them making their own. Indeed, it may be said, that not until the manufacturing districts of the Midland Counties began to assume the aspect which has acquired for them the title of the Black Country, could the manufacture of horse-nails be called a trade; of late years, however, horse-nails have become an important branch of industry, and a leading article in trade, the consumption, indeed, being very large; and when it is considered that each horse has in its four hoofs 28 or 30 nails, and that these nails are wearing out all day and all night, and require renewing about once every month, and that in Great Britain and Ireland there are at the present time not less than three million horses, representing a demand exceeding a thousand million nails per annum, the trade is entitled to take rank with others in importance and influence, and being a leading article of general and universal demand, it is one also in which there is great competition, and, consequently, there are all those inducements to produce a cheap article; there is, of course, the production of an inferior article, and there is the periodical reduction of workmen's wages, and, consequently, there are the usual strikes, and, to vary it, occasional lock-outs, resulting in the exercise of patience on the part of the public, who are reduced to the necessity of waiting for their nails until they can get them. These disputes, instigated by delegates, are delegated to other delegates to adjust; in fact, instead of mutual interests producing mutual harmony, all this goes on periodically, fully proving that the horse-nail trade is of some standing and reputation, and claims a share in that discord which has been so long distracting the great centres and homes of our industry all over the country. Such events as these in the horse-nail trade have produced their inevitable results; one is to make the article dear, another is to make its supply very irregular, and often very scarce, and lastly, and of more serious importance, to make the quality very uncertain. It will not, therefore, be surprising, putting the foregoing facts together, and considering that nearly all other kinds of small articles, such as screws, carpenters' nails, steel pens, needles, pins, hooks and eyes, and a host of other such small ware, are with success produced by machinery, that efforts should have been made to induce machinery, by some means or other, to rectify the defects, errors, and uncertainties of the hand-made horsenail; and attempts have been made, and indeed so frequently, that one might almost say that they are always being made, and it may be a curious question—how is it that all previous attempts have failed?—for failed they have. Is it owing to the powerful prejudice in the minds of the men who use these nails, so that they refuse to adopt a machine-made nail? The feeling existing against nails produced by machinery is certainly strong enough to damp the spirits of the most enterprising inventor. But this cannot be the reason, for there are so few of the nails made by machinery (at least those patented during this century) that have reached the hands of the consumer. The failure of many of the patents in which the nails made have not reached the hands of the consumer, has been in the machinery itself. And we believe that the secret of some thirty failures during this century is to be found in this simple fact, that the mechanic or engineer who has had the inventive powers to construct a new method of making horse-nails by machinery has been almost entirely ignorant of what his machinery has been required to produce. The high qualities and peculiar properties requisite in a horse-nail (and anything less than this standard is worthless) can only be ascertained after some considerable practice in using horse-nails.

Now, although I am fully conscious that the gentlemen whom it is my honour to address this evening have a knowledge and command of a vast number of very important subjects, I feel sure they will forgive me if I assume for a few moments that they have not also horse-nails at their finger-ends. In a few words, therefore, before I describe our process of making nails, I would endeavour to show what this ungainly, awkward-looking nail must be, and do, and suffer during its short career. You, probably, need not be informed that if a carpenter wanted to fasten a piece of iron, weighing some few pounds weight, to protect an object that was constantly being beaten, knocked, and thumped on stones, he would either bolt or secure that iron on with screws let in flush, taking care that their heads were protected; the idea of nails, with big countersunk heads and small shanks, driven in, would be impossible; but, as it is also impossible to insert screws or bolts into the hoof of a horse, it becomes necessary to make it possible not only to fix the shoe securely on with a nail, but also to keep it there without getting loose during a period of about 30 days. To do this successfully, a nail must be, not only properly adapted in its properties to hold its position when in its place, but be also of such a quality as to enable it to find its position, and the difficulty that occurs is, that these two properties are in a measure antagonistic. That part of the horse's hoof into which a nail enters, is, as you are aware, a horny substance of different degrees of toughness, some hoofs being exceedingly hard, the common phrase being "as hard as mahogany." Into this hard substance a nail must penetrate under the blows of a hammer, and for this duty the nail must be perfectly rigid and stiff, to prevent any "buckling," which may lame the horse (a not unfrequent occurrence, and against which nature, by some oversight, has not made provision). Now, you probably know that iron possessing these rigid and hard properties is not the iron to stand being bent at sharp angles, its tendency being to break; but it is absolutely necessary that a nail should be bent to a sharp angle, some half inch from the point, to clinch it in the hoof. If this be not done, or if in doing it the nail should crack in the bend, the inevitable result will be that the nail, after it has been at work for a short time, will become loose, and drop out. There is also another part of the nail which, though not required to bend, is more frequently the cause of a shoe coming off. You will observe that, where the countersunk of the head terminates, the shank, comparatively slender, begins abruptly at an angle. It is at this part of the nail that the union between the iron shoe and the hoof is effected, and where the nail finds least support surrounding it; and, consequently, where the nail should be the strongest, there, in consequence of this angle formed by the countersunk, is the nail's weakest part. But the form of the nail here, as in other parts, is inevitable; the count rsunk is to hold the shoe, while the small shank is to penetrate the hoof, and there is nothing short of the very finest description of charcoal iron, worked in the best possible manner, that will stand this test; anything less than this degree of perfection will result in an imperfect and unsound nail. Enough, it may be said, as to the quality of the nail, but, unfortunately, not so; we have not even come to the point, and if ever there was a point of difficulty it is certainly to be found in the point of a horse-nail. A nail with an unsound point, if attempted to be driven, will probably lame a horse; so that if all its other qualities are perfect, the nail unsound at this point is worse than useless, it is dangerous, and in the hands of a careless farrier may ruin a horse. It has always been difficult to obtain a sound-pointed nail in those made by hand, and hitherto impossible in those made by machinery. This question of the point has had most careful consideration in our factory; a few weeks ago we desired to ascertain the relative value between our nails and those made by one of our first-class hand-makers as to soundness of point; the experiment was made at the time for our own satisfaction, and not for publication, but we are happy to state the result. Of the hand-made, one in ten proved unsound at the point, while after testing upward of 100 of our nails we discontinued the experiment, as there was not a single nail of the entire hundred but was perfectly sound. There are three causes that may result in failure to an inventor seeking to produce horse-nails by machinery. One is in some fundamental defects in the principles on which he has constructed his machinery, which, though producing highly satisfactory nails, nevertheless, either wears out or knocks itself out in its work; another, that already alluded to, the nails produced being worthless, in consequence of the inability of the inventor to comprehend the qualities so essential in a sound nail, but I should feel favoured if, on this occasion, I have permission to state a third, and that is—want of capital. My father, during an experience of forty years in connexion with the business of a farrier, acquired a perfect knowledge of what a horse-nail should be; but during that period (it not being a fortune-making business) he never acquired a fortune adequate to produce and launch out patent machinery for making horse-nails. For upwards of ten years my father and I have laboured at machinery for this purpose, but for the first four years to a very limited extent; and when, six years ago, we had arrived at what we considered some degree of success, we laid our plans before Messrs. Moser, of Southwark, and they were at once taken up with confidence and energy, and during the lengthened period we have worked with this firm, funds have been liberally supplied, and, of course, a large amount has been expended, or I should not be in a position to lay before this Society, as I hope now to do, a perfect system of making horse-nails by machinery, having at the same time in our possession high testimonials from all parts of England of their superiority in quality, form, finish, and regularity, which no hand-made horse-nail has ever attained.

I will now endeavour to describe the process of making what we call our H.P.-horse-nail, from the flat rod of iron until it is ready for the market, having reference to the diagrams.

The iron employed we import from Sweden, and it is known as the best Swedish charcoal nail rods. These rods are flat, being about $\frac{7}{16}$ inch wide by $\frac{1}{8}$ inch thick, according to the size of the nail, and of convenient lengths, about 2 feet 6 inches.

The first process in our system of manufacture consists in rolling these rods to a form suitable for the manufacture of the nails, by the machines which have to operate in the subsequent stages of the process. This rolling is the most important operation as regards the quality of the nail, and I will endeavour minutely, but as briefly as possible, to describe it.

The heating of iron for making horse-nails has a most important influence on the quality of the nail, by whatever process the iron may be worked. Unsound points in hand-made nails are of frequent occurrence, not from the quality of the iron, nor, indeed, from want of skill in working the iron, but from want of judgment in heating it, the rods being frequently overheated or burnt—not sufficiently, perhaps, to destroy the body of the nail; but when the farrier has to hammer a fine point to the nail for driving, the iron, instead of coming up sharp and sound, becomes rough and spongy, and, under a powerful lens, will appear like a coarse brush, and the nail is said to be hollow-pointed. Now, as we have also to heat the rod, it may be fairly asserted that we run the same risks; but I wish to show, and that in a few words, that this is not the case, and the reason that it is not is, that we are able to employ for the heating of our rods a Siemens furnace. It is quite unnecessary here to describe this valuable furnace, and I will only show how the iron cannot be burnt. For our purpose we keep the gases in the furnace in a reducing state, and, owing to the non-oxidising nature of the flame, it is impossible to burn the iron; melt it we may, burn it we cannot. This statement is the result of experiment; we have overheated our rods until a portion has melted away, and those rods, when rolled, have produced perfectly sound iron, uninjured in every respect as to quality, but reduced, of course, in weight.

With the exception of the annealing and colouring (to which I shall presently refer) this rolling of the rod is the only part of our process in which the iron is worked hot.

The flat rods, six in number, are placed in a Siemens furnace, which is kept at an exceedingly high temperature, and in which the rods are brought to a welding heat in about 30 seconds. In this state they are withdrawn from the furnace, and tossed in quick succession down an inclined tapering shoot, which communicates with the rolling mill. The rods slide down, of course, on their flat side, but are required to enter the rolls on their edge. On ariving at the rolls, and about their centre, which they must unerringly strike, they come in contact with the edges of the rolls, which are bevelled on the periphery, and by this arrangement the rolls at once turn the rod on its edge, and carry it through the mill at a speed of 1,000 feet per minute. The rolling-mill has a solid casting for its base and standards, in these are fitted the bearings, which, you will observe, are of considerable length. Running on these bearings are the shafts of the mill, made of steel; to these shafts the rolls are fixed by means of keys and nuts; the lower shaft is driven by a coupling attached at one end, the opposite end of both upper and lower shafts having a pinion keyed on, so that the upper shaft is driven by the lower one.

The roll on the lower shaft is perfectly plain, and of a width that exactly corresponds to the roll on the upper shaft; the upper roll, however, has a number of recesses formed at intervals on its surface, which correspond to the bulbs on the rods when they leave the mill (each bulb or projection afterwards becomes the heads of two nails), also between the recesses on the roll that form these future heads. The space on the surface of the roll produces the shank of the nails, and this space is turned of such an eccentric form, that the required taper of the nail from head to point is attained. Each of these rolls, which is only the required width of the nail, is solid on to a collar or flange, the side of the upper roll having its bearing against the solid flange of the lower roll, and the bottom roll bearing against the flange of the upper roll; but the tendency of the iron, when passing through the rolls, is to separate the rolls, and into the aperture thus created the iron for a certainty enters, and though the aperture may be so fine that it cannot be discerned or guaged, the iron, when delivered, has on it a fine fin or feather. To obviate this defect, on the bottom shaft an iron collar is placed, against which the back of the top roller works, and is thus prevented from spreading in the horizontal direction, and causing the fin on the rod. These rolls are 7 inches in diameter, and travel at the rate of 540 revolutions per minute. To assist the iron freely leaving the rolls, at all times a stream of coal tar is kept constantly running on the rolls, which, falling while the hot rod is passing through, creates a carbonaceous deposit upon the rolls, protecting them thereby from any friction that might be caused by the iron in its transit through, and thus preventing wear, in addition to which, the tar also forms a lubricant between the rolls and flanges, and prevents their heating to any appreciable extent. One ton of rods is rolled in nine hours by two men and three boys, the two men being required to feed the mill from the furnace, and the boys to straighten the rods as they leave the mills, and deposit them in troughs to be removed to the next machine.

The second machine consists simply of a pair of plain rolls, two feet diameter, between which the rods are passed, that the bulbs or projections which are now flat may be reduced to a form nearly square, and somewhat nearer the form required for the head. This machine is worked by two girls. The third machine is the cutting machine. This consists of a frame, through the centre of which passes a shaft, having at one end driving pulleys, at the other a slide, which receives a reciprocating motion from a crank pin on the end of the shaft. By this machine the rod is divided into nail blanks. The cutters are so arranged that at each descent of the slide two blanks leave the rod. There are two pairs of cutters, one pair dividing the bulb in the centre, thus forming two heads, while, at the same time, the other pair of cutters separate the two shanks at an angle required to produce the tapering point of the nail; and should any slight discrepancy occur in the length of the rods between the heads, so that the shanks would turn out of various lengths, a third pair of cutters descends simultaneously with the other two, and thus removes any excess of length.

When separated from the rods, the nail blanks remain on the machine, and, to remove them, a reciprocating arm, working alternately with the cutters, pushes the blanks down an incline into receiving boxes. The machine is worked by a young woman, who cuts 32,000 nail blanks per day. The nail blanks at this stage have a somewhat rough appearance, from the scale on the surface, as also from a sharp, and, to a slight extent, a rugged, edge. To remove the injury in the wear of the subsequent machines that might be caused by this scale and rough surface, the nail blanks are placed in a revolving rumbler, which is nothing more than a plain iron cylinder three feet in diameter, and into which one ton of nail blanks is placed, and left there until, by mutual friction, they acquire a perfectly smooth surface, and, at the same time, the point comes into a slight share of improvement, its sharpness being rounded off and smoothed. Thus clean and smooth, the blanks are passed on to the heading machine, where the heads are formed into the counter-sunk shape required. This machine consists of two vertical frames, between which, and near the base, revolves a die roller; this roller contains twelve pairs of dies, having an intermittent motion communicated by a ratchet rod connected to an eccentric on the driving-shaft of the machine. In these dies the nail blank is placed as the roller revolves, and as the dies rise towards their top centre, they are forced together by means of a pair of grippers attached to levers at either side of the machine, and thus the nail blank, which dropped loosely into the dies, is now firmly held, while the vertical plunger, which contains the heading punch, descends, and forces the head of the nail blank, which projects some half-inch out of the dies, down into the dies, thus bringing the lump of iron —now about three-sixteenths of an inch square and half an inch long—into a tapering or counter-sunk form. The roller, to enable the top die to perform this operation, waits an instant, and then continues its rotation, and, as the plunger with its top die ascends, the pair of dies in the roller are simultaneously loosened, so that as the roller revolves, the nails drop from the dies, the dies being loosened by the levers, and advanced by the ratchet motion. While this is going on the dies following are being supplied with nail blanks, and so the operation is continued. It may be added that should the blanks refuse to leave the dies, as they occasionally do in consequence of the heavy pressure that has been put upon them, a mechanical hammer is provided, which smartly tapping the dies, the blank immediately leaves its position. This machine is also attended by a young woman, who feeds it with 25,000 nails per day.

The headed blanks, in consequence of being pressed cold, are rendered somewhat hard in the head; it is therefore necessary, before they enter the next machine, to anneal them in a muffle, worked similarly to our other furnaces on Siemens' regenerative principle. The blanks are allowed to cool very slowly in the pots, thus becoming exceedingly ductile.

We have now arrived at the last mechanical process in which the form of nail is finished. This machine is similar in type to the heading machine last described, its motions being communicated by a shaft passing through bearings at the upper part of two side frames; a cam upon this shaft works a central plunger, the lower part of which contains the top die, and which, being the required form, acts upon the front or face of the nail; there are also two lateral dies which give the nail the required shape on the sides. These dies are fixed in slides, receiving motion by means of levers from arms fixed to the plunger, and acting on the levers by friction rolls. The die forming the back of the nail is a chilled cast-iron table, in which are twelve studs; this table or roller has an intermittent motion, communicated by a ratchet from the driving shaft at one side of the machine. The headed blanks are placed on the roller with their heads resting against the studs, the roller carrying them forward, and bringing them to their position exactly beneath the upper die, where they remain while the plunger descends, and the lateral dies operate on the sides of the blank; these lateral dies, after this their first operation on the side of the blank, now partially retire, while the plunger, with the top die, passing down between them, shapes the nail on its face, then, as the plunger rises, the lateral dies again come forward, pressing the blank a second time on its side, and finishing the shaping as the roller or die-table revolves with a ratchet motion; the nail (for it is no longer a blank) drops by gravity at the opposite side of the machine. Again, this machine, like the others, is worked by a young woman, the daily production being about 21,000 nails. The mechanical operations are now completed, but previously to sending the nails into the market, they require a final tempering and colouring. This is done by heating them in enclosed pots in the annealing muffle, and withdrawing them at a bright red heat, after which they are spread over a large floor, where they are left to cool.

This last operation gives to the nails their proper amount of rigidity, while they retain that perfect ductility they acquired in the first operation at the rolling-mill. It also produces upon the nails a coating of oxide, termed scale, preventing rust, and gives to them a good colour and marketable appearance.

The nail is now completed, and ready for the final pointing, which it is to receive at the hands of the farrier previous to being driven into the horse's hoof.

Before you are a number of tests, bearing, we think, ample testimony to the quality of the nail. It may be thought that these samples are easily prepared for an occasion like the present, but I think an inspection of them (which I invite) will convince any one that it would not be easy to prepare such samples from bad, or indeed slightly inferior, quality of material; nay, I will go so far as to say it cannot be done. It is impossible to select nails, especially to test in this way, in consequence of all our nails being the same. These nails, tested as you see, are taken from the bulk, and there are other nails here not tested, and should any persons desire to have those tested in a similar manner, he may take away a few for that purpose.

The nails tested have all been worked cold; the shanks that are beaten out are as thin and sound on the edge as the blade of a knife—no crack whatever; others are twisted into screws, others are pointed and clinched, as they would be when in the horse's hoof; and on the bend or angle they have been drawn out cold and pointed, the point coming out sharp and solid from the very bend. We think we are speaking quite within the limits of truth when we say that the quality of this iron cannot be surpassed, and is not produced elsewhere in this country. We attribute its perfection to three causes:—First, it is the best Swedish charcoal iron; secondly, it is heated in the Siemens furnace; and lastly, and certainly not the least important, it passes through our rolling mill, already described.

In conclusion, I beg to thank you, Mr. Chairman and gentlemen, for the honour you have done me in so attentively and patiently following me throughout this paper, and I trust you will as kindly forgive the blemishes you may have noticed, and attribute them to what may have been apparent to you—some want of experience in addressing a meeting like the present.

Specimens of the various bars and nails in the different stages of their manufacture were then handed round to the members.

DISCUSSION.

The Chairman said he hoped there were gentlemen in the room who were sufficiently interested in the question—and indeed everyone who kept a horse was deeply interested in it—who would give the meeting the results of their experience in the subject before them and of the art of manufacturing nails for horse-shoes generally.

Mr. Wilson said there was little to add to the paper, but that the name of the engineer who assisted to bring this beautiful machinery to perfection had not been mentioned. He was not certain whether this machinery was the same as what had been constructed by Mr. Jabez James, of Lambeth. If it was the same, it was only due to him that his labours should be mentioned and his services in connection with it recognised. He made the remark entirely of his own accord.

The Chairman remarked that if there were any gentlemen acquainted with the process needful for the shoeing of horses, perhaps they would kindly criticise these nails. If they could suggest any way in which they could be improved, or if they could point out any defects, they would be conferring a benefit, not only upon the essayist, with regard to this particular manufacture, but upon society in general. He thought there was something very remarkable about the ductility as well as the usefulness of the nails. There was one question which must have presented itself to the minds of most of them, as it did to his. In the ordinary mode of making the nails, even from the best of iron, it was usual to allow a blast of air to fall upon the iron, so as to promote a chemical change, which has always been thought to be highly beneficial to the iron. There was an entire absence of that in the process before them; and the question he should like answered was how far the absence of this was likely to be beneficial or injurious to the progress of the manufacture. Hitherto it had been thought beneficial, and it must be within the knowledge of many of them that that was the usual mode in which nails of this character were made.

Mr. Botly said he should like to know whether these nails were applicable to every manufacture of horse-shoe. Because first they had the old one, requiring eight nails to each shoe; then they had another, requiring no nails at all; and then they had another improved shoe, where there were only five nails required. There was Gray's patent, and two or three others. He presumed they would be applicable to every description of shoe. The machinery which had been described to them was exceedingly fine, and of beautiful construction as well as of great ability. Another question was this. In the winter, when snow or ice was on the ground, our horses were "roughed;" were these nails applicable to that operation, which the blacksmith generally performed to prevent the horses falling? As to the excellence of the iron used, he could speak to that himself. Swedish iron was superior to everything that could be got from any quarter. It was the most superior of all in its toughness, and, indeed, in every way.

Mr. Broderick said he had heard it stated, but he did not know it of his own knowledge, that farriers could not use the nails—that no amount of hammering would make them sufficiently hard at the points to go into the hoof. He would like to know whether this complaint had been heard of, for that was most important.

Mr. Cattrall had examined the nails which had been made both by hand and by machinery, and he had come to the conclusion, as far as the short space of time he had had to examine them enabled him, that those made by machinery were very much superior to those that were hand-made, not only in a chemical point of view, but also in a mechanical. He considered that the very fact of the influence of the oxygen from the use of the blow-pipe upon the hand-made nails was such that you got a chemical change which was in no way calculated to give elasticity and toughness to the nails. There was a chemical reaction which took place on the surface of the nail, and the chloride and the oxide of iron were produced in a more condensed and solid form; whereas in the machine-made form that was avoided. Consequently a tougher nail was produced, and the quality of the nail was more fully established, and therefore much superior to the nail made by hand. With regard to the point of the nail, the machine-made nail appeared to him to be somewhat finer in appearance than the hand-made; but nevertheless, if the quality of the iron was superior to the hand-made nail, he was apprehensive—and he had come to that conclusion from a very long and extensive practice in the trade—that it would not require so much labour by the farrier who had to point it. He should like very much to give the nails a fair practical trial at one of his own forges, and he should then be in a position to speak more fully as to their real value.

Mr. Stanley thought it would be better for some one to speak who had used them. He had tried some of them, and found them rather too soft. The farrier could not hammer them hard enough to stand against the horn; whether that could be remedied he did not know. The quality of the iron appeared to him to be almost too soft.

The Chairman asked what was the process of hammering.

Mr. Stanley replied that it was the use of a small hammer upon them on a very small anvil, prior to driving them into the foot.

Mr. Dollar said he was able to speak practically on the subject. Last week the firm of Messrs. Moser sent him forty of the nails. He carefully examined them, and had one of his horses shod with them. It was only fair to the general body of nail-makers that he should emphatically contradict the statement made in the paper with regard to the class of nails generally used. The point of the nail was a very important part of it, and he found five of the nails sent him pointed "loose." In the hand-made nails in general use there was not one "loose" pointed nail in every hundred. That he could say from his own practical experience. The meaning of "pointing" was the getting rid of the scale and getting it ready to go into the horse's hoof. The machine-made nails "buckle," and in the fore-foot of the horse into which they were driven several of the points would not come out. He saw the horse shod, and saw the practical defects. As to the wearing, he could not tell yet, as it had been only done four days. He thought there was a defect in the making of the nail, the iron being simply rolled. Judging from a common-sense view of the matter, he thought the machinery did not supply to the iron what was required to give to it the necessary stiffness. The machine made nails were like those hand-made-nails in the making of which the blow-pipe had been too freely used. They were not stiff enough. The appearance of the nails was everything that was wanted, as far as appearance went.

Mr. Chapman said he should like to ask the last speaker whether the nails made by hand were not annealed?

Mr. Dollar said they were not annealed at all. They liked to get the iron to a certain temperature—what they termed a low welding heat. Then the iron was worked as quickly as possible, and laid down at red heat and allowed to cool. They then scaled well, and if made from the best Swedish iron, they had a nice white, silvery appearance. If made too warm under the blow-pipe, the scale came off and they had a nasty blue colour.

A Gentleman inquired whether the hand and the machine nails were made of the same iron?

Mr. Dollar said they tried to get Swedish iron, and he believed that in the manufacture of a good article nailers would work nothing else. What they had to complain of in the trade was, that they got nails not badly made, but of an inferior description of iron. There were a great many little men in the trade, and, of course—when there was something like £6, or even £8, a ton difference in the price of English and Swedish iron nail-rod, these nails being made out of doors—the men were in the habit of employing inferior English instead of the best Swedish iron, which had been given out to them for working.

Mr. Smart inquired whether the best rod-iron was hammered out or rolled out? He had seen the process of hammering out iron by machinery, and he believed that the iron so produced was very superior to that which was rolled. If that was the case, he did not see why machinery should not be so constructed as to hammer it through instead of rolling it out. It appeared to him also that the rod was rather thin for its length, and if it were made slightly stouter there might be more hammering afterwards, which would tend to strengthen it.

Mr. Moser said he would venture to reply to one or two of the speakers. The first gentleman remarked that the names of the engineer had been omitted. All he had to say on that point was that Mr. James entered into a contract to make the cutting machine according to the drawing furnished to him. Mr. James had nothing to do with the making of the process whatever. He had nothing whatever to do with the inventing of the cutting machine, and nothing to do with any other portion. He had the drawing furnished to him, and he sent it home in due course, and the work was finished in first-class style.

After some remarks by several speakers on the different prices of hand and machine-made nails, and the discount that could be respectively allowed,

The Chairman called upon Mr. Huggett to reply.

Mr. Huggett said that with regard to Mr. James assisting to bring out the invention, he manufactured the cutting-machine only, and did it in his usual high-class way. He also made, at the earlier stages, a rolling-mill for them, which did not succeed, although it was entirely in accordance with their own drawings. But he had done nothing for them except in accordance with their drawings. The second speaker, Mr. Botly, wished to know if all kinds of nails could be made under this process. There was a card fixed on the wall, containing the various sizes and descriptions of nails, which would be sufficient to prove that they could make any form of nail. There was the French, Austrian, shoulder, horse, and others. The third speaker made some observations as to the nails being soft. When they first sent round a large number of samples, they had all sorts of complaints that the nails were too hard, too soft, too thick, and too thin. In fact, the list of complaints of that kind would scarcely be credited. On the other hand, they had a large number of reports, and the largest number by far were quite favourable to their nail. Gentlemen who had used their nails had ordered them over and over again. In the first instance some of the nails were too soft, but they found after the reports came in that they could remedy that to any point they pleased in the final colouring, and tempering. and heating, which was done in closed pits, and the nails were then taken out and spread on a floor. By heating them to a pretty red heat, one degree of hardness was obtained, and by a lower heat a softer degree was obtained, and the action of the oxygen upon the nails at the various heats produced a harder or a softer nail, and the nails that they had manufactured and coloured to-day were as nearly as possible the proper temperature, so that he would not say but what it might have been so in the first instance; it was not so now. As regards the pointing, they really required less pointing than the hand-made nails. He believed there was not one veterinary surgeon who would not say that he often found it necessary to knock off the point. He believed that even to shoe one horse one could scarcely go through that operation, taking the thirty-two nails, without knocking off more than one point. Their nails were better to work upon, because they were a little thicker at the point. Mr. Dollar was unfavourably impressed on several accounts. He had had a horse shod with them, and he stated that five nails were loose at the point. Now, in pointing these nails a little experience was required in the manipulation by the man who pointed them. Of course, it was impossible to make them absolutely the same as those made by hand, although they had approached it. Their nail did not require hitting quite so hard. It required striking more lightly, and by that means he felt sure they would not find one in a hundred bad. He also went into the question of the iron rolled not being so stiff as the iron hammered. The iron which was used by the hand-made maker, as had been already stated, had a blast of air allowed to play upon the point of the nail, and he objected to too much of this oxygen. That did the nail no harm at all. The only action it had was that the blast of air kept the iron hotter while it was being hammered out—consequently the nail came out and was dropped into the box hotter than if it had no blast upon it. The iron itself was no worse at all. The only reason for its coming harder was, that the hammering it at a lower heat had a tendency to injure the iron, making it brittle instead of ductile. He also spoke of the way in which the iron was changed by the smaller makers. Consequently, the hand-made nail was likely to be made of inferior iron; but they were not likely to run any risk of deterioration. Another gentleman raised a question of rolled *versus* hammered iron. They obtained the best iron that could be obtained; they bought the finest Swedish iron that could be obtained. They had testimonials from all parts. He would add that, by the new process, nails could be made of any degree of stiffness or durability, without becoming brittle. If a sample were sent, he would engage to turn out a batch of nails of precisely the same temper.

The Chairman said it rested with him to ask the meeting for their thanks to Mr. Huggett for his valuable paper, but, before doing so, it might be well, perhaps, to suggest an answer to a question that had been put, namely, why the blow-pipe was used on those nails which were hand-made, and what the effect of dispensing with it was likely to have. The blow-pipe was used, as they knew, for the purpose of maintaining the heat during the process of its use. It was liable to oxidize the nail partly. If there was any one present at all connected with welding operations, he would know it was wanted to prevent that oxidation; it was necessary to form a kind of gloss over the iron thrown off, so as to keep the oxidation from the piece of iron to be welded. It struck him, theoretically, the dispensing with this blow-pipe arrangement was likely to produce a very satisfactory result, because there would be no liability for particles of oxide of iron entering into the point. As to the hammering of the points, clearly they were prepared by a different manufacture, and would require a different scale. Only experience could determine what that mode should be. Every one was familiar with the working of steel, and that steel purchased in two different shops might require two different treatments; and it was very frequently found that what was called the same steel, purchased at intervals of two or three weeks, must be treated differently. As to the hammering, any one who at all understood the question would see that these would probably require a lighter blow than the others, from the process by which they had been made.

A vote of thanks was then given to the lecturer, and the proceedings closed.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

The Committee on Steel as Applied to Railway Purposes met for the first time on Thursday afternoon, at Stanhope-lodge, Kensington-gore, Mr. John Ramsbottom being in the chair, and the following members being present:—Mr. W. Adams, Mr. W. G. Beattie, Mr. A. McDonnell, Colonel C. S. Hutchinson, R.E., Mr. F. W. Webb, and Lieut.-Col. F. H. Rich, R.E. Mr. Cole, C.B., and Captain Grover, R.E., attended the meeting. The Committee considered the objects and scope of the proposed Exhibition, and agreed to notify them to the principal manufacturers of steel tyres, rails, axles, springs, girders, &c. They recommended that sufficient space should be allotted to the London and North-Western Railway Company for a complete representation of the steel products of the Crewe works. Among the promised objects were instanced a curious American steel fire box, and a Bessemer steel rail 30 feet long, which was in the International Exhibition of 1862, and has since been continuously used at Crewe without turning. It was suggested that specimens of steel which had stood work would be peculiarly interesting. It was stated that the Society of Arts has offered a large gold medal for the best specimen of steel in next year's International Exhibition. The Committee adjourned till the 7th January, 1873.

The first meeting of the Committee on Class 10, Surgical Instruments and Appliances for the London International Exhibition of 1873, was held at three p.m., on Tuesday, the 26th November, at the offices in Stanhope-lodge, Kensington-gore; Mr. Cæsar H. Hawkins, F.R.S., was voted to the chair; and among those present were, Mr. J. Hilton, F.R.S.; Mr. Prescott G. Hewett; Mr. R. Quain, F.R.S.; Mr. W. White Cooper; Mr. J. Luke, F.R.S.; Mr. T. W. Nunn; Mr. E. Saunders; Dr. G. T. Gream; Dr. W. S. Playfair, and Dr. H. J. Domville, C.B.

Captain G. E. Grove, R.E., acted as secretary to the Committee, and Mr. H. Cole, C.B., was present as the representative of her Majesty's Commissioners for the Exhibition of 1851, under whose auspices the current series of Annual International Exhibitions is being carried on at South Kensington.

The Committee was informed of the steps which had already been taken towards notifying the particulars of next year's International Exhibition to the manufacturers of Surgical Instruments and Appliances at home nd abroad.

The following resolutions were then passed:—

"1. That the individual members of this Committee undertake to interest instrument-makers on the subject of exhibiting improved surgical instruments and appliances, and will request them to give an early intimation to the Committee of their intention to contribute to the Exhibition of 1873."

"2. That the Royal College of Surgeons and other public bodies, or private collectors, should be requested to lend the ancient surgical instruments in their museums; that steps should also be taken to obtain a loan from the Italian government of the ancient surgical instruments recovered from the ruins of Pompeii, and that similar applications should be made to other foreign governments who possess similar collections."

"3. That a communication should be forwarded to the medical journals, and to the *Journal of the Society of Arts*, explaining the objects of the proposed Exhibition of Surgical Instruments and Appliances, and requesting instrument makers and others to contribute specimens. Applications to exhibit should be forwarded before the 31st January, 1873, and the goods delivered on the 11th March, 1873."

With reference to the last paragraph of resolution 2, it was suggested that the Spanish government should in particular be communicated with; and that among public bodies in England the Royal Medico-Chirurgical Society, the Obstetrical Society, and the University of Edinburgh should be applied to.

A letter was read from Dr. Henry D. Noyes, of New York, offering a case of optical appliances for treating ocular diseases, and it was proposed that the Commissioners should, when acknowledging it, suggest that he should try to interest the American instrument-makers in next year's London International Exhibition.

After the transaction of some more business the Committee adjourned until Monday, the 23rd December.

The second meeting of the Committee, for Silk and Velvet, was held on Tuesday last, the 3rd instant. The Committee decided upon specially inviting a large number of firms connected with the silk trade to exhibit, so as to complete the representation of all branches of the trade, and certain members undertook personally to ensure a comprehensive representation of foreign manufactures. There were present Sir Daniel Cooper, Bart., chairman; Mr. F. Bennoch, Mr. Cassells, Mr. F. Cobb, Mr. J. Chadwick, Mr. Higginbotham, Mr. Arthur Lewis, Mr. Lintilhack, and Mr. Tucker. Mr. Cole, C.B., and Capt. Clayton, R.E., attended the Committee.

Amongst recent additions to the Carriage Department Earl Onslow has promised to lend an old family coach belonging to his father. Her Majesty has also promised to send a state coach to the Exhibition, and the Speaker of the House of Commons will send his.

During the past week a telegram has been received by the Commissioners from the Japanese Government, asking for a considerable grant of space (about 200 feet by 20) for the exhibition of the products of that country. Japan will, in consequence, probably be well represented, especially in the department of silks.

In accordance with the memorandum published last July, the Commissioners have been negotiating with various foreign academies and artistic societies with a view to the examination of works of art in their respective countries, and their transmission, properly certified, to the Exhibition. Official relations have now been established with different bodies in the following countries:—Holland (Societies of Arts); Denmark (Artistic Society, Copenhagen); Germany (Kunst Verein); Italy (Royal Academy); Switzerland (Societies of Artists).

EXHIBITIONS.

Dublin Exhibition. — This Exhibition, which was opened by His Royal Highness the Duke of Edinburgh, on the 5th of June last, was closed last Saturday. Their Excellencies the Lord-Lieutenant and the Countess Spencer took the principal part in the closing ceremony. At four o'clock their Excellencies arrived at the principal entrance, where a guard of honour of the 1st (King's) Dragoon Guards was stationed. They were received by a deputation of the Council, with the manager and secretary, Mr. Edward Lee and Mr. Alfred Emden, and conducted through the Sculpture-hall and along the centre of the main building to the daïs in the Leinster-hall. The "Hallelujah Chorus" was sung by the choristers of the New Philharmonic Society. Mr. Edward Lee, the manager, then read the "report of the proceedings and results of the Exhibition." This report noticed the facts connected with the establishment of the Exhibition, and congratulated the Executive on its success, especially considering the shortness of the time allowed for preparations. Amongst other matters spoken of was the Loan Museum and the National Portrait Gallery. It stated that the Exhibition had been open 154 days and 58 evenings, and the entire number of admissions had been about 420,000, making an average of about 2,700 per day. Contrary to the original intention, it was finally decided that medals and cirtificates should be awarded to exhibitors in the various departments. Mr. Lee was afterwards knighted by the Lord Lieutenant.

Bordeaux.—The Society of the Friends of Art of Bordeax announces its twenty-first exhibition of works of art for the 1st of March, 1873. The importance of this and other local exhibitions to art and artists, is exemplified by the fact that, at the last held in the same city, the sales amounted to nearly four thousand pounds.

SILK SUPPLY.

One of the most successful results of silk culture in the colonies is now being exhibited at the Society of Arts.

Some few years ago, Dr. Hiddingh, of Stellenbosch, Cape of Good Hope, conceived the idea of employing the native female labour in the cultivation and reeling of silk, and on a previous occasion he sent reeled silk to the Silk Supply Association, which took as high a class as nearly equal to No. 3 Chinas. This was manufactured into scarfs by the firm of Potts, Wright, and Co., Macclesfield, and returned to Dr. Hiddingh, who, continuing his laudable exertions, has now sent home silk which, upon being again submitted to the same eminent manufacturers, has drawn from them a report exceeding the highest expectations formed. They have produced most beautiful fabrics from the silk, which they class with the commoner Italians, and confirm their report by offering to take as much of the same quality as can be supplied at 36s. per pound—the price of No. 3 Chinas being about 28s.

These results are so extremely favourable that they cannot fail to excite attention in all the Colonies; and it may be mentioned, Mrs. Neil, a lady from Australia, who has recently visited the different magnaneries of Italy and the south of France, is now on her way out with seed from Mons. Roland, of Switzerland, said to be perfectly free from disease for three generations past. From Queensland great progress is reported in the planting. Mr. William Corte's mulberry plantations are said to contain 5,000 trees ready for working, and the results of last year have been to produce a good deal of grain, although the quality of this must be doubtful, until the particular produce of the place has been tested in European markets.

SILK GROWING AND REELING IN SYRIA.

The principal productions of Syria available for export are silk, cotton, wool, oil, sesame seed, millet seed, Indian corn, wheat, barley, tobacco, madders, sponges, fruits, &c. They are exported from the ports of Latakia, Tripoli, Beyrout, Sidon, Tyre, Acre, Caiffa, and Jaffa. The falling off apparent in the year 1870-71 is due to deficient harvests, and the stoppage of the ordinary export trade of silk to France in consequence of the war. According to the report made by Vice-Consul Jago upon the commerce and agriculture of the Velayet of Syria, this article is cultivated chiefly in Mount Lebanon, the plain of Beyrout, and Tripoli. A small quantity is also produced in the Latakia, Sidon, and other districts. The average production of cocoons is estimated at 1,600,000 to 20,000,000 okes, valued between £500,000 and £600,000. Prior to 1840, the native method of reeling prevented any considerable quantity being exported to Europe, and the surplus crops were sent chiefly to Egypt, Morocco, Bagdad, and Turkey, where it was consumed in the manufacture of the silk and cotton goods used for upper garments by the richer classes,—an industry, however, which has been much diminished by the competition of European looms. The introduction of a better system of reeling is due to a French gentleman, who, in 1840, established the first silk factory on the French method on Mount Lebanon. The improvement consisted in stifling the cocoons instead of hurriedly reeling them while fresh, in diminishing the diameter and in creating and regulating the speed of the reels, and in the employment of steam instead of wood for heating the basins into which the cocoons are plunged, whereby uniformity in the thickness of the thread is attained. The native way of spinning produces a thick, coarse thread, of varying size, and therefore unadapted to European looms. The new system has obtained to such a degree, that at the present time there are 85 silk-spinning fabrics, containing 4,000 basins, in the country, besides a few establishments which are engaged in the stifling and drying of the cocoons for exportation in their natural state. Of these factories, about a dozen are in the hands of foreigners, chiefly Frenchmen, while the remainder have been established and are being worked by natives, who have thus shown themselves apt to learn and ready to profit by the instruction conveyed into the country by European enterprise. About three-fourths of the cocoons produced are spun in the above factories, and the raw silk sent almost exclusively to France for the use of the Lyonnaise looms; while the remainder is partly exported to Europe, and partly retained for home consumption, being spun in the coarse, native way, suitable for the manufactures of the country. Beyond a small quantity of waste silk, none appears to have been sent to England for some years, the manner of reeling not appearing as yet to have accommodated itself to English machinery. The factories obtain their supplies of cocoons from the peasantry in the surrounding districts, to whom the rearing of the silkworm is the chief resource; but the little care given to its cultivation, and to prevent the spread of the disease, which first made its appearance in 1851, raises great doubts as to the future of this most important production, at all times liable to constant risks from climateric influences, unless something is done to improve the system, and remedy the disease.

The silk year lasts, in ordinary times, ten months, from June to the end of April. It, however, depends upon two things, viz., prosperity in France on the one side; and, on the other, an abundant crop in Syria, permitting purchases to be made at advantageous prices. The duration of the spinning averages from eight and a half to nine months. The factories give employment to numbers of persons of every age, sex, and religion; and it is estimated that above £40,000 are annually expended in wages in Mount Lebanon alone.

The ten French establishments in the country employ, for instance, in the aggregate, from 1,200 to 1,250 persons. In three of them girls form nearly nine-tenths of the total number of hands. In the others the proportion of the women is insignificant, and they are only employed at harvest time for assorting cocoons. The girls are from nine to eighteen years old, after which age they remain at home, and cease to hire themselves. In those establishments where the two sexes are employed, a strict surveillance is exercised over them. The native workman is found generally to be very intelligent, and to take readily to spinning. The girls show rare patience and application, and evince greater skill than the boys. The character of both is docile. The largest proportion of nationalities among the *employés* are Maronites, and the remainder Greeks, Catholics, and Druses. No Moslems are employed. The Druses are found useful as messengers, labourers, and for out-door work in general, the characteristics of the race unbefitting them for sedentary occupations. The work is from sunrise to sunset, with three stoppages for food and repose. Silence is imposed, and disputes and misconduct punished by fines. The total value of the ten French factories in the Lebanon is estimated at from £72,000 to £80,000. This, with the value of the seventy or eighty others in the country, will give an idea of the importance of the Syrian silk trade and the capital laid out. In the year 1871, great success attended the hatching of the seed, so much so as to necessitate the destruction of a proportion of the worms for the want of a sufficient quantity of leaves. The crop of cocoons was, therefore, greater than in former years, but the quality and yield was barely an average, atrophy, the result of insufficient food, being the cause, and the cocoons were consequently only partially developed in a large proportion. The white mulberry tree is, necessarily, an important feature in the Lebanon and the silk-producing districts generally. The trees are planted in rows, about four paces from each other. During the first eight years they give a greater or less quantity of leaves, after which the produce remains stationary, if properly cared for, otherwise the yield soon begins to decrease. Much attention, however, is given to the cultivation; the land is ploughed three or four times a-year, weeds are extirpated, and irrigation practised. In May, in the plains, and in June in the higher lands, the first crop of leaves is gathered for the nourishment of the silkworm, and the branches are cut off. In the autumn the second crop is gathered, and serves as fodder for sheep and cattle.

PATENT LAWS IN JAPAN.

Amongst the recent innovations in Japan is the introduction of a patent law. As the whole text of this instrument is not very long, we append a translation, furnished by the Foreign-office to the *Commissioners of Patents' Journal*:—

May 25, 1871.

Henceforward exclusive permission to trade in newly-invented articles of all kinds whatsoever will be granted to the inventors; in consequence whereof, should any person residing in any part of the country be desirous of obtaining such exclusive permission, the application shall for the present be made to the Home-office, in accordance with the regulations which follow.

Patents shall be granted for a term of years to all persons who increase the conveniences of life, who newly invent any chemical apparatus, machinery, utensils, or furniture, weapons, woven fabrics, &c., or who improve existing furniture or utensils.

The term of years shall be fifteen years, ten years, or seven years, according to the value of the invention.

Any person desirous of obtaining a patent shall send in his application to the local authorities of the district in which he resides, accompanied by a description, drawings, &c., which shall be forwarded to the Home-office, and the Home-office shall issue the patent.

The objects of the invention or the improvement shall be carefully drawn in cross-section and plan, and in the case of machinery the parts must be numbered or lettered in accordance with the description, so that everything may be clearly comprehensible at a single glance; and the seals of the inventor and of his surety must be attached to the drawings. Models may be furnished of articles of which drawings cannot easily be made.

When the document containing the patent is issued by the Home-office the local authorities shall deliver it after having obtained a receipt from the inventor and his surety.

A duty of five rio (£1 1s. 3d.) shall be paid annually in advance during the period for which the patent is granted into the hands of the local authorities.

The duty may be increased or diminished, according to the nature of the invention. The amount shall be forwarded to the Home Department as soon as it is collected.

No duty shall be paid until six months have elapsed from the granting of the patent, that period being allowed for the inventor to try whether the sale be remunerative, and when he has ascertained that it is remunerative he will pay in one year's duty to the local authorities.

If from the trial made during the first six months the sale turns out to be unremunerative, the application may be withdrawn at the option of the patentee, but in case such application be made after the expiration of the six months, the duty for one year already paid in advance will not be returned.

The applications sent into the Home-office will receive consideration according to priority of arrival.

Where the invention of another has simply been improved, the application must distinctly state the name of the original inventor and the nature of the improvement. Where the invention in respect of which an application is made resembles a prior invention by another individual, but actually differs in construction or use, the points of difference must be clearly laid down in the application.

No patent will be granted for articles of general convenience, though the inventor be known beyond the possibility of mistake, and be yet alive, if the invention has been in general use for several years previous to the application.

Separate patents will not be given to each individual who may have combined with others to produce an invention, but a single patent will be issued in the name of all the partners of the company.

The owner of a patent may freely dispose of it for such sum as seems fit, during the period for which it has been granted; and both parties shall make application to have the fact endorsed upon the patent.

The patentee is at liberty to establish branch shops in his own name, or to teach others how to make the articles patented by him.

Should the patentee die before the patent expires, he may leave the patent to a relation, but application must be made to have the transfer endorsed thereon.

The Home-office shall publicly notify in each case that a patent has been granted to such and such a person, of such and such a place, giving also the names of the department, province, and the seat of the local authority, in consequence of his having invented such and such an article.

Should the patentee incur such losses during the term of years as he is unable to make good, if the article after due inquiry is found to be of indispensable public necessity, an extension may be granted.

Each separate article must bear the words "by government sanction," together with the name of the inventor.

Fines shall be imposed on persons who fradulently make use of a patentee's name, or who, not being in the enjoyment of a patent, make use of the term "by government sanction."

ANALYSES OF LONDON MUD.

With reference to the analyses of street sweepings that the Society has now under consideration, it may be worth while to refer to former experiments of the same sort. Amongst some of the most important were those undertaken in 1866-67 by Dr. Letheby. He did not, we believe, attempt to discriminate between the different sorts of mud from different pavements, but he collected mud from the stone-paved streets of the City, and subjected it to analysis. The average per-centage of moisture was found to be 35·3 per cent. of the weight of the mud in the driest weather, 48·5 in ordinary weather, 70 to 90 in wet weather. When the mud was dried and compared with dried fresh horse-dung and common farmyard dung, the following were the results :—

Constituents.	Fresh horse dung.	Farm-yard dung.	Mud.		Average
			Maximum organic.	Minimum organic.	
Organic matter...	82·7	69·9	58·2	20·5	47·2
Mineral matter...	17·3	30·1	41·8	79·5	52·8
Total	100·0	100·0	100·0	100·0	100·0

The largest amount of mineral matter was always found in wet weather, when the abrasion is greatest. The average of horse-dung was taken as 57 per cent. The accurate proportions of stone and iron were not determined, but the most probable proportions were 30 of stone and 13 of iron. On wood pavement the amount of organic matter was larger, and amounted to about 60 per cent.

Mr. Sidebotham's experiments, last year, on the dust blown into a railway carriage, will be familiar to most who take any interest in the subject. These experiments were made when travelling between Saltley and Camp-hill, near Birmingham, and an account of them is published in the Proceedings of the Literary and Philosophical Society, vol. x. p. 205. More than half (2·9 grains out of 5·7 grains of dust collected) proved to be minute particles of iron, the largest of which was $\frac{1}{150}$ of an inch ; these were, for the most part, in shape like "clinkers" from a furnace. The rest of the dust consisted largely of cinders, glass or quartz, yellow metal, sand, coal. &c., &c.

The labours of Dr. Angus Smith and Mr. J. B. Dancer do not bear directly upon the subject, as they treat of matter suspended in the air, not lying on the ground. As regards the general health of those living in cities, they are even more important ; but as the Society's object is to investigate the condition of our street and road pavings, they need not here be more than referred to.

A curious effect of road-dust is mentioned in *Dingler's Polytechnisches Journal* (vol. 190, p. 174). It was found that the trees on the leeward side of a road, after the wind had been blowing for some time strongly in one direction, grew more vigorously, on account of the organic matter carried to them by the wind.

So far back as the year 1845 the subject was attracting some notice. In the *Mechanics' Magazine* for January 18, in that year, a correspondent writes about the different sorts of mud produced on stone and wood pavements. The writer considers that the mud is composed almost entirely of horse-dung, and that this is ground into the wood, and so makes the surface slippery and unsafe ; with the granite, on the contrary, the mud simply lies upon the surface, and is pushed aside by the horses' feet, which consequently get a firm hold upon the granite. Another writer maintains that the mud is produced by abrasion on the granite, and only carried to the wood from the granite. This theory, as might be expected, comes from a staunch supporter of the wood paving. According to Mr. Whitworth's evidence before the Health of Towns Commission, wood pavements are more difficult to clean than stone. From the softer nature of the material this might have been expected. Of course, all these remarks apply to the old wooden pavements only, not to the new and improved description now on trial in several parts of London.

In the article last week on asphalt, we have to draw attention to an error. In the description of the method of applying the material, read, "Spread over the surface to a depth of $1\frac{1}{2}$ inches to $1\frac{7}{8}$ inches," instead of "Spread over the surface to a depth of 16 to 20 inches." The mistake arose from a substitution of *decimetres* for *centimetres*.

PATENTS ON BRUSHES, &c.

Blue-books are so seldom read that we make little apology for extracting the following, which forms the introduction to a recent volume, "Abridgments of Specifications Relating to Brushing and Sweeping," published by the Patent Office :—

With regard to the manufacture of brushes at present, there are, of course, as many methods as there are descriptions of brushes. Speaking generally, it may be said that brushes are of two kinds, those composed of a single tuft or fibre, and those of many tufts set in a "stock" or back. Of the first sort, the simplest are the "pencils," or small brushes used by artists. The smaller sorts of these are set in a quill, the larger in a metal tube. The fibres used are the hair of the camel, goat, squirrel, sable, marten, badger, &c., and, for the larger size, hog's bristles. In the process of manufacture a small bundle of hair is tied together, care being taken that the hairs are arranged to form a point in the centre of the brush ; this is pushed to a sufficient length through the large end of the quill or tube. The quill has been moistened, and contracts as it dries, so as to hold fast the hair ; or if a metal tube is used, it is slightly compressed upon the hair. In larger brushes, made of a single tuft, a mass of hair is secured by binding or otherwise, and the handle driven into it through the bristles. This process has, however, numerous variations. In the second class of brushes a suitable back is prepared and bored with holes to receive the tufts of bristles. These "knots" are generally formed by tying a bundle of fibres together and dipping it in cement ; after which each knot is placed in the hole prepared for it. In brushes which are sufficiently short to admit of the hair being doubled, "wire drawing" is used. A tuft of bristles is drawn through each hole by a wire passed across its middle, and the doubled end is thus forced in. This process, as well as those alluded to before, is capable of numerous modifications, the sketch here given being as brief and general as possible.

The most common material for brushes is procured from the bristles of the hog, which are imported into this country principally from Russia. Various vegetable fibres are also employed, as well as animal hair of nearly every description. The war with Russia is said to have interrupted the supply of bristles, and to have given a considerable impulse to the introduction of various vegetable substitutes. In 1870 the value of brooms and brushes exported was £56,287, that of those imported, £26,035. The value of the bristles imported in the same year was £366,767.

Among vegetable fibres employed are those of the Mexican aloe. Brushes of fibre are specially suitable for lime-washing, because the alkali does not affect them as it does bristles. Vegetable fibre is also mixed with bristle for purposes of adulteration ; cheap but less serviceable brushes being made of the mixed materials.

Most of the different parts of brushes are now made by machinery, and machinery has even been applied to the complete process of brush-making. One of the most recent improvements connected with the subject consists of an American machine for trenching, wiring, and inserting bristles in brush backs.*

In the way of history, not much is to be gathered about our subject. That brooms for cleaning and sweeping purposes have been known since the very earliest periods, and by the rudest and most uncivilised people, is certain enough. Amongst the relics belonging to the iron age, disentombed from the peat-mosses of Sleswick, were found two birch-brooms,† curious manifestations of ancient tidiness. The remains amongst which these brooms were found probably belong to the second or third century, as is evidenced by Roman coins mixed with them. In classical writers, from Homer downwards, we find, as might be expected, casual references to these domestic implements. They would not be of sufficient importance to cause more than an accidental and careless notice. Thus we find (Homer, Od. xx., l. 149), when Euryclea is clearing away the remnants of the suitors' feast, she bids the slaves :—

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* Described in *Scientific American*, July 20, 1872.

† Lubbock's "Prehistoric Times," p. 9, edit. 1872.

ἀγρεῖθ', αἱ μὲν δῶμα κορήσατε ποιπνύσασαι.[*]

Later on we find similar allusions ; Sophocles (Antigone, 409) and Euripides (Hecuba, 363) both use the word *σαίρω* in the sense of sweeping, though it might be too much to assume that a broom was necessarily to be employed. Aristophanes is rather more definite. In his Pax (l. 59) he makes one of his characters address a comic prayer to Zeus :—

Ὦ Ζεῦ, τί ποτε βουλεύει ποιεῖν ;
κατάθου τὸ κόρημα · μὴ 'κκόρει τὴν 'Ελλάδα.[†]

Eupolis, *κολ* 9, uses the same word ; but there is little use or interest in multiplying such references. We may mention that Theophrastus (H. P. 6. 1. [illegible]) speaks of the *στοιβὴ* or *φέως*, a shrubby plant (*Poterium spinosum*, Linn.) used to make brooms ; hence *στοιβῆς πυθμήν*, Hipponax (Bergk's "Lyrici Græci"), 42. 8. It appears that the tails of animals were commonly used as substitutes for brushes, just as they are now.

In Latin authors we find similar casual references. It is stated that the best Roman brooms were made of palms, others of twigs of different sorts. Plautus (Menœchmi, 1. 1. 1.) has the word *peniculus*, which Festus translates "a small brush for removing dust." A character named *Peniculus*, a parasite, begins a speech :—

"Juventus nomen fecit Peniculo mihi
Ideo quia mensam quando edo detergeo."[‡]

In the same play (2. 3. 40.) the word occurs again. Scopa or scopæ also meant a broom. "Scopas dissolvere," "To undo a broom," *i.e.*, to throw everything into confusion, is a proverb used by Cicero (Or. 71. 235). Plautus, too, uses the word (Stich, 2, 2, 23).

Munditias volo fieri ; efferte huc scopas. [§]

and in the same scene (ll. 27 and 51) again.

Scopula is used for a little broom (Cato, R. R. 26), and in some sort in contradistinction to penicillus in Columella (12. 18) ;—the author is speaking of preparations for vintage—"Deinde penicillo detergitur et ferventissima pice infusa novo alio rutabulo et scopula picatur."[‖]

Pliny appears to be the earliest writer who speaks definitely of a brush made of bristles. He recommends as a remedy for burns (N. H. l. 28. c. 71.) "Setarum . . . . e penicillis tectoriis cinis cum adipe tritus."[¶]

Elsewhere (N. H. l. 33. 7), in speaking of colouring for a wall, he says, "Parieti siccato cera Punica cum oleo liquefacta candens setis inducatur."[**] A similar receipt is given by Vitruvius (Lib. 7. c. 9.), "Ceram Punicam, igni liquefactam, paulo oleo temperatam, parieti seta inducere."[††]

To trace any further the history of such common articles as brooms would be practically impossible. It does not even seem possible to discover the origin of the ordinary wire-drawn brush. Like most articles in daily use, the brush is below the dignity of history.

Turning to painters' brushes, we find that, as far as they can be traced back, they seem to have been of the same construction as at present. Some Chinese artists, even now, use a bamboo with one end split up into filaments, but, according to a passage in Morrison's Chinese Dictionary,[†] hair-pencils were invented by the Chinese about 300 B.C. As Homer speaks of painting upon ships, we may conclude that artists' brushes of some sort were in use in Europe previous to his time, while the paintings in Egypt prove even greater antiquity. Ezekiel (B.C. 600) too (xxiii. 14.), speaks of "men pourtrayed upon the wall, the images of the Chaldeans pourtrayed with vermilion, etc." It is hardly needful to argue that the existence of painting proves the use of the brush. Certain descriptions of wax colours were laid on with the style (*cestrum*, *γραφίς*) made of metal and pointed at one end, but other colours were applied with the hair pencil (*penicillus*, *ὑπογραφίς*). Smith's Dictionary of Antiquities, under the article Pictura, refers to a work of Zahn[‖] in which a Figure of Painting, discovered in the so-called Pantheon at Pompeii, is described. The figure holds in her left hand a palette and brushes. Pliny in his account of painters and painting (Nat. Hist. books xxxiii., xxxiv., and xxxv.) frequently speaks of the brush as a common implement. In relating the story of Protogenes and Apelles (N. H. l. 35. c. 36.) he says, "Arrepto peniculo, lineam ex colore duxit summæ tenuitatis per tabulam."[‡] The word penicillus or peniculus occurs frequently in the books alluded to, and other authors (Quintilian, lib. 2 ; Cicero, Ad Familiares, 9. 22 ; Marcian. Dig. 33., 7, 17.) use it occasionally. Pliny (b. 35., c. 41.) speaks of a method of painting ships, in which the melted wax was laid on with a brush.

A few details have been preserved respecting the brushes used by mediæval artists. Mrs. Merrifield, in her work on the subject,[§] has translated some passages bearing on the subject.

In the Public Library at Brussels there is preserved a MS.,[‖] written in 1635, by Pierre le Brun, a painter, in which a description of various matters connected with the art of painting is given, and many technical terms explained. In the first chapter "De la Platte Peinture," the following passage occurs :—"Les pinceaux sont fait d'un poil doux toutefois qu'il ait une résistance pour se tenir droit et faire une pointe assez ferme pour peindre, les poils d'ouris [ours] y sont tres bons, moustoil, foines et autres semblables ; on se sert aussi de petite bruissette fait de soye de pourceau (ou cochon). L'on a aussi des pinceaux fait de poil de poisson pour adoucir."

This is translated as follows by Mrs. Merrifield :[¶]—"The pencils are made of a soft kind of hair, but which has sufficient resistance to keep itself straight, and to make a firm point for painting ; the hairs of bears are very good, so are those of martens and similar animals. Small brushes made of hog's or pig's bristles are also used, and pencils of fishes' hair[**] for softening."

In two fifteenth-century miniatures, reproduced by Mrs. Merrifield, the artist is represented with a brush apparently resembling those in use at present. In each case also a tray full of brushes is figured by the artist's side.

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[*] "Come now, let some of you make haste and sweep the house."

[†] "O Zeus, whatever dost thou mean to do? Put by the besom, don't sweep Greece clean out."

[‡] "The boys have dubbed me 'Brush,' because I sweep the table clean at all my meals."

[§] "I want the place cleared up, go fetch a broom."

[‖] "Then it [the wine-vat] is brushed out with a broom, and boiling pitch is poured in, and spread over it with a spatula [some smearing instrument is meant by *rutabulum*] and a brush."

[¶] "The ash of bristles from plasterers' brushes ground up with grease."

[**] "Let Punic wax, dissolved in oil, be laid on hot with a brush upon the wall when it is dry." This Punic wax was ordinary yellow wax, purified and bleached.—See Pliny, N.H. l. xxi., c. 49.

[††] "To lay on the wall with the brush a coating of Punic wax melted on the fire, and slightly tempered with oil."

[*] "Dictionary of the Chinese Language." Macao. 1815. Introduction, p. ix.

[†] "Die schonsten Ornamente und merkwürdigsten gemalde aus Pompeii Herkulanum und Stabiœ." Berlin. 1828.

[‡] "Snatching up a brush, he drew across the board with the colour a line of the utmost fineness."

[§] "Original Treatises . . . . on the Arts of Painting." London, 1849.

[‖] No. 15,552. It is quoted *extense* in Mrs. Merrifield, pp. 759 et seq.

[¶] Ibid. p. 770.

[**] Probably seal's fur.

In a MS. preserved in the Library of the University of Padua,[*] entitled, "Ricette per far ogni sorte di colore," is a receipt for boiling hair.

"*Per fare crino bollito belliss*^{mo}.—Si pigla le cume e zuffe, cove di bovi, cavalli, vache, vitelli, ma averti che le cove de' cavalli non sono bone. Si pongono in acqua fresca, e si lava acciò non le resti untume ne sozzure alcune, di poi falle fillare in corda poi si pone in parollo (sic) di liscia, e si fa bollire per 6 hore."

This is translated by Mrs. Merrifield[†]:—"To make excellent boiled hair:—Take the manes, forelocks, and tails of oxen, horses, cows, and calves (but remember that the tails of horses are not good), place them in fresh water, and wash them so that there may not remain any grease or dirt; then string them on a cord, afterwards put them into a vessel with ley, and let them boil for six hours."

This seems to show that painters of that time were obliged to make their brushes for themselves, as, indeed, would be probable enough.

In another part of the same MS.[‡] directions are given for making a brush for "graining" by inserting hogs' bristles into a flat back of wood.

The use of brushes for purposes of the toilet seems to be a comparatively modern invention. Combs are very ancient. They are found of ivory and bone, in barrows, British, Roman, and English. Savage nations used—and use even at the present day—fish-bones for combs. Egyptian and Greek combs have been discovered made of boxwood, and we hear of ivory combs in use among the Romans. Wright[§] tells us how the Danish invaders used to comb their hair daily, to the surprise of the more slovenly English; and elsewhere[||] the same writer gives a picture from a 13th century MS. which represents a lady combing her hair. The author of the metrical history of Jean IV., Duke of Bretagne, has the line—

> "Les Francois estoient bien peignés."[¶]

In the comedies of the Restoration period are many references to the custom practised by beaux, of curling their perukes.

"Combing the peruke, at a time when men of fashion wore large wigs, was even at public places an act of gallantry. The combs for this purpose were of a large size, of ivory and tortoiseshell, curiously chased and ornamented, and were carried in the pockets as constantly as the snuff-box at Court."[**]

Among all such notices it does not appear that any use was made of the hair-brush. Nor is it till we get down to times much more recent that we find this now universal toilet implement ever mentioned. In 1770 Peter Gilchrist wrote a "Treatise on the Hair," in which he gives full directions for hair-dressing of every sort. He speaks frequently of combing it, but never alludes to brushing it. In the same year also a similar work was published by David Ritchie, but he likewise, while giving full directions about combing the hair, does not speak of brushing it. Had hair-brushes been in general use, these two writers would probably have mentioned them. That they were known is made evident by the following extract from Owen's Dictionary of Arts and Sciences, dated 1763, in which it is said that, "Beard-brushes pay a duty, on importation, of 1s. $3\frac{40}{100}$d. the gross or twelve dozen; whereof 1s. $1\frac{1}{2}$d. is drawn back on exporting them. Comb-brushes pay 2s. $6\frac{80}{100}$d. for the same number, and of this 2s. 3d. is repaid. Head-brushes pay 1s. $3\frac{40}{100}$d. the dozen; rubbing-brushes $3\frac{8}{100}$d. the dozen; weavers' brushes $11\frac{55}{100}$d. for the same number, in all of which a proportionable drawback is allowed. However, it is to be observed that brushes are among the number of goods prohibited to be imported." Swift, in a remarkably coarse set of verses called "The Lady's Dressing Room," published (or written) in 1730, mentions among other articles a brush, but one apparently only to be used for cleaning combs.

"Notes and Queries" (1st series, vol. xi., page 299), gives an extract from the "Annual Register" of 1773, which goes to show that hair-dressing was a "pitiful and womanly" employment, "not fit for young men to follow."

Of shaving-brushes we can speak with more definiteness. On October 7th, 1814, a correspondent wrote as follows to the *Gentleman's Magazine*:—"I am old enough to remember when the operation of shaving in this kingdom was almost exclusively performed by the barbers; what I speak of is some threescore years ago, at which time gentlemen shavers were unknown. Expedition was then a prime quality in a barber, who smeared the lather over his customers' faces with his hand, for the delicate refinement of the brush had not been introduced. The lathering of the beard being finished, the operator threw off the lather adhering to his hand by a peculiar jerk of the arm, which caused the joints of the fingers to crack, this being a more expeditious mode of clearing the hand than using a towel for that purpose; and the more audible the crack the higher the shaver stood in his own opinion and in that of his fraternity."

This note was in answer to one alluding to a passage in Stubbe's "Anatomie of Abuses," printed in 1583. The passage refers to the barbers of the reign of Queen Elizabeth, and is quoted as follows in the *Gentleman's Magazine* for September, 1814, p. 207:—"And when they come to washing, oh how gingerly they behave themselves therein. For then shall your mouth be bossed with lather, or some that riseth of the balles (for they have their sweete balles wherewith all they use to washe), your eyes closed must be anointed therewith also. *Then snap go the fingers, ful bravely, God wot*," &c.

Hone, in his "Every-day Book," vol. 1, p. 1,267, refers to these passages, and quotes from Lyly, who speaks of the "knacking of the hands" by a barber; from Green, who describes a barber "that can snap his fingers with dexterity;" and from Ben Jonson, one of whose characters, *Morose* in the "Silent Woman," desires a quiet barber, who "hath not the knack with his shears or his fingers."

Smith, in his "Topography of London,"[*] says:—"The entertaining and venerable Mr. Thomas Batrich, barber, of Drury-lane, informs me that before the year 1756 it was a general custom to lather with the hand; but that the French barbers, much about that time, brought in the brush."

In confirmation of this, it may be added that Randle Holme, who wrote on heraldry in 1688, gives a list of barbers' instruments, in which a shaving brush is not mentioned, though a clothes brush is.

J. Jenning's "Family Cyclopœdia" (1822) speaks of a "stomach-brush" as "a curious instrument, which excited considerable attention about the middle of the last century, but which has never been much used;" "nor can we say a great deal in its favour." No further description is given. The same authority recommends the use of the tooth-brush; "some medical men disapprove of the use of tooth-brushes, whilst others as strongly recommend them." and considers the hair-brush and nail-brush alike useful.

Curiously enough, in many languages the word for a brush and the matter removed by its use are the same.

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[*] Ibid, p. 648.

[†] Ibid, p. 710.

[‡] Ibid, p. 716.

[§] "History of Domestic Manners." London. 1862. p. 60.

[||] Ibid, p. 260.

[¶] "The French were carefully combed." Quoted in Lacroix's "Histoire de la Coiffure, &c." Paris, 1851.

[**] Sir John Hawkins' "History of Music," vol. iv., p. 447, note.

[*] Smith (J. T.) "Topography of London." London: 1810, p. 33.

In old English even the word brush used to signify dust or dirt. Chaucer has:—

> "And ever among, the brush away she pikid
> From her clothes here and there."

The Greek χόρημα means both "refuse" and a "broom." For instances of this in other languages, reference may be made to "Wedgwood's Dictionary of English Etymology." The true derivation of the word is, however, certainly to be connected with "bristle."

INTERNATIONAL TELEGRAPHY.

The following appeared lately in the *Daily News*:—

Sir,—Your article of Saturday last induced me to procure and read Sir James Anderson's pamphlet on the above subject. Perhaps you will allow me to make a few remarks on it in the interest of the public. Sir James writes wholly and avowedly as a representative of the present cable interests, and argues, in the first place, that low tariffs are inconsistent with high dividends to the present companies. In this he is probably right; but when he goes on to claim that government should protect them from competition, and grant them a virtual monopoly in order to keep up a high tariff; or else should purchase their cables at a fancy price, and then give the public the benefit of a low tariff, the justice of what he says is by no means so evident. It would be a generous, and might be a wise policy—wise in the highest sense, for generosity is the highest wisdom—in consideration of what they have effected, to repay them for their expensive lessons in the school of experience, for their mistakes, for the large sums spent by way of promotion money, for the extravagant cost of cables, made not for cash, but in exchange for shares of a doubtful value—it might be wise to do this in order to get rid of the incubus of the present interests; but that he should venture to advocate a prohibition of competition and a monopoly in their favour, is startling, and I do not think wise on his part. Now a few words on the scientific part of the question. Sir James Anderson denounces the laying of mere cores, or cores lightly protected, and advocates cables, if anything, stronger, heavier, and more expensive than the present ones. That it would be an advantage, *cæteris paribus*, that the cables should be stronger there is no doubt; greater absolute weight might also be an advantage, if ships could be found large enough to carry them; greater specific weight would probably be a disadvantage; but it by no means follows that they should be more expensive; on the contrary, they may well be very much less expensive. The core of copper and gutta-percha is an element at once of weakness and of high cost, and a long and costly series of experiments has proved that this core may be dispensed with altogether; or even if not altogether discarded, may be rendered effective for a small fraction of the present expense. I have no hesitation in saying that cables equally effective might be laid at from one-half to one-quarter of what the present lines have cost. Nothing can better prove the mischief of a high tariff than Sir James Anderson's own statement, that the present costly messages are almost wholly commercial or political, and that the cables are seldom used for domestic or personal communication. When we consider how many Englishmen have dear friends and relatives in the colonies and in foreign countries who cannot get an answer to a letter for weeks or months, what statement could be more damnatory than that the present tariff, and all tariffs hitherto tried, are too high for such a use? Surely the private interests of shareholders to the amount of ten or twelve millions of money ought not to be allowed to prevail against the great claims of civilisation and humanity, nor should the deterring influence of an association of capitalists be able to bar the way against the progress of science.—I am, &c.,
Electricus.

CORRESPONDENCE.

TECHNICAL EDUCATION.

Sir,—In my remarks during the discussion on "Technical Education," I perceive, from the report, that I was misunderstood on a few points. It was not to "Gothenburg," a town in Sweden, but to Wurtemburg, a kingdom in Southern Germany, that I alluded; and the "Polytechnische Schule" in Stuttgart forms the centre of technical education of Wurtemberg only, not of Germany.

For the insertion of these corrections in the next number of the *Journal* I shall feel greatly obliged.—I am, &c.,
G. C. Mast.

Belgrave College, 148, Buckingham Palace-road, S.W.,
December 2nd, 1872.

Sir,—Permit me to add a few words with reference to Mr. Webster's excellent paper on Technical Education, on behalf of primary schools, especially those in rural districts. One of the greatest difficulties in them is to get children in any way to associate their school teaching with what they see around them and have to do in their daily work; there is no real life in it. It is the same with their elders. Learning is "great medicine," sometimes despised and sometimes held in awe, but seldom rationally appreciated. There can hardly be a better or more direct remedy for this than some suitable branch of "applied" teaching. The Education Department give a capitation grant for two "extra subjects," and one of these might well be some technical matter taught in that scientific manner which Mr. Webster so well advocates, rather than the crudities which so often pass for a scientific subject. But the work must be begun with the teachers, and what I would specially urge, therefore, is the action of the Society with and upon the training colleges. Moreover, technical education, properly given, besides affording the readiest means of conveying some practical ideas of scientific method, both to the teachers and to the taught, should further help to bridge over the great gulf that there now often is between the teachers and the shrewd but illiterate people who, in the remoter districts especially, must often be their only neighbours, and should be their chief support. The latter know little or nothing of books, and can only understand a subject the concrete; the former know nothing but from books, and so abstract it from all its surroundings as to render any "practical" conclusions impossible. Teachers and their country neighbours are thus often as oil and water. Well chosen technical matters should afford common ground for the beginnings of an intercourse which could not fail to be of the greatest advantage in every way to education, and in this, as in many other cases, it is the first step which costs most.—I am, &c.,
Rowland Hamilton.

CHANNEL PASSAGE.

Sir,—I have read Mr. Mackie's letter in the *Journal* of November 29th. Will you kindly allow me to reply to it?

I will pass by his personalities and remarks as to dissimilarity and the value of my drawings, now in the Polytechnic, and apply myself to what he terms hard and tangible facts, and not to imaginative data.

I may say I have spent fifteen years in endeavouring to put—so he calls it—a real good thing before the public, and not a "mare's nest."

The following facts may be relied upon, and can be authenticated:—

In 1854 I designed my first treble boat, with two tunnels and four paddles, as shown by Mr. Mackie in the *Graphic*, and in 1862 put my ideas into practice by purchasing of Simmons, of Putney, a boat (30 ft. long by 2 ft. wide) having a flat floor and flat sides; on to this I joined two hulls, one on either side, with the paddles between, in the tunnels.

This boat was tried on the Thames, in the presence of some friends, and the result was I was cordially laughed at for my want of success. I next tried the four-wheel boat, with one hull only, discarding the outer hulls and channels, this time at Kingston, not wishing to risk Putney again. Push, the boat-builder, assisted at the experiment; again no success. The reason was obvious; the front paddle-wheel churned up the water, the after one revolved in the water as churned; the consequence was, one paddle dragged the other and the boat as well.

Since that time I have devoted myself to twin boats, first in theory, and in 1867, 1868, 1869, and 1870 by exhibiting, in various places, the model of the vessel I am now advocating.

During the last two years I have built and engined, at my own heavy cost, a twin boat, 50 ft. by 18 ft., which will be shortly ready.

Before putting in the engines I subjected her to very rough usage, besides floating her with one hull full of water and the other empty; in this way she is quite safe, by anchoring one hull down to the shore with screw tackle, so as to leave the other to lift with the tide, under which circumstances no strain has occurred. Further, during the gales we have had the last fortnight, she has been lying opposed to the full fury of the south-west wind and tides, and has ridden them out easily, when it was impossible to stand on a steamer of similar tonnage lying alongside. All as stated herein can be vouched for by many. I think I may now say, with Mr. Mackie, that I have worked sincerely for public appreciation, at no small cost to myself of time and money, and in associating myself with Captain Dicey I feel I have done right for the public and myself also.

Treble and twin boats are not new; of these boats the most notable example of failure is that of the *Gemini*, which ran on the Thames, from London to Gravesend, about 18 years ago. This boat failed because the hulls were too close together, the paddle-wheel in the centre, and there was no cabin accommodation. Since that time twin boats have been in use on the Clyde, New York, the Mississippi, Rhine, and elsewhere, with varying success or failure. And lastly, there was the beautiful *Swan of the Exe*, an excessively lively example, which rolled about in such a manner that sometimes she forgot herself, and actually, at last, lost her head. I will conclude by saying that I still adhere to the last paragraph in my first letter to you, in which I state that Captain Dicey and myself will carry out the experiment, which we trust will attract public attention; also, that I wish Mr. Mackie a good success with his new model.

I am, Sir,
Your obedient servant,
A. Sedley.

92, New Bond-street, 2nd December, 1872.

TELEGRAPHIC EXPERIMENTS.

Sir,—The following experiment may interest your readers:—On November 4th the cable from Dover to Boulogne was broken by a ship's anchor, about five miles from Dover. By the kind permission and co-operation of Mr. Bourdeaux, the engineer of the Submarine Telegraph Company, I placed my instrument, as shown lately before the Society of Arts, between the end of the broken cable at Dover and the water-pipes of the town. To our surprise we could distinctly read every message to and from Ostend, Calais, and Dover, on the Dover-Ostend and Dover-Calais cables. The explanation was as follows:—Part of the electrical current which went to earth at the Dover water-pipes, went on to a second earth formed by the end of the broken cable, and in its passage made signals on the instrument. Thus, the enormous fault formed by the Dover water-pipes was not sufficient to prevent a susceptible current of electricity passing on to the broken end of the Dover and Boulogne cable.

We also asked the French operator at Boulogne to send a current through the broken cable, and got a feeble result; but as we were not able, without special authorisation from the French government, to get him to put on such batteries and instruments at Boulogne as were necessary, and the remaining cables were fully occupied with messages, we did not follow out this portion of the experiment. The first experiment, however, shows what an enormous fault may exist without preventing the action of the delicate instrument which was described in a former number of your *Journal*.—I am, &c.,

H. Highton.

Putney, Nov. 13th, 1872.

SUBTERRANEAN HYDROLOGY.

Sir,—The subject of subterranean hydrology, alluded to by Mr. Leon Jourd'hui, in his letter to the *Journal* is certainly one of great importance, and one that has met with but little attention. The thanks of all hydraulic engineers would certainly be due to your correspondent, if he could help to throw a light upon this hitherto dark subject; and I would venture to suggest to him the advisability of reading a paper, giving a brief outline of the investigations of Paramelli and others, and the practical results that have been obtained in this branch of science.

There is, perhaps, no country in the world where the subterranean waters are utilised on so large a scale as in Northern Italy; and the rich plains of Lombardy owe a great deal of their fertility to the *fontanelli*, or springs, which are especially prized for the irrigation of the *marcite*, or winter meadows, from the great stimulating effect of the water on vegetation, due to its high temperature. The importance of this sort of irrigation speaks for itself when it is stated that the volume of water supplied by *fontanelli* in Northern Italy is estimated at 3,000 cubic feet per second, of which the value in money in round numbers would amount to not less than a million sterling. The search for water in Italy is a matter of mere chance, although it is met with, more or less abundantly, at a short distance below the surface of the earth. But the certainty of finding abundant springs anywhere is not the case; and, although the existence of springs is said to be indicated by certain signs, such as dampness of the soil, or a mist resting on certain spots at night and morning, it is often the case that the excavations for a fountain-head have to be abandoned, and a search has to be made elsewhere, either from water not being found sufficiently near the surface to be available for irrigation, or from the springs being too small to insure an adequate return for the expense to be incurred for making the necessary channel to lead the water into the land.

It would occupy too much space to give particulars as to the formation of *fontanelli* in Italy, and I must refer those interested in this subject to the late Captain Baird Smith's report upon "Italian Irrigation," where a good account of these springs may be found.

If it were possible to ascertain, with any degree of certainty, the position of hidden subterranean streams of water, it may readily be imagined the immense value that such a knowledge would be, not only in Italy but in many other countries, such as Australia, Africa, and Spain, where large tracts of land are literally parched up during the summer months from scarcity of water.

I consider it to be the duty of those who possess such knowledge to make public the result of their researches for the benefit, not only of themselves, but also for all mankind.—I am, &c.,

P. Le Neve Foster, Jun., C.E.

Mortara, Lomellina, Italy.

ARTIFICIAL FUEL.

Sir,—With reference to the letter of "Anglo-Italian," in the last number of the *Journal*, describing a method adopted in Italian tan-yards for utilising the spent-bark or tan as fuel, permit me to point out that upwards of fifty years ago the same process was common in English tan-yards, and, for aught I know, may prevail still. I recollect well seeing the tan thus made into balls by hand, and dried in racks, in the tan-yard of a relative, who, I may add, used no other fuel than this in his kitchen, except, perhaps, at times adding a log of wood. This fire was made on the hearth without any grate, and it answered admirably for both warming and for cooking. Better dinners than used to to be served at my relative's table could not be desired. If I recollect right, the fuel was also sold to the people of the village at a low price.—I am, &c., A Sexagenarian.

NEW ZEALAND FLAX.

Sir,—In the *Journal* of the Society, of the 22nd of November, I have seen the address which was so ably delivered at the first ordinary meeting, on Wednesday, the 20th inst. The benefits the Society have conferred, by the means adopted for bringing to public notice subjects, which would otherwise have failed to attract attention, are therein fully set forth; and the progress made in assisting the food supply by the introduction of Australian meat, Indian meal, bread, &c., fully show how desirous the Society is at all times to develop any industry calculated to prove of ultimate benefit. It touches lightly upon plans adopted for the promotion of the cotton culture and silk supply, and then states:—"The subject of fibres is of great importance, in reference to the supply of raw material for various manufactures, and the Council will continue to give to it the same active attention as during late years, and they trust the efforts they have made in Turkey will lead to practical results."

I would venture to draw your attention to the fibre now being produced in large quantities from the plant *Phormium tenax*, in our colony of New Zealand. For many years past this fibre has been known as a fibre, when properly prepared, adapted for making very strong rope; it is only, however, within the past four years that it has been an article of regular importation into this country. I notice in the *Journal* that works referring to *Phormium tenax* have been presented to your library; and I think your Society would greatly benefit this important branch of industry in one of our far-off colonies, if you would cause notice of the progress therein recorded to be extracted from these works, so that our manufacturers may learn that a fibre which, less than two years ago, was considered perfectly useless for any textile fabric, is now in a fair way to prove of very great value, not only for making the coarse material fitted for colonial use, such as wool-packs, corn-sacks, &c., but, when used as a mixture, will greatly improve and strengthen fabrics similar to those which have hitherto been composed of ordinary flax and Russian hemp. Your *Journal* published a letter from me on the uses of the *Phormium* fibre, on the 2nd August. Since that date Mr. A. K. Forbes, of Hatton Mill, Arbroath, has manufactured further fabrics from the "native dressed" fibre, for Dr. J. G. Featherston, the agent-general for New Zealand, and from fibre prepared by myself. On page 19 of "The Report of the Commissioners Appointed to Inquire into the Preparation of the *Phormium* Fibre," you will find that, so late as 13th June, 1871, one of our leading Dundee manufacturers gave it as his opinion, that this fibre "is not suitable for fine fabrics of cloth, and for common purposes it would have to compete with jute, which is much more easy to manipulate." Mr. Forbes has now worked up a very large quantity of the fibre, and from his practical experience, he having gone beyond the stage of experiments, gives it as his opinion, that if cloth were made in New Zealand from the *Phormium* fibre, it would entirely supersede jute for consumption on the spot, though here in England it could never compete with it. When the works on the *Phormium* fibre, now in your library, have been carefully perused, I think it will be admitted that there is every prospect of this fibre eventually becoming of great service to our manufacturers; although no doubt the prejudices and antipathy which they, as a body, always exhibit against the introduction of any fibre which is new to them, and therefore requires more care and attention at their hands, and occasionally a slight alteration of machinery, will prevent that rapid development of its uses, to which its merits must lead in a few years, in spite of any adverse opinions which may be offered.—I am, &c., C. Thorne.

16, Mark lane, E.C., London,
November 23rd, 1872.

STORING POTATOES.

Sir,—Will you kindly permit me, through the *Journal*, to say a few words on the subject of storing potatoes for winter use? The plan that I have adopted, with invariable success, during the last eight years, has been, to sprinkle the floor where I intended keeping them with fine, unslaked lime, over which I spread a layer of potatoes, four or five inches in depth; I then sprinkled again with lime, and added another layer of potatoes the same depth as before, and thus continued till the whole were disposed of. The lime I use is about one-fortieth part by measure of the potatoes.

I have found that potatoes thus treated have never become infected with disease, and where disease was already existing it has not spread; besides which, the quality of the potatoes has been rather improved than otherwise by the treatment, especially where they were watery or waxy. At a time of scarcity like the present, every precaution ought to be used by which such a valuable article of diet may be preserved from decay.—I am, &c., J. Boyes.

Shrewsbury, Nov. 21st, 1872.

DEAF AND DUMB INSTRUCTION.

Sir,—I wrote to the *Journal* in August, 1871, calling the attention of the Society of Arts to the oral instruction of the deaf and dumb, and since then several letters on the subject have appeared in its pages, and a paper has been read, followed by an animated discussion.

The association which was formed for the purpose of furthering the general adoption of this method of instructing deaf mutes, has in the meantime commenced active operations, and during the past summer a day school has been opened at 12, Fitzroy-square. The progress made by the pupils, even in the short time they have been there, is very great, and I trust that those of your readers who feel interested in the subject will pay it a visit, so that they may judge for themselves, and, at a subsequent period, see what progress shall have been made by individual pupils. The school is open for public inspection every Wednesday afternoon, and affords an opportunity for everyone to judge of its merits by a personal inspection, an opportunity which I hope will be taken by many of your readers and their friends.—I am, &c., Lionel Van Oven.

34, York-terrace, Regent's-park, November 26th, 1872.

We have received from Messrs. Cassell a complete set of their *Technical Educator*. In it is comprised a vast variety of information on subjects the most dissimilar, information, indeed, which it would be difficult to light upon in any other work of which we are aware.

OBITUARY.

Sir Donald McLeod.—The recent fatal accident to Sir Daniel McLeod is too fresh in public memory for it to be necessary for us to do more than mention that in its victim we lost one of our members, and an active member of the Society's Indian Committee. Sir Donald was a son of the late General McLeod, of the Bengal Engineers, and a grandson of Donald McLeod, of Gearies, Ross-shire. He was born in 1810, and, after receiving his education at Edinburgh and at Haileybury, entered the Bengal Civil Service in 1828. In 1843 he became magistrate and collector at Benares, and Financial Commissioner of the Punjaub in 1854. He was at Lahore during the greater part of the Indian Mutiny, and held the Lieutenant-Governorship of the Punjaub from 1865 down to 1870. He was nominated a Companion of the Order of the Bath (Civil Division) in 1860, and a Knight of the Order of the Star of India on the reconstruction of the Order, in 1866. He became a member of the Society in the beginning of the present year.

GENERAL NOTES.

Preserved Raw Meat.—The first consignment of fresh meat in joints from abroad was safely received in London during the past week. The meat was shipped at Marseilles on the 12th instant. Yesterday a lunch took place at the Cannon-street Hotel, in order to test the condition of the meat. As the great difficulty has hitherto been to obtain the meat uncooked, the experiment should go far to settle the question.

Coal in Italy.—The high price of fuel in England seems to have given an additional impetus to coal-mining in Italy. A company has just been formed for the purpose of working the carboniferous formation in the vicinity of Iglesias, in the island of Sardinia, over an area of about 5,900 acres.

The People's Library at Liege and Antwerp.—The People's Library at Liege contains at present 6,511 books, or 12,831 volumes, all of them bound. Since 1869 the library has been increased by 2,144 works, comprised in 4,958 volumes. The Municipal Council allows the institution a grant of 700 francs annually, and the number of students at home (exclusive of readers in the building) has amounted to 8,153 men and 1,064 women. At Antwerp, we learn, the number of readers at the People's Library has increased by 139, forming a total of 922. These readers may be classed as follows:—From 10 to 16 years, 256; from 17 to 25 years, 390; from 26 to 35 years, 158; from 36 to 50 years, 177; and over 50 years, 41. As regards sex—825 men and 97 women. According to their occupations—145 students at schools and colleges, 90 clerks, 550 artisans, 17 soldiers, &c. The receipts and expenses almost balance each other, and are under 1,000 francs.

Railway Statistics in Italy.—The Alta Italia Railway Company has 648 locomotive engines at work on their lines, and 48 in construction. The number of passenger carriages owned by this company is 1,799, and 194 more building. The goods waggons made for the present traffic are 9,732 in number, and 33 more are building, together with 10 goods engines. The Southern Railway Company owns 186 engines, 679 passenger-carriages, and 2,338 goods waggons; and their rolling stock will shortly be increased by 29 engines, six passenger-carriages, and 340 goods waggons now building. The total length of line at present opened in Italy is 6,393 kilometres, and the traffic is worked by 1,085 locomotives, 3,643 passenger carriages, and 15,833 goods waggons. The rolling stock now in course of construction is 87 engines, 200 passenger-carriages, and 2,055 goods waggons.

Railways in Turkey.—The *Levant Herald* states that the Turkish government have given orders for the surveys of the proposed line of railway from Tripoli, on the Syrian coast, to Bagdad, to be made at once, and two engineers have been sent to the former place to commence operations. The line would be about 550 miles in length. At Bagdad it is intended that it should join the Persian Gulf Railway, as originally designed, and thus connect the Gulf with the Mediterranean. This is a step in the right direction, and it is to be trusted that a larger staff of engineers will be sent without delay, and that no time will be lost in completing the missing link in the direct railway route to India.

Ostriches.—The Buenos Ayres papers urge the local government to take strenuous measures to stop the killing of ostriches (*Rhea Americana*). The extensive slaughter of these birds, now going on, may be judged from the fact that in the month of August 9,200lbs. of American ostrich feathers (which enter into commerce in Europe as vulture feathers) were exported from Buenos Ayres, including 7,200lbs. from the Bunda Oriental. The Jesuits of Paraguay, according to Sr. Ojeda, had 1,000 tame ostriches, which used to come every day at the twelve o'clock bell to get corn. Dr. Vavasour had a flock of tame ostriches at Pichinango, which used to go out in the fields and return every night to sleep in the farm buildings. Dona Nicanora Castriz had some which would come and lay their eggs in her lap, hatching them in her bedroom. Ostriches are now very rare in Paraguay or Corientes, but more numerous in Entre Rios, Banda Oriental, and Buenos Ayres. A prize of £60 sterling is offered by the Uruguay Rural Society to the person that can show in 1874 the largest number of tame ostriches. As the African ostrich has been successfully domesticated and reared for its feathers in both North and South Africa, there is no reason why attention should not be given to the American ostrich for the feathers, which are in much request.

Vareck, or Sea Wrack.—This sea-weed, which is used for stuffing mattresses in France, and presents the great advantage of not harbouring insects, and which is burned for the sake of the soda and iodine which it contains, is found on the Brittany and other coasts in considerable quantities; but attention is now being drawn in France to the enormous quantities of the weed to be found in the neighbourhood of the Gulf Stream, where it forms what looks almost like an immense prairie in the midst of the ocean. This sea of varech, or *sargasso*, as the Portuguese call it, covers a space nearly equal to the whole area of France. The weed itself is the *fucus natans* of botanists, a plant without roots, which floats in the direction of the waves and currents. Soundings, taken in this sea in the years 1851-2, show depths varying from 2,600 to 7,000 metres. M. Leps, a captain in the French navy, who has carefully studied the subject, is of opinion that this vareck, or goemon, as it is also called, might be utilized for agricultural and industrial purposes more readily than that which is found on the coasts of Europe, and he suggests that it might either be brought home in compressed bundles, or that vessels might carry the necessary apparatus to burn it on the spot, and bring home only the soda and iodine which it contains. He argues that this would be a lucrative occupation; for iodine, which is now obtained only from the weed thrown on our coasts by the sea, is dear, and promises to be still dearer, on account of its employment in the production of a green pigment. It is said to be contained in such small quantities in sea-water that thirty millions of pounds of the latter only gives one pound of iodine. The idea of utilising this huge sea of vareck certainly deserves the consideration of practical men.

The centenary of Linnæus's death will be celebrated at Stockholm on the 10th of January, 1873, when a statue of the great Swedish naturalist will be unveiled. He died at Upsala (in the university of which city he was for many years Professor of Botany), in the sixty-eighth year of his age.

We learn from the *Mechanics' Magazine* that a portion of the New York Central Park has been selected for the location of memorials to the inventors of all nations. One of these memorials is to be erected to Elias Howe, "The Inventor of the Sewing Machine."

NOTICES.

EXAMINATIONS, 1873.

The attention of candidates is drawn to an error in paragraph 55 of the Programme. After the words "accidence," the words "and in passages" should be inserted.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

THE LIBRARY.

The following works have been presented to the Library:—

Jahresberichte der Handels, und Gewesbekammern in Württemberg für das Jahr, 1871.

Annual Report of the Vigilance Association.

The present position of Science in relation to the British Government. By G. Gore, F.R.S. Presented by the author.

Scientific Education. By G. Gore, F.R.S. Presented by the author.

Scientific Instruction, its Aims and Methods. By G. Gore, F.R.S. Presented by the author.

The Further Extension of Birmingham Industries. By G. Gore, F.R.S.

Proceedings of the Royal Geographical Society. Nos. 3 and 4 of vol. 16. Presented by the Society.

The following Report has been purchased for the Library:—

Eighteenth Report of the Postmaster-General on the Post-office.

ORDINARY MEETINGS.

The following are the dates of the Wednesday evening meetings, the chair being taken at eight o'clock:—

1872.	December......	—	11	18	—	
1873.	January	—	—	15	22	29
,,	February	5	12	19	26	
,,	March	5	12	19	26	
,,	April	2	—	16	23	30
,,	May	7	14	21	28	

For the meetings previous to Christmas, the following arrangements have been made:—

December 11.—"On Galvanic Batteries." By the Rev. H. Highton.

December 18.—"On Russia, her Industries, Commerce, and Means of Communication." By Leone Levi, Esq., Professor of Mercantile Law, King's College, London, and one of the Deputies to the International Statistical Congress at St. Petersburg.

INDIAN MEETING.

On Friday, the 13th instant, at 8 o'clock, Capt. Lyon will exhibit his Photographic Transparencies, illustrative of Indian Architecture, Idols, and Every-day Life.

CANTOR LECTURES.

The first course of Cantor Lectures for the ensuing Session will be on "The Practical Applications of Optics to the Arts, Manufactures, and to Medicine," by C. Meymott Tidy, M.B., Joint Lecturer on Chemistry, and Professor of Medical Jurisprudence at the London Hospital, and will consist of five Lectures, to be delivered on the following evenings, at eight o'clock:—

Lecture III.—Monday, December 9th, 1872.

Applications of Optics in the Arts, illustrated in the Science of Photography.

Lecture IV.—Monday, December 16th, 1872.

Polarised Light, and its Practical Applications.

Lecture V.—Monday, December 23rd, 1872.

Spectrum Analysis as Applied to Manufactures, illustrated in the Bessemer process, and to Medicine in the Detection of Blood.

MEETINGS FOR THE ENSUING WEEK.

Mon.....**SOCIETY OF ARTS, 8** Cantor Lecture. Dr. Tidy, "On Practical Applications of Optics to the Arts, Manufactures, and to Medicine."
Institute of Surveyors, 8. Mr. W. Sturge, "Statistical Notes on the Prices of Agricultural Produce, Labour, and Rent, from the early part of last century to the present time, with Remarks on the Present Aspect of the Labour Question."
Farmers' Club, $8\frac{1}{2}$. Mr. H. M. Jenkins, "Some Comparative Results of Large and Small Farm Systems in providing Food for the People."
Royal Geographical, $8\frac{1}{2}$. 1. Mr. R. Crawford, "On a projected Railway Route over the Andes, from the Argentine Republic." 2. Capt. Lindesay Brine, "Guatemala and Yucatan, and their Ruined Cities."
Medical, 8.

Tues....London Institution, 4. Prof. Rutherford, "The Nutrition of the Body."
Royal Medical and Chirurgical, $8\frac{1}{2}$.
Civil Engineers, 8. 1. Renewed Discussion on "The Aba-el-Wakf Sugar Factory." 2. Colonel W. H. Greathed, "An Account of the Practice and Results of Irrigation in Northern India."
Photographic, 8.

Wed....**SOCIETY OF ARTS 8.** Rev. H. Highton, "On Galvanic Batteries."
Graphic, 8.
Royal Literary Fund, 3.
Royal Society of Literature, $4\frac{1}{4}$.
Archæological Association, 8.

Thurs...Royal, $8\frac{1}{2}$.
Antiquaries, $8\frac{1}{2}$.
Royal Society Club, 6.
Mathematical, 8.

Fri......**SOCIETY OF ARTS, 8.** An Exhibition of Photographic Transparencies, illustrative of Indian Architecture, Idols, and Every-day Life, by Captain Lyon.
Architectural Association, $7\frac{1}{2}$. Mr. C. Baily, "History, Illustrated by Stained Glass, and Exemplified in the Windows of Long Melford Church, Suffolk."
Astronomical, 8.
Quekett Club, 8.

Sat......Royal Botanic, $3\frac{3}{4}$.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,047. Vol. XXI.

FRIDAY, DECEMBER 13, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ECONOMIC USE OF COAL FOR DOMESTIC PURPOSES.

With reference to the sum of £500 placed at the disposal of the Council through Sir William Bodkin, by a gentleman who does not wish his name to appear, for promoting, by means of prizes or otherwise, economy in the use of coal for domestic purposes, the Council have decided to offer the following prizes :—

1. For a new and improved system of grate suitable to existing chimneys as generally constructed, which shall, with the least amount of coal, answer best for warming and ventilating a room.—*The Society's Gold Medal and Fifty Pounds.*

2. For a new and improved system of grate, suitable to existing chimneys as generally constructed, which shall with the least amount of coal, best answer for cooking food, combined with warming and ventilating the room.—*The Society's Gold Medal and Fifty Pounds.*

3. For the best new and improved system of apparatus which shall, by means of gas, most efficiently and economically warm and ventilate a room.—*The Society's Gold Medal and Fifty Pounds.*

4. For the best new and improved system of apparatus which shall, by means of gas, be best adapted for cooking, combined with warming and ventilating the room.—*The Society's Gold Meda and Fifty Pounds.*

5. For any new and improved system or arrangement not included in the foregoing, which shall efficiently and economically meet domestic requirements.—*The Society's Gold Medal and Fifty Pounds.*

The Council reserve to themselves the right of withholding all or any of the above prizes, as the judges appointed by them may determine.

The competing articles must be delivered not later than the 1st of December, 1873, with a view to their being tested, and subsequently shown in the London International Exhibition of 1874.

Further particulars as to place of delivery and other arrangements will be published as soon as they are finally settled.

PRIZE FOR STEEL.

The Council have resolved to offer the Society's Gold Medal to that manufacturer who shall produce and send to the London International Exhibition of 1873 the best specimens of steel, suitable for affording increased security in the construction of locomotive and marine engines and boilers, and for other engineering purposes.

The conditions of the competition and further particulars will be published subsequently.

TECHNICAL EXAMINATIONS.

The Programme of Examinations in the technology of the Arts and Manufactures of the country, in reference to which notices have already appeared in the *Journal*, is now ready for issue. These examinations will be held annually, in conjunction with the examinations of the Science and Art Department, and due notice will be given of the particular subjects selected each year.

The 1873 Examinations will be held in the technology of Cotton, Paper, Steel, Silk, and Carriage-building. Candidates, in order to obtain certificates in any of these subjects, must pass the examinations of the Science and Art Department in certain sciences, which are specified in the programme as bearing upon the particular art or manufacture. In addition to these, special papers will be set in the technology of each manufacture, by examiners appointed by the Society of Arts.

The examinations of the Science and Art Department will be held during the first three weeks of May, the technological paper being worked on the evening of the 14th May. The dates of the Science subjects are given in the Science Directory, published by the Science and Art Department.

In order that these Examinations may really be successful in promoting technical education in this country, it is desirable that encouragement should be given to candidates by the offer of prizes and scholarships. With this object the Council appeal to the trade guilds of the city of London, to merchants and manufacturers, and to members of the Society generally, to aid them by contributing to the prize fund.

IMPROVED CABS.

The term of "three months' regular use in the streets," hitherto put forth as a condition of this competition, has been reduced to "one month."

PROCEEDINGS OF THE SOCIETY.

FOURTH ORDINARY MEETING.

Wednesday, December 11th, 1872, Lieut.-Col. A. Strange, R.A., F.S.A., Member of Council, in the chair.

The following Candidates were proposed for election as Members of the Society:—

Bell, George William, 114, Chancery-lane, W.C.
Carillon, John Wilson, Wormhill, Buxton, Derbyshire.
Corner, William Mead, F.R.G.S., 104, Leadenhall-street. E.C.
Dewes, William Petitt, Ashby-de-la-Zouch.
Eliot, Major-General John, Limpsfield, Surrey.
Goodenough, Capt. James, R.N., United Service Club, S.W.
Harper, William H., jun., Protestant Grammar School, New Shoreham, Sussex.
Kirton, John W. 73 Belgrave-road, Birmingham.
Muir, Edwin, C.E., Canal Wharf, Rochdale.
Neal, John, 44, 46, and 48, Edgware-road, W.
Raiser, L., 5, Hereford-square, South Kensington, W.
Russell, Thomas, Saracen Foundry, Glasgow.
Sanford, Percival, 8, College-gardens, Dulwich, S.E.
Yates, Richard, 80, Falmouth-road, New Kent-road S.E.

The following candidates were balloted for and duly elected members of this Society.

Allison, F. F., 127, Leighton-road, N.W.
Baker, George C., 24, Offerton-road, Clapham, S.W.
Bodkin, Frederick Edwin, Merton-lane, Highgate, N.
Browell, Capt. Langton, R.N., J.P., Freshfield, Millbrook, near Southampton.
Carrington, John Bodman, 13, Regent-street, S.W.
Clement, Robert Pardy, Brighton-villa, Prospect-hall, Walthamstow, E.
Cocks, Stroud Lincoln, 58, Harold-house, Finchley-road, N.W.
Couch, Arthur, 172, Wapping High-street, E.
Greenhough, D. W., 1, Suffolk-villa, Breakspeare's-road, Upper Lewisham, S.E.
Halstead, Henry Richard, 3, Rose Bank, Manningham, Bradford.
Head, John, The Orwell Works, Ipswich.
Johnson, Frederick J., Lincoln-house, Broad-green, Croydon.
Jones, David, 27, Mincing-lane, E.C.
Kennedy, Lieut.-Col., J.P., Bombay and Baroda Railway Company, 45, Finsbury-circus, E.C.
Lord, David Lintott, 29, Somerleyton-road, East Brixton, S.W.
Ogle, Richard, Broad Oak-park, Worsley, near Manchester, and 2 Pall-mall, Manchester.
Sarson, Henry, 71, New North-road, N.
Saunders, John, Armley-house, High-street, Bromley, Middlesex.
Sefton, David Heywood, Land Mortgage Bank of India, 17, Change-alley, Cornhill, E.C.
Tayler, Henry, 44, Finsbury-circus, E.C.
Triggs, Reuben, 18, Clarewood-terrace, East Brixton, S.W.
Whitaker, John, Hill-side, Primrose-hill-road, N.W.

The Paper read was—

GALVANIC BATTERIES.

By the Rev. H. Highton, M.A.

I shall not attempt to give any ultimate explanation of the phenomena of galvanism. It appears to me that it is true wisdom in science not to attempt to do more than to give an intelligent and comprehensive classification of the phenomena themselves. Deeper theories may sometimes be useful in suggesting experiments, if it be borne in mind that those theories must always be doubtful, and mere matters of guess, and, at best, simply provisionary. Thus Maxwell has shown that the laws of hydraulics may be applied to electrical currents, though he cautiously and wisely guards us against supposing that it follows from this that there is any real electric fluid similar to ordinary fluids. It would have been well if other well-known scientific men had been content to follow his example. In the same way I should object to the assumption of any ultimate theory of galvanism, beyond the mere intelligent and classified expression of the laws of the phenomena.

In the kindred subject of heat, I think great injury has been done by asserting that it is "a mode of motion," which has introduced many wild and visionary ideas. If the word "motion" be meant simply as a translation of the Greek word *κίνησις*, which includes nearly all kinds of change, and it also be meant that a change of temperature is a mode of motion in the ordinary English sense of the word, the assertion is, in a certain sense, true, but deceptive; if it be meant that simple heat, without change of temperature, is motion of any kind, this is not only extremely doubtful, but, I believe, absolutely untrue.* With regard to galvanism, then, I would merely say that it would appear that wherever there is a chemical there is also a galvanic action, which only requires proper arrangements to be made for exhibiting it.

Perhaps the simplest method of producing a galvanic current is by the formation or decomposition of water. Thus, if we have two plates of platinum, the surface of one of which is covered with a film of hydrogen, and the other with oxygen, on making a metallic connection between the two, a galvanic current passes, and the hydrogen and oxygen unite and form water. Conversely, if we take two metals, one of which has a greater affinity for oxygen than the other, and place them in water, then, on metallically connecting them, the water is separated into oxygen and hydrogen, the oxygen uniting with the more oxidizable metal, and the hydrogen being evolved on the surface of the other metal, and a galvanic current flows. I will show you both these actions by actual experiment. In both cases one pole of the battery is said to become positive and the other negative, and the action passing between the two is commonly called a galvanic current.

Take, again, the simplest of all forms of a galvanic battery—zinc and carbon, with a dialyte, as it is called, of dilute sulphuric acid between them; the oxygen of the water unites with the zinc, and forms oxide of zinc; the sulphuric acid unites with the oxide, and forms a sulphate of zinc, and the hydrogen is evolved on the surface of the carbon. This double chemical action gives rather more electricity than the single action, as you see.

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* Aristotle, in his "Physics," suggests an important principle which might with advantage be studied by our modern theorists on the subject of heat. He says ("Physics" V., 1. 5.) 'Αλλ' 'ίσως οὐχ ἡ λευκότης κίνησις ἀλλὰ ἡ λεύκανσις. That is, "But perhaps whiteness is not a mode of motion, but whitening is;" so by analogy heat and cold are not modes of motion, but heating and cooling are so—that is in the Aristotelian sense of the word.

Now, it is a well-known fact that chemical combinations frequently produce heat, and it is also a well-known fact that an electrical current in passing through a homogeneous conductor also produces heat; and it is an exceedingly interesting problem to ascertain what relation the heat of the chemical combination bears to the heat produced in the conductor of the current. An investigation of this kind requires the most delicate and expensive apparatus, much more delicate and expensive than I possess; but in searching into the records of the most trustworthy experimenters on this point, and comparing the results obtained by them, I have arrived at the following conclusions:—

1. That, in all cases of galvanic action, the heat evolved in the battery, plus that in the exterior circuit, is exactly equal to the heat produced by the chemical action.

2. That, in most cases, a certain portion of that heat is retained exclusively in the battery, besides what is due to the internal resistance of the battery, and is not transmitted through the circuit.

3. That the potential of the battery varies, not only with the total chemical heat produced, but also with the proportion which that part of the heat which is transmitted through the circuit bears to the total chemical heat produced by the action of the elements of the battery. Indeed, the potential of a battery is exactly proportional to the amount of heat transmitted through the circuit by each unit of the atomic weight of the metal or other substance consumed or chemically changed. Thus, if we take two batteries, one of zinc, sulphuric acid and carbon, and another of zinc, sulphuric acid and copper, the heat evolved by the sulphoxidation of the zinc is the same in both cases; but the potential of the former, and consequently the heat evolved in the circuit, is greater;—what becomes of the difference? Is the heat in some mysterious way lost? No; the surplus heat is not evolved in the circuit at all, but remains in the liquid of the battery, useless for the production of electricity. Now, it is an exceedingly remarkable circumstance that the only battery yet examined in which the whole of the heat produced is transmitted through the circuit, is that form of the Daniell's battery in which zinc, in a solution of sulphate of zinc, is used for the positive, and copper, in a solution of sulphate of copper, for the negative, and in which the sulphuric acid and oxygen are transferred from the copper to the zinc.

With zinc, strong sulphuric acid and platinum, about five-sixths of the heat produced is transmitted through the circuit, but this varies somewhat with the strength of the acid; with iron in sulphate of iron and copper in sulphate of copper, only about two-thirds are transmitted; with copper in nitrate of copper, and silver in nitrate of silver, about $\frac{39}{82}$. In this way we account for the circumstance that, with the same positive metal, the potential varies with the character of the negative metal, less of the heat of the oxidation of the positive metal being transmitted through the circuit, and more retained in the battery itself. I may as well say that I obtained these results by comparing some well known experiments of M. A. Favre with some very important ones of M. Soret, which are scarcely known at all. I will illustrate this by showing you the amount of current derived from the oxidation of iron in conjunction with carbon, silver, and copper respectively.

But the whole subject of the relations between heat and electricity is one which requires deep and accurate investigation. M. Favre, in France, and Dr. Joule, in England, are the principal experimenters on this subject, and having spent very much time in carefully examining the published records of their experiments, I have no hesitation in saying that the conclusions they deduce cannot be accepted till they are repeated and varied with the most careful precautions, either by themselves or by others. It is much to be regretted that the committee of the British Association appointed three years since to investigate and report on the question in which these points are involved, and since reappointed from year to year, have not yet made public a single syllable by way of report as to their proceedings or conclusions.

I will only make one observation more before I leave this part of my subject, and that is, that chemical actions which produce cold create a galvanic current, and therefore produce heat, as much as those actions which primarily produce heat. Thus, copper and carbon, acting on water, produce a current exactly the same in kind as zinc and carbon, although the heat produced by the oxidation of copper is less than the cold produced by the separation of the hydrogen and oxygen of the water. Again, you will see that while the combination of sulphuric acid with water, which produces heat, produces a galvanic current, the combination of acetic acid and water, which produces cold instead of heat, produces also a galvanic current of exactly the same kind as the combination of the sulphuric acid and water. Let me then show you these facts by actual experiment. And I may note, by the way, that it is a curious circumstance that the combination of many acids and other substances with water, while they produce a contraction of volume, at the same time produce cold, not heat. In the combination of an alkali with an acid, which also produces much heat, you will see that a strong galvanic current is produced, and in this case the alkali, like the water in the former case, acts as the positive, and the acid as the negative. These circumstances, with many others, illustrate the fact that the view of heat, as given in Tait's "Thermodynamics" and other better-known treatises, namely, that there is a certain absolute zero of temperature, fixed at – 272 *C.*, where heat finally ceases to exist (just as there is a certain absence of motion when a body is at rest), and that all heat above this point is equivalent to a certain amount of mechanical force, is a view utterly erroneous; that, on the contrary, any variation of temperature, either upward or downward, involves mechanical force, and that the true zero of temperature is, when all contiguous bodies are of equal temperature, just as the true electrical zero is when all contiguous bodies are of an equal medium of electrical tension.

But I now turn to the more practical view of the subject. And here let me begin by saying that, in order to understand practically the action of a battery, the most essential thing of all is thoroughly to comprehend what is called Ohm's law. I have no hesitation in saying that the discovery of Ohm's law was to electricity not a whit less important, indeed, I should say more important, than Newton's law of gravitation in astronomy and general physics; in fact, it has been like the rising of the sun to travellers groping their way in darkness. It is now, of course, universally acknowledged as the great law of electrical action, though, I need hardly say, that, when first enounced, it was received by the scientific men of the day with the utmost scorn, and actually denounced as the wild ravings of a madman. But Ohm was then an unknown man—now his name is a household word with all electricians. This great law then is, that the quantity of electricity passing through each part of a circuit in a given time is proportional directly to what is called the potential or electro-motive power of the elements, and inversely to the total resistance of the circuit. Thus, to express it algebraically,

$$Q = \frac{E}{R}.$$

Again, the resistance of the circuit consists of two parts—the internal resistance of the battery, and the resistance of the rest of the circuit. Calling these R' and R'', we have the equation,

$$Q = \frac{E}{R' + R''};$$

and in the practical comprehension of this equation under the different circumstances to which it is applicable consists the whole difference between a good and a bad electrician; everything as regards the relation between batteries, the work they have to do, and the cost of doing it, depends upon this equation. If we have many similar cells in a battery, say n cells, then the equation becomes

$$Q = \frac{n\,E}{n\,R' + R''}.$$

Q represents the amount of chemical action going on in a given time in each cell, and if R'' be small, it is plain that, though with many cells we get many times the waste of zinc and other elements of the battery, we get no addition to the current; on the other hand, if R'' be large, we want a good many cells to produce the same current, and, in fact, as I said before, in the practical application of this equation to every varying case lies the whole art of the proper or improper use of a battery, and the art of using such batteries as are properly suited to the object desired to be attained. It will be obvious, from what I have said, that the main points of merit in a battery are—

1st. A large potential, or electro-motive force.

2nd. A small internal resistance, for where there is much internal resistance a large part of the power of the battery is wasted in itself, in overcoming—if I may so speak—its own friction. To these two points I may add two more, viz:—

3rd. Constancy, or a power of keeping up an action nearly uniform.

4th. Permanency, or the power of working for a long time without attention or fresh making up of the battery.

When I say that the heat produced in a given time—and in some cases the magnetic power—is as the square of the quantity, and not simply as the quantity, you will see at once the great importance of having a large potential.

The two instruments I have here will serve to show the first three points in different batteries, namely, the potential, the internal resistance, and the constancy for at least a short time. The permanency must, of course, be a matter of time to ascertain. The first instrument, a galvanometer with a large resistance, will, I think, show practically better than any other the potential of a battery. By either observing the degree of deflection with the same resistance, or the resistance through which the same degree of deflection is produced, we get a good practical idea of the potential of a battery. And this is really all we want; an exact theoretical determination is valueless, as it is always varying, more or less, from moment to moment.

I will now show you the practical potential of a large number of combinations. Let us take, as a convenient standard, zinc in sulphate of zinc, copper in sulphate of copper.

It is more convenient in practice, though a little larger than the British Association unit, which they call a "Volt," in which the negative is copper in nitrate of copper.

You see the degree to which it attains; now, let us compare with this the following elements:—

Zinc, dilute sulphuric acid, platinum.
Do. do. carbon.
Do. do. silver.
Do. do. copper.
Do. dilute sulphuric (‖) [*] nitric acid, platinum (or Grove's form).
Do. do. (‖) nitric acid, carbon (or Bunsen's form).
Do. a mixture of dilute sulphuric and chromic acids, and carbon, without a porous cell, as rerecommended by Roscoe and Bunsen.
Do. dilute sulphuric acid (‖) carbon and mixed sulphuric and chromic acids.

I add a little permanganate of potash to the negative, and you see the potential raised a little. Now I will show you some forms of my own.

Zinc, solution of potash (‖) carbon packed in a mixture of carbon, precipitated sulphur, peroxide and of manganese with dilute sulphuric acid.
Zinc, common salt (‖) .. do. do.

Next what is in most respects, I think, the most convenient, and best, and cheapest in action (for the power produced) of all batteries:—

Zinc, common salt (‖) .. carbon packed in granulated carbon, peroxide of manganese, with a mixture of sulphuric, nitric, and chromic acids.

The potential of the first of these then is, as you see, very high, much higher than a Grove or a Bunsen, indeed, nearly fifty per cent. higher. The second and third also considerably higher; the third is very constant, very enduring, and, from the peculiar chemical action of the materials, emits none of those poisonous nitrous fumes which have so seriously and permanently injured the health of many who have used the Grove or Bunsen batteries. Now we will try the potential of iron instead of zinc; this, you will see, is about three-fourths that of zinc, so that four cells of iron will be about equivalent to three of zinc. But as iron is about one-third the price of zinc, and is much less liable to be affected by local action, it would seem as if there was great advantage in using iron. But as every pound of iron consumed will take a little more acid and manganese than the zinc (that is in the proportions of eight and seven), and the internal resistance of four cells will be more than that of three, there is, on the whole, probably not much economy in using iron. Here is another battery in which no acid is used, and in which the potential is as high, or nearly as high, as a Grove, and very constant in its action. It is zinc, solution of salt, (||) carbon, and the peroxide of manganese, with a mixed salt of sodium, tin, and mercury. For telegraphic purposes, where the use of acid is thought objectionable, I know no better form.

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[*] The mark (‖) is intended to denote a porous diaphragm.

But instead of zinc or iron, or indeed any metal, we may use any oxidizable liquid, and collect the electricity derived from its oxidization by means of a carbon plate. The cheapest, probably, of all is common salt; you see this gives a very fair potential, in fact not very short of a Daniell. Again, take sulphate of protoxide of iron, a very cheap material, which may be kept in a state of protoxide by placing in it pyrites or other sulphide of iron, which is a material almost valueless. Cyanide of potassium, you will see, gives a good potential; also hyposulphite of soda, and sulphide of soda or potash. You will observe that the potential of this last is very much greater than a Daniell, and approaches that of a Grove. Sulphide of calcium—a waste material in many places—gives a very good potential. Again, brandy and water, sugar and water, milk, flour and water, all of which, being oxidized by the oxidizing materials of the negative side of the battery, produce a considerable galvanic current. Indeed, with these kinds of materials the battery plays the same part as the stomach and lungs of the animal body, the negative part of the battery supplying oxygen to oxidise the food materials of the positive part, just as the lungs furnish oxygen for oxidising the food supplied to the stomach and brought into circulation in the blood. You will observe that milk and tea are more easily acted on, and give a larger potential, than brandy and water or flour and water. But before I conclude this part of my subject, I ought to show you the potential of some other of the common forms of battery, namely, the Wollaston, the Smee, and the Le Clanché. You will see they are much inferior to some of the forms I have shown you, besides having other disadvantages which I shall show you in due time.

Well, let me next show you the internal resistance and constancy of some of the common forms of battery. In order to show this properly, we must, of course, take elements of an equal size. This instrument is a galvanometer of very small internal resistance, so that, practically, it shows you what is the internal resistance of the battery, as that is the main element of resistance. Of course the potential also affects the result, so that the degrees in this instrument will practically show you the combined result of potential and small resistance, where a large amount of current, with a small resistance is required; and the loss of power in a minute (I cannot afford time to show you the effect of a longer duration) will give you some idea of their constancy.

Let us just take that modification of the Daniell now used in the Post-office and generally for telegraphic use. You have seen that it stands low in the scale for potential; and you will now see that for small internal resistance it stands very low indeed, but that its constancy for one minute at least is perfect. But still the amount of electricity produced in a minute is so very small that it ought to remain constant, there being so little expenditure of force in the time. Now, compare with this two forms of battery introduced by myself for telegraphic purposes—zinc in salt or dilute acid for positive, and carbon placed in granulated carbon and peroxide of manganese with dilute acid for negative. You will see the comparatively enormously large quantity of electricity which this produces; though in the course of a minute, where there is no resistance, it, of course, partially exhausts itself, the peroxide not being able to furnish oxygen rapidly enough for the supply; but, after a short interval of rest, it recovers its full potential. On the London and North-Western Railway ten of these cells were found to work to Manchester equally well with 60 of the ordinary sulphate of copper batteries; not of course, that the potential is six times as large—indeed, it is not more than double—but in damp and wet weather, where there is much leakage from the wires, the small internal resistance of these batteries enables them to supply enough electricity to make up for the leakage, whereas the larger internal resistance of the Daniell batteries prevents them from supplying in a given time more than a comparatively small given quantity, which will not bear much loss from leakage. I am glad to say that this form of battery is being fast adopted for railway use. Then we try the Wollaston—a small potential, a small resistance, and a very rapid fall of power; then the Smee—a small resistance, fair potential, and, in consequence of the rapid escape of hydrogen, considerable constancy. To this battery the hydrogen fumes are a great objection. Next, try the Le Clanché, a fair original potential, moderate resistance, and rapid fall of potential. Next, the form I mentioned before as introduced by myself, with a higher potential than the Le Clanché, and much more constant, though, like the Le Clanché, used without an acid, and therefore quite as permanent. It is simply a solution of common salt with a combined salt of sodium, tin, and mercury in the negative. This combination has the peculiar property of being able to extract rapidly the oxygen from the peroxide of maganese. The tin causes in time a little local action, but if it be left out, the mercury by itself cannot so rapidly extract the oxygen, and the local action caused by the tin is very small indeed. Next the "Grove," a high potential, very little resistance, even an increase of potential as the liquid gets warm; Bunsen the same; but both, after a short time, producing intolerable poisonous fumes, which produce dangerous inflammation of the lungs, take away the voice, and when a man's system has once been injured by them, act upon the lungs on subsequent occasions with the utmost rapidity. For myself, I am now so sensitive to them, that I cannot expose myself to them for even a few minutes without losing my voice and my chest getting seriously affected; besides, they are far from permanent, as a few hours exhaust their power. Next, I try the bichromate battery, without porous cells; small resistance, high potential, but soon losing its power, and very expensive and wasteful in use, destroying itself by a single night's action. Next, the bichromate, with a porous cell, high potential, moderate resistance, moderate constancy, but very expensive in use. Next, let me take my own form, which, for general practical use—as for induction coils, for keeping up a powerful magnetic action when required, and other such purposes—I think is far superior to all others. Zinc in salt, carbon packed in granulated carbon and peroxide of manganese, filled in with dilute sulphuric acid, mixed with a little nitric and chromic acids. Here is very high potential, as I showed you before, moderate resistance and great constancy. I have had them standing for months, used occasionally, and losing but little of their original potential.

For electro-plating, in power, convenience and long endurance, they exceed all others. Some electro-platers prefer iron as the positive, some zinc; for each has his own peculiar preferences and modes of working; but they are now becoming largely adopted, having more than the power of the Bunsen, without the inconveniences, and lasting, I may say, 30 times the length of time. Some electroplaters have had them in daily use for two months at a time. The chromic acid has the especially valuable property of absorbing all nitrous fumes.

To show you the power of the battery, here is an electro-magnet magnetised by a single cell. I will defy the strongest man in this room to separate the soft iron keeper from the magnet.

Where very great constancy and a very large current of electricity is not required, the nitric and chromic acids may be omitted, and then the local action becomes next to nothing; but with the latter a moderate-sized battery of a single cell has been used for plating six dozen forks at once.

I am afraid that I have occupied you too long, but, as it is, I have been obliged to compress my matter unduly, and to omit many points on which I should have wished to dilate.

DISCUSSION.

The Chairman said that the effects of galvanism, like all other natural phenomena, depended upon certain fixed laws, but these admitted of an almost infinite variety of combination, and possibly some gentlemen present, whose studies have been directed to this matter, might be able to add to the knowledge which had been so interestingly conveyed by the reader of the paper. Or if there were any points on which anyone desired further information, he had no doubt Mr. Highton would be happy to afford it if possible.

Mr. H. Rawlinson, C.B., said it was often stated in papers, though not so often now as formerly, that some one had invented a method by which galvanism would take the place of, and supersede, steam. He should like to know if Mr. Highton could inform them whether there was any possibility or probability of this being the case.

The Rev. Mr. Highton said that so much had been written on this subject, by Youle and others, that he could only repeat what he had already stated, that he believed their conclusions required further experiment before they could be finally accepted. If, however, they were conclusive, it would appear that the power produced by any force was simply the equivalent of the heat produced, and in that case certainly the consumption of zinc or iron could scarcely ever be compared in cheapness to that of carbon. However, they must await he report of the committee appointed by the British Association three years ago to examine the subject of the mechanical equivalent of heat, which, in reality, involved this whole question. He did not himself think the experiments of Messrs. Favre and Joule could at present be accepted as conclusive.

Mr. John Fordred asked what form of battery was most suitable far telegraphic purposes.

The Rev. Mr. Highton said it would depend on the character of the work to be done. If the battery were to be used by a country postmaster, who knew nothing about it, and only wanted it perhaps once or twice a-day, the best form would probably be the Le Clanché, or the one with a mixture of sodium, mercury, and tin; but if, on the other hand, it was required for an office where it could be properly attended to, he should recommend zinc in salt, with dilute acid, peroxide of manganese, and carbon as the negative. This was used very successfully on the Midland, North Western, and Brighton lines of railway.

The Rev. Wm. Law said he had found, in using a Highton battery, that the acid rose up through the carbon by capillary attraction, and corroded the binding screw, thus interfering with the action. He had lately found the action of a battery of this kind, with rather short carbons, almost suspended through the deposition of an oxide on the end of the binding-screw in this way, and he would like to know what was the best way to remedy the evil. The plan he had found most efficacious was to deposit a collar of copper on the top of the carbon by electrotypic action, then to solder a stout strip of copper upon it, and then dip the whole of the top, just covering the collar, in boiling paraffin. The result was that thet paraffin penetrated the carbon, and to a great exten preserved it from the action of the acid. If there were any better method of preventing the evil he had mentioned, he should like to know it.

The Rev. Mr. Highton said the plan described would be successful to a certain extent, but not altogether. Probably the best method would be to platinise or cover with gold electrically the point of the binding-screw which pressed upon the carbon.

The Rev. Mr. Law said he had tried platinum collars, but he found there was a curious indescribable salt generated by the action of the acid.

The Rev. Mr. Highton said perhaps the most effectual way was to clean the binding-screws every time they were used. He had never found any corrosive action in the course of a single evening.

The Chairman, in proposing a vote of thanks to Mr. Highton, said the Society of Arts lent itself more to the dissemination of a practical knowledge of science, as applied to the use of mankind, than to the dissemination of philosophic theories, and certainly it had thoroughly fulfilled its functions that evening in having obtained from Mr. Highton so valuable an addition to its stock of knowledge from the result of his long labours and deep study of this most interesting and useful subject.

The vote of thanks being carried unanimously,

The Rev. Mr. Highton briefly acknowledged the compliment, and the meeting separated.

We notice, in last week's *Building News*, an interesting sketch of the growth and progress of the Society. We would draw special attention to the remarks on the Endowment Fund, the value of which we are glad to see so cordially appreciated by our contemporary.

The Bessemer Steamboat Company (Limited), has recently been introduced, with a capital of £250,000, in shares of £50 each. The company has for its object to run the above-mentioned vessels between this country and various parts of the Continent, the same to be hereafter decided upon.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

The first meeting of the Committee on steel was held at the Exhibition-offices, Stanhope-lodge, Upper Kensington-gore, on Monday, the 25th November, 1872. Colonel F. Campbell, R.A., was voted into the chair, and among those present were F. A. Abel, Esq., F.R.S.; J. Anderson, Esq., L.L.D., F.R.S.E.; C. Asprey, Esq.; Colonel T. Inglis, R.E.; J. Latham, Esq.; E. J. Reed, Esq., C.B.; J. Gordon Smith, Esq.; and Captain A. C. Tupper, F.S.A. Sir William G. Anderson, K.C.B., and Mr. H. Cole, C.B., attended the meeting on behalf of her Majesty's Commissioners; and Captain G. E. Grover, R.E., was present as Secretary.

The Committee was informed of the progress which had already been made in preparing for next year's Exhibition, and in consequence of the high importance attached by many members of this Committee to the representation of steel as used for railway purposes (such as rails, axles, tyres, &c.), the locomotive superintendents of the chief railways in the kingdom, together with the Inspectors of Railways under the Board of Trade, had been invited to favour the Commissioners with advice as to forming a good exhibition of this class of manufacture. These gentlemen will hold their first meeting on the 28th inst.

General Scott, C.B. (the secretary of the Royal Commission), had recently visited Sheffield and discussed the proposed exhibition with the leading manufacturers in that town, most of whom had promised their cordial co-operation in the scheme.

After considering the question of a proper definition of steel, the Committee agreed that the materials known in the trade as "homogeneous metal" possess properties which are accepted as characteristic of steel, and should, therefore, be included in an exhibition which embraces all varieties of steel, but that malleable cast-iron will be more appropriately included in the Exhibition of cast-iron in 1879.

It was notified that all applications to submit objects proposed for exhibition should be made before the 31st of January, 1873, and that the objects should be delivered on the 10th of March, 1873.

A meeting of sculptors (presided over by Mr. Durham, A.R.A.) was held on Monday, at the Royal Albert-hall, to inspect the space proposed to be devoted next year in the East Picture-gallery to British sculpture. After visiting the space a resolution was passed approving of the same. The Committee adjourned to the 9th of January.

The Marquis of Ripon presided last Friday, at the Privy Council-office, over a meeting of the General Purposes Committee, appointed by her Majesty's Commissioners for the Exhibition of 1851, to carry out the current series of Annual International Exhibitions. There were present Sir William Anderson, Sir Francis Sandford, Mr. Edgar Bowring, Mr. Cole, Mr. Gibson, Dr. Playfair, and General Scott, secretary.

The Committee for Cooking and its Science held its second meeting at Gore-lodge, on Saturday, December 7, and examined a preliminary list of cooking processes suggested for exhibition. It was resolved to print and send the list to each member, in order to obtain suggestions, and for the purpose of preparing a detailed list of dishes, of which it was desirable to show the preparation during the Exhibition. The following gentlemen were present:—The Hon. F. Leveson Gower, M.P., Chairman; Mr. Follett Synge, Mr. James Bateman, F.R.S.; Professor Voelcker, Mr. F. B. Alston, and Dr. Birdwood. Mr. Henry Cole, C.B., and General Scott, C.B., attended the meeting on behalf of her Majesty's Commissioners; Mr. E. Craigie, Deputy-Commissioner, and Lieut. H. H. Cole, R.E., were present, the latter as secretary to the committee.

The Committee for Implements for Drinking and for the Use of Tobacco and Narcotics of all Kinds held its first meeting on Thursday, December 5, at Gore-lodge, and discussed the limits which had been put on this section of the Exhibition in view of not encroaching on the classes of Glass, Goldsmiths' Work, &c., to be represented as Industrial Classes in future years. A sub-committee was formed to advise on the formation of a display of ancient implements, and to examine the applications already sent in to lend old implements. The following gentlemen were present:—Dr. Thudichum, Mr. W. Bragge, F.S.A.; Mr. F. W. Moody, Mr. Thomas Whitehead, and Mr. Henry Durlacher. Mr. Henry Cole, C.B., attended on the part of her Majesty's Commissioners, and Lieut. H. H. Cole, R.E., was present as secretary.

REPORT ON TOBACCO PIPES.

It is the intention of her Majesty's Commissioners to exhibit specimens of all kinds of tobacco pipes, tobacco grinders, &c., made before 1800.

The following report on the subject has been drawn up by M. Berger:—

1. There exist but few special collections of pipes, or, in general, of smoking apparatus. After making every research, I cannot cite more than two collections:—1st. The first has been bequeathed to the town of Douai, by an amateur named Berthoud. 2nd. The second is to be found at Paris, and belongs to M. le Baron Watteville, chief of the Depôt des Livres to the Minister of Public Instruction. A third collection exists, it is said, or has existed, in New York.

2. The several ethnographical collections of costumes and of domestic or other instruments which are to be found in Europe might furnish some interesting specimens of pipes.

3. I think that the flint and steel (briques) and tobacco pouches should, of necessity, form an integral part of the collection of pipes which will be brought together.

4. I can only mention a very few works to consult. Amongst others:—"The Smoker's Museum," by M. Cardon, manufacturer of pipes at Paris, Boulevard de Sebastopol. "The Art of Smoking," a poem by Barthelemy, where may be found some curious notes. "The review of the Society of Antiquaries of Zurich." In this collection is to be found a memoir upon the ancient forges of the Jura Bernois, where mention is made of the custom of smoking as having already existed amongst the Romans. These people are said to have smoked aromatic herbs, such as the thyme or the wild thyme, as well as the dried leaves of the walnut-tree.

5. There do not exist, as far as I remember, any implements of smoking dating from an age so remote; it appears, however, that certain Swiss collections possess some, and they also contain some analogous instruments (*L'Epoque des Lacustres*).

6. I have examined in detail the collection of the Baron de Watteville. His oldest pipes are Mexican, and date from before the conquest by Cortez. These pipes are of complicated forms, in hard clay or in wood.

7. I need not dwell upon the infinite number of valuable and interesting specimens that the East and the extreme East can furnish. These countries are, so to

speak, the countries of smokers and fine pipes, from the simple Turkish short pipe, of hardened mud of the Bosphorus, to the Chibouk of Syout clay, with amber mouthpiece, enriched with precious stones, to the Narghilhé, ornamented with Persian enamel, to the pipes of Armenia, of which the bowl rests upon rollers in order to avoid all trouble to the smoker, who breathes the smoke from its long tube. There are also the bell-shaped pipes of Bagdad, of Bussorah, of Tiflis, the cocoa-nut water-bottles of Damascus, of Mecca, &c. Collections, without trouble, of the various types from India, the Indian Archipelago, and the English colonies, can be made also. The Chinese, Coreean, and Japanese pipes, for smoking tobacco, opium, and hachish, will afford a collection easily to be found and completed. The Western European countries offer forms of infinite variety. France alone can furnish for each of her provinces pipes of which the forms can be counted by thousands, in wood, in metal, in porcelain, in meerschaum, in clay, &c.

8. It is possible to procure pipes of the time of Louis XIV., numerous specimens of which have been found in the bed of the Seine, some of them enclosed in cases of stamped or embossed morocco, with secret opening. These pipes are generally of ordinary clay, the bowls very small, reminding one of Dutch pipes.

9. France offers also a kind which is indigenous. I mean "political pipes." There has not been a politician in France, since the commencement of the century, whose features have not been moulded in clay to form a pipe-bowl, either in the form of a portrait or a caricature. Certain parts of these figures are enamelled, and remain white when the pipe is coloured. I have been told of a person who for more than forty years has bought all the pipes of this kind which have appeared; also, that an amateur has succeeded, with the help of certain directors of prisons, in procuring the pipes which the more celebrated condemned criminals have smoked for the last time before death. He possesses notably the pipes of the condemned communists (*Troubles de la Commune*).

10. The pipes of the east of France, called *Franc-Courtoises*, of which the central manufactory is, and has always been at St. Claude, are perhaps the most varied. They greatly resemble the Swiss. These last are generally in porcelain, in wood, and in chamois, and izard-horn; they vary in nearly every canton, though they approach the German pipe in the district of the Tyrol, and assume the Piedmontese or Savoy forms as they approach Italy. The German pipes can, by themselves, constitute a collection, perhaps as numerous as those of the East. Art is not wanting in them, and we find in Vienna pipes in amber which are real *chefs-d'œuvre* in delicate carving. Pipes of hard roots, twisted in the most extraordinary shapes, are in vogue in the Harz and Bohemian mountains. I need not speak of the pipe of the German student, which, in the German universities, plays a part at least as important as his rapier or his books. Belgium and Holland will furnish but little else than the long pipes of white clay, with fine and delicate stems, straight, bent, or turned in spirals. Spain, Portugal, and Italy prefer the cigar and cigarette to the pipe too much to furnish any special types. Greece offers but few specialities in the way of pipes. I know of several, however, in carved wood, of workmanship even more original than that of the Swiss and Tyrolean manufacturers. One, amongst others, which represents Bellerophon overthrowing the Chimera, is to be found in the collection of the Baron de Watteville. Russia and Scandinavia, on the contrary, have a curious arsenal of smoking implements. There are Russian pipes, which were hidden in a walking stick, at the period when the Imperial edicts prohibited smoking. The Siberian pipes in ivory, in which the inhabitants of certain districts smoke dried poisonous mushrooms; the pipes of the Cossack of the Don, with his steel (cased) in leather attached to the stem. Pipes of graphite of the Oural; the small metallic pipes of the Laplanders.

11. Other parts of the world abound with pipes of different models, of which the nomenclature would form an entire book. The principal specimens may be found represented in the ethnographical collections of the chief cities of Europe. We will quote at chance: The Indian Calumet, in red rock of Arkansas. The pipes of New Guinea, which remind us of the Egyptian style. The double-stemmed pipes of the Gaboon. The pipes of the Upper Nile. The common pipes of the Egyptian fellahs. The pipes of the Hottentots, of which the stems are formed of a bull's horn. The pipes of Lagos (Central Africa), in the golden clay of Onidda. The pipes of Bosnia, in clay damascened with silver. Pipes of Madagascar clay. Pipes of Vancouver. Pipes of Pudor (Senegal). Wooden pipes from the Marquis islands. North African pipes with two bowls &c., &c.

12. It is necessary to remember that the formation of such a collection of pipes will cause a very considerable amount of work and occupy a good deal of time. At the moment of closing this note, I hear of the existence of an old Latin work, published at Lyons, and bearing the following title: Tabacologia; hoc est Tabaci seu Nicotianæ descriptio Medico-Chirurgico-Pharmaceutico vel ejus præparatio et usus in omnibus ferme corporis humani incommodis. Per Johannem Neandrum Bremanum, Philosophicum et Medicum. The author quotes all passages from ancient writers which may relate to the custom of smoking.

CHANNEL PASSAGE.

In an article on the rival schemes for channel passage boats, the *Engineer* speaks rather disparagingly of both Captain Dicey's and Mr. Bessemer's. Of Captain Dicey's twin-ship, it says:—"It is quite possible that such a ship will roll very little, but we have been taught hitherto that rolling was as much a question of position of centre of gravity as of beam, and it is not difficult to to see that circumstances might arise under which Captain Dicey's ship would roll excessively, not because she was too narrow, but because she was too wide. In any case, we have no hesitation in stating that in our opinion the inventor has adopted the worst possible device of several to prevent rolling. It may be that there are other advantages of a totally different character proper to the double-ship system. If so, we do not know what they are; but we do know that there are objections to the system of the utmost weight. If any of our readers will take the trouble to set out a ship of the kind, and to make a few calculations, they will find that the strains to which the bridge work, or connecting girders, will be exposed, are of the most alarming character. There is no conceivable direction which the strains will not take, and from the nature of the case they must one and all be dealt with by sheer brute force. There can be no such thing as introducimg a tie 2in. diameter to take a strain in one place which if allowed to go undealt with there, could only be met with by a bar 4in. in diameter in another place. Of course we do not pretend to maintain that Captain Dicey cannot get his ships fastened securely together, but we do maintain that security can only be secured by the use of an enormous weight of iron and at a great expense. As to the means of propulsion, nothing can by possibility be worse than the location of the paddles, as every engineer knows. If great beam is really necessary, then the Channel steamer of the future must have it, but the paddles should be kept outside the hull, and being placed well forward and well aft, where the beam of the vessel narrowed, they would little, if at all, augment the width. The floats should be fixed at a slight angle with the shaft, so as to drive the water away from the sides of the hull. So much capacity would be afforded by the filling up of the unused space wasted in the twin-ship, and by the abolition of the cross-bridge girders, that the draught of water might be much reduced over any thing practicable with the Dicey ship. In one word, a boat 360ft. long, 55ft. wide, and drawing 7ft. or 8ft. of water, and propelled by two pairs of paddles, as far asunder as they could conveniently be placed, would be in every respect superior to any double-bodied craft which it is possible to construct."

Nor are the observations upon Mr. Bessemer's plan much more complimentary:—"Mr. Bessemer's proposed ship we regard simply as a model of misplaced ingenuity. As everyone is acquainted with the general construction of his patent suspended cabin, it is unnecessary to describe it fully here. It will in his proposed Channel ship constitute a splendid suspended saloon, 50ft. long, hung amidships, and prevented from feeling the roll of the ship by hydraulic brakes, worked by a species of steersman, on whose energy, fidelity, and skill, the immunity of the passengers from sea-sickness will altogether depend. On the inventor's own showing, Mr. Bessemer has been unable to grapple with the pitching difficulty, and he has therefore got Mr. E. J. Reed to design him a ship so long and so low at the ends that she will not pitch. Mr. Bessemer disposes of the rolling motion, Mr. Reed gets rid of pitching and ascending, so that as far as these two motions are concerned there ought to be no sea-sickness, and yet we venture to say that the Bessemer saloon will not save many pangs to the voyager that could not be just as well eluded by other means. Those who have had most to do with the sea know best that it is not the rolling of a ship that gives greatest trouble to an uneasy stomach, nor is it the pitching. These can be avoided by taking up a position somewhere amidships. The maximum torturing influence is the bodily up and down motion of the ship. It is the apparent sinking of the deck from under foot that elicits the direst groans and establishes the sharpest pangs. With this motion Mr. Bessemer's suspended cabin cannot deal. That it will save some persons from uneasiness, and to a certain extent promote comfort, we do not wish to dispute. That it will for ever banish sea-sickness is a proposition which a heavy gale in the Channel would effectually disprove in half an hour."

The *Engineer* sums up as follows, and advocates a plan the simplest of all:—"Plainly stated, our opinion on the whole subject is, generally, that no complex devices of any kind are required to render the passage from Dover to Calais comfortable, if not delightful. All that is needed is a vessel of such length that she will not pitch much or rapidly; and of such beam that she may be very safe, although the centre of gravity stands very high. This combined in a way well understood with large bilge pieces or fins, will reduce rolling to a point where it will cease to do harm. A long easy roll will upset none but the weakest stomach. As regards pitching, almost perfect immunity will be secured by placing the saloon in the mid-length of the ship, instead of at the stern, as in existing steamers. The boat must be double-ended, of course. Were such vessels put into competition with Mr. Bessemer's or Captain Dicey's it would be found, that, as far as accommodation was concerned, they would probably be all alike; that the Bessemer ship would possibly be found the most comfortable by a few exceptionally qualmish people, and that, on the whole, the big simple ship would keep the best time, require least for maintenance and first cost, bring in the largest return to her owners, and, in a word, satisfy the legitimate requirements of the public better than any of the rival schemes now discussed. It happens, however, that no one can take out a patent for the only thing really wanted, and, therefore, no one will supply it."

To all these theoretical objections no answer can be given but the answer supplied by experiment. If it is shown, by practical experience, that all that is required is that ships should be built on the plans proposed by the *Engineer*, so much the simpler and better, but it will be at least as well to wait and see how the new vessels behave in a rough Channel sea, before we condemn them off-hand.

SIDA RETUSA.

With reference to this fibre, which was shown in the last International Exhibition, Messrs. Noble, the well-known fibre brokers, report as follows:—

"We have examined the fibre; it will be of great value, provided there is a large quantity that may be sent from Queensland, so that is is worth the while of spinners to devote themselves to it.

"There is in the fibre value of upwards of £30 per ton if sent clean and free from 'woody stalk.'

"We would recommend you only to steep it, and crush out as much of the wood as possible, and send it; it will then bring from £11 to £12 per ton, and it will rise in value according to the way it is cleaned; but as labour is scarce, we think it is the best way to send it rough at first; if you find that labour becomes more plentiful you can clean it more; the difference consists in the amount of labour expended, when properly understood, and saving of expense in freight in what would be wasted.

"But do not trouble yourself about it unless plenty can be produced in the country, as little lots would not bring their real value.

"To show you that quantity will be sure to work its way, we may mention one article of similar though inferior quality—Jute from India. Thirty seven years ago a little was brought into this country, only about 3,000 bales a year, of 300lbs. to the bale, and it was pronounced as worthless except for adulterating, but I recommended it to come in quantity. It has made for itself a market, made the fortune of Dundee, and last year there was imported 1,600,000 bales."

TRADE-MARKS IN AMERICA.*

The annexed abstract of the law and practice of these trade-marks has been prepared by George Hazeltine, LL.D., for publication in the Society's *Journal.*

The subject of a "registration" may be either a lawful trade-mark, to which applicant is already entitled by use, or one he proposes to adopt. The name alone of a person, firm, or corporation cannot be the subject of a registration, nor a trade-mark registered or used by others for the same class of merchandise. The claim to a registered trade-mark connected with any unlawful business, or injurious articles, or for which protection was obtained fraudulently or with intent to deceive the public, cannot be maintained.

The applicant for a registration must, according to law, be a person, firm, or corporation, domiciled in the United States, or in a foreign country where similar privileges are granted, by treaty or convention, to American citizens. But the office has decided that Englishmen may register trade-marks on the supposition that English laws afford similar privileges to foreigners, in the absence of treaty or convention, which supposition is erroneous, and, strange to say, no treaty or convention exists between the two countries on this subject.

The application for a protection is made by filing in the Patent Office the applicant's name, residence, and place of business, a particular description of the goods, and the class of merchandise to which the trade-mark is to be applied, a description of the trade-mark, with facsimiles, the duration of prior use, declaration under oath to ownership, and correctness of the description and illustrations filed. When the applicant is a firm or corporation, some member or officer must make the declaration.

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* The only American legislation upon trade-marks is contained in the Patent Act of July 8th, 1870, section 77 to 84 inclusive, prior to which date this subject was regulated by common law, and there was no registration. Though the mode of obtaining redress for infringement is prescribed by the Act, the common law remedies are preserved, and may be enforced, even in the absence of registration.

The duration of the registration is thirty years, subject to a renewal for a like term if application is made six months before the expiration of the original term. No provision is made for extension beyond sixty years, when the proprietors must resort to their common law rights and remedies. The registered trade-mark used on articles manufactured abroad will not be effective unless protected by registration at the place of production. The official fee for the original or renewed term is twenty-five dollars, or about five pounds. The law provides for a remedy in the courts of law and equity for infringement. The registered trade-marks may be transferred the same as copyrights.

RAISED MAPS FOR THE BLIND.

Maps for the blind have hitherto been such expensive and clumsy curiosities that, practically speaking, they can scarcely be said to have existed. Some persons, indeed, who ought to have known better, have gone so far as to assert that the blind are incapable of learning geography. But on a close examination of all the facts of the case, it will be found that this assertion—if it means anything at all—can only mean that without globes or maps, and without any regular oral instruction either in physical or political geography, the blind make but very poor progress in this branch of study. It cannot, of course, be maintained that loss of sight is any help either to a man or a child in acquiring a knowledge of the surface of our globe. But as it is abundantly clear to every intelligent observer of the sightless and their ways, that blindness does not prevent its victims from guiding themselves through crowded and intricate streets, it may fairly be presumed, until clearly proved to the contrary, that they are capable, when helped by good teaching and suitable appliances, of acquiring a very useful amount of geographical knowledge. So far as the experiment has yet been made in the case of individuals, or on a somewhat larger scale in a few of the more advanced institutions for educating the blind, the results have been thoroughly satisfactory. In order to render the attainment of these results more easy and certain, as well as to encourage the managers of schools for the blind to give their pupils more general and systematic instruction in this branch of knowledge, the British and Foreign Blind Association has just issued two relief maps of England and Wales, the one political or elementary, and the other physical.

In both of these maps the whole of the land is raised clearly and unmistakably above the level of the sea, so that the finger of the blind pupil will at once tell him whether he is on terra firma or on the treacherous deep. The rivers are marked by decided depressions in the surface of the land, and in order that the blind explorer, whenever he comes upon a river, may at once know in which direction the stream is flowing, the side of the depression which represents the right bank is made vertical, while that which represents the left bank is shelving.

In the elementary map the divisions of the counties are marked by raised lines, and when, as so often happens, counties are divided by rivers, the raised boundary line is always carried along the right bank of the stream, thus making the distinction between the right and left bank still more marked. All the more important towns are marked by numbers in the French dotted system, and these numbers are explained by an index, printed in relief and also in black and white, so that they can be used either by the sighted or sightless. Wherever two or more important towns come together, and where, therefore, if both were marked by embossed numbers some confusion might arise from the crowding of signs, one only of such towns is numbered, while the position of the others is indicated by single dots. By this system of numbering and grouping the towns, it has been found possible, although the map is not inconveniently large, to indicate the exact position of about 243 places. The principal headlands and bays are indicated by numbers, which are embossed upon the sea at a distance of half-an-inch from the coast. This space of half-an-inch has been left in order that the finger may pass round the coast line without being interrupted by the roughness of the dots which represent the numbers. The places upon the coast thus marked are about 36 in number. The whole of both maps is engraved and printed in the ordinary way, so that where the embossed indications fail, the blind student may be helped by the eyes of a friend or teacher.

The physical map represents, with very considerable accuracy, all the chief diversities of surface, representing not only the prominent hills and valleys, but also showing the general slope of each district. In this map the places are not numbered, but the positions of the towns are indicated by single dots.

From these particulars it will be clear that no small pains have been taken to render these maps as useful as possible, and it is to be hoped that they will soon be introduced into all our schools for the blind. As they are issued at a low price there is no reason why each pupil in a class should not have a map before him while the lesson is proceeding, and thus be enabled to supplement the verbal explanation of the teacher by tangible inspection. In addition to this, the pupil will be able, by means of the embossed index already mentioned, to prepare his lessons alone, and will thus be encouraged in habits of self-reliance, which are in some danger of being undermined when the pupil has nothing to depend upon but the oral instruction of the teacher.

The maps are intended as the commencement of a series, and it is to be hoped that the British and Foreign Blind Association may be able to complete it.

CORRESPONDENCE.

A TWINBOAT IN THE HURRICANE OF SUNDAY NIGHT.

Sir,—As Captain Dicy's twinboat has been the subject of a contest in the *Times* and other papers, it may be amusing and instructive to some of your readers to know how a twinboat, 50 feet long, behaved in the fearful tempest which raged at high-water, about 8.30 p.m., in Battersea-reach. This, for a mile and-a-half, offers a broad expanse, over which the gale howled along, raising a sea that, in the short space of three-quarters of an hour, sank, within the writer's view, seven barges, one or two lighters, many boats, two large floating boat-houses, about 70 feet long, two dummies alongside, and, to end the list, the writer's new steamer, 45ft. by 9ft., which, in the short space of five minutes, had the saloon and paddle-boxes swept clear away, and, in less than ten minutes more, was sunk by a series of waves. All this took place whilst a hundred people were looking on.

The twinboat was lying broadside exposed to the full force of the gale. Luckily, her moorings held, and although she was deluged by the waves and the pontoons half-filled, she rode out the gale, with an oscillation so slight that it was easy enough to move about on her deck, and by her means two small yachts were reached and placed in safety, but in a terribly dilapidated condition.

The force of this storm was something terrific. Large masses of water were carried over the river wall, 10ft. high, into the gardens in Lindsey-row; and old inhabitants say they can only recollect one gale equal to it in fury, and that was many years ago.

On examination of the twinboat on the Monday, nothing was found injured in any way, except that the hull was a little chafed in parts. The cross-girders showed no sign of wrenching or distortion; but the boats had evidently made distressing efforts to get free, for one of the stems had battered a space out of the river wall some 3 ft. square by 9 in. in depth, though no damage, as before stated, had occurred to the hull.

The twinboat is 50 ft. over all, 18ft. wide, and at the water-line each hull is about 33 inches wide.—I am, &c.,

A. Sedley.

92, New Bond-street, 10th December, 1872.

CHANNEL PASSAGE.

Sir,—I have lately crossed from Boulogne to Folkstone, and had an opportunity of trying the accommodation afforded by the South-Eastern Company's new boat, the *Albert Edward*, which has been fitted with a covered deck fore and aft. These coverings have windows on the side, and practically form deck-cabins. There were more than three hundred passengers on board, and it blew half a gale of wind with occasional showers. There was, of course, the usual plentiful amount of sea-sickness, but we were thoroughly protected from the wet, and the ventilation was perfect. Take it altogether, there was a marked improvement in the way of comfort as compared with former voyages. The lower cabin, too, was decidedly improved; but there is still room for further improvement in ventilation there, as well as with regard to the arrangements under the deck coverings. I would suggest that more order and discipline should be maintained in the appropriation of places by the passengers and the disposition of the luggage. However, what has been done in the way of improving the existing boats is a step in the right direction; and I congratulate the company on what they have already accomplished, looking forward hopefully for still further amelioration of the miseries of this passage.—I am, &c.,

Felix Summerly.

The first report of the Wealden exploration states that several obstacles have been met with, but the boring is now proceeding at a depth of 96 ft. in a bed of hard blue limestone. The committee will be recommended to reduce the diameter of the bore.

A suggestion has been put forward in America, that telegraph wires be extended to all the lighthouses on the coast, and that a system of signals be arranged to be exhibited from the lighthouses to give notice to passing vessels of approaching storms or changes of wind.

It is said that some 6,000 or 7,000lbs. of Australian gold, recently coined by the French Mint, proved so brittle that all the pieces can be easily broken, and have, therefore, to be re-melted. This is attributed to the presence of a small per-centage of antimony and arsenic, extremely difficult of removal, elements which are known to produce a similar effect in all metals or alloys subjected to the molecular changes induced by the action of the dies in the coining press.

It is stated that an agreement has been come to by the Dover Harbour Board and the South-Eastern and London, Chatham, and Dover, to promote in Parliament a scheme for diverting the traffic between Dover and Calais, Folkestone and Boulogne respectively, into a single route from Dover to Boulogne. In favour of the proposal, it is stated that larger boats can be employed, and the passage performed in only a few minutes more than is required now.

An American whaling bark, the *Java*, of New Bedford, is provided with an upright five-horse power engine, to be used in cutting up whales and discharging cargo, hoisting topsails, if required, etc. This is expected to prove a great saving of time and labour, as it usually requires fifteen or sixteen men to cut up a whale, while, with the help of the engine, six men can easily attend to it. The engine is stationed in the forecastle, occupying a space ten feet by four feet. It will be the first ever carried to sea in a whaler for these purposes.

GENERAL NOTES.

A University of Arts and Trades.—According to the *Scientific American*, a prominent citizen of Toledo, Ohio, has matured a plan, and presented to the city a building site for the establishment of a "University of Arts and Trades," for the promotion of knowledge in these and the related sciences by means of lectures and oral instruction; of models and representative works of art; of museums of the mechanic arts, and of whatsoever else may serve to furnish artists and artisans with the best facilities for high culture in their respective occupations, in addition to those furnished by the public schools.

Echoes in Public Buildings.—The *American Railway Times* describes a novel method which has been adopted to prevent the recurrence of an echo in the new court-house at Bloomington. A Mr. Carlock suggested that the stretching of small wires at a proper height and at suitable distances would be of great benefit. This was tried, and the effect proves to be a vast improvement. The theory is, that the wires (so small as to be hardly visible) break the sound-waves and prevent the reverberation, hitherto the chief obstacle and annoyance. Three or four wires only, crossing the room, were found sufficient to effect this wonderful change.

The Gas-Stokers' Strike.—The *Mechanics' Magazine* sums up the result of the gas-strike:—"The only ultimate results of their ill-judged proceeding will be to stimulate invention in the three-fold path, firstly, of improvements in storage and the prevention of waste by leakage; secondly, of superseding manual labour to a larger extent by the aid of steam and mechanical appliances; and, thirdly, of superseding gas itself as an illuminating agent, to a considerable extent, by the utilisation of hydrocarbons, and by the practical adaptation of the magnesium, oxy-hydrogen, or electric light. In all these respects there is an almost unlimited field." The production of what is called "air-gas," *i.e.*, air passed through a liquid hydro-carbon, is carried on to a considerable extent in America. For lighting purposes on a larger scale, however, it is said not to be found very efficient.

Mr. Abbot on Examinations.—At a recent meeting of the National Association for the Promotion of Social Science a paper was read, by the Rev. E. A. Abbot, on "The Proposed Examination of First Grade Schools by the Universities." Of this scheme Mr. Abbot is a strong advocate, and, amongst other arguments, he remarked on the immense number of separate examinations now going on simultaneously through the country. Of course, he referred mainly to classical schools, but the general idea is equally applicable to all examinations. After enumerating numerous examinations for the younger boys—such as those for the Army, Navy, &c.,—he proceeded as follows:—"Later on, for boys of 18 or 19, impend other conflicting and multitudinous examinations for the army, for the civil service, and for matriculation examinations for different colleges. At Trinity College, Cambridge, and, I believe, at almost all the colleges at Oxford, there are distinct entrance examinations, most of them requiring the preparation of special books. It is not impossible that in one class a master may have a dozen boys or more preparing for twelve different examinations of this kind, in addition to their ordinary school-work. Surely the universities as well as the schools would derive benefit from a simpler system, diminishing this terrible waste of examining labour, and enabling teachers at the universities, instead of continuing school studies and school tests, to turn their attention to objects worthier of their powers. To sweep away, then, this multitude of conflicting examinations, to establish two efficient tests for all boys in England, one for boys at 16, the other for boys at 18 or 19, and to give these tests a substantial value by obtaining their recognition, either as preliminary or as complete tests for entrance to the university and to the legal and medical professions; and to do all this without destroying the freedom and individuality of our teaching, and the wholesome differences of our public schools—this must surely seem an object so obviously desirable, that the only question is whether it can be attained." *Mutato nomine de te fabula narratur*, and there are many opportunities for amalgamating examinations, and thereby saving both time and power.

Photographs of the Moon.—Some remarkable photographs of the moon have just been produced and exhibited at the Paris Observatory. They were produced by means of a powerful telescope and afterwards enlarged, and even small indentations and irregularities of surface and outline are perceptible; moreover, these views are stereoscopic. The earth not being large enough to subtend the necessary angle, the photographers of the Observatory, having obtained one picture, were compelled to wait until the moon herself had moved into a favourable position to take the second. The first photograph was taken on the 16th of September, 1868, and the second on the 13th of the present month of November.

A New Export.—The ship *Miltiades*, bound for London, has on board a shipment of 100 tons of bone dust prepared for exportation in an altogether novel manner, and one which promises to come into extensive use. The manufacture of bone-dust and other animal manures has greatly increased in Melbourne since meat-preserving operations commenced. By means of strong pressure the crushed bones are moulded into cakes of 6 in. square and 3 in. thick, something like flooring tiles, each cake weighing a little over 6 lb. These bone-dust tiles are just adhesive enough to admit of their being handled freely, thrown about like bricks if necessary, and are yet so free that when required for use they can readily be crushed or melted by the application of a little hot water. A ton weight of the manure measures twenty-six cubic feet, and contains 352 of the cakes. If the consignment per *Miltiades* is well received, the export of compressed bone-dust will probably prove a valuable addition to the commercial resources of the colony.—*Melbourne Argus.*

Coal in the Faro Isles.—The report received of the results of the examination of the coal measures in the island of Sudero, is very favourable. The exploring expedition sent out from Copenhagen was conducted by M. Johstrupp, the Professor of Mineralogy at the University of Copenhagen, assisted by a Silesian mining engineer and two practical miners. The coal seams at Prœstifildet are said to be of considerable extent and thickness. Fifty tons have been brought away for trial in various applications, with steam-generators, and for making gas, &c. If found of good quality it would be necessary for the government to construct a suitable port and accessories, buildings, and miners' dwellings.

NOTICES.

EXAMINATIONS, 1873.

The attention of candidates is drawn to an error in paragraph 55 of the Programme. After the words "accidence," the words "and in passages" should be inserted.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

THE LIBRARY.

The following works have been presented to the Library:—

Memoirs of the Royal Astronomical Society. Part II., vol. 39. Presented by the Society.

Quarterly Weather Report of the Meteorological Office. Part I., January to March, 1872. Presented by the Committee.

Memoir of the Late John Brogden. By R. Smiles. Presented by the author.

Statistics of the Colony of Victoria for the year 1871. Part V. Accumulation.

The Age of Tin. A pamphlet on Tinned Meat, Milk, &c.

INDIAN MEETING.

This Evening (Friday), at 8 o'clock, Capt. Lyon will exhibit his Photographic Transparencies, illustrative of Indian Architecture, Idols, and Every-day Life.

ORDINARY MEETINGS.

Wednesday evening, at eight o'clock. The next meeting will take place on:—

December 18.—"On Russia, her Industries, Commerce, and Means of Communication." By Leone Levi, Esq., Professor of Mercantile Law, King's College, London, and one of the Deputies to the International Statistical Congress at St. Petersburg.

CANTOR LECTURES.

The first course of Cantor Lectures for the present Session is on "The Practical Applications of Optics to the Arts, Manufactures, and to Medicine," by C. Meymott Tidy, M.B., Joint Lecturer on Chemistry, and Professor of Medical Jurisprudence at the London Hospital. It consists of five Lectures, the last two of which will be delivered on the following evenings, at eight o'clock:—

Lecture IV.—Monday, December 16th, 1872.

Polarised Light, and its Practical Applications.

Lecture V.—Monday, December 23rd, 1872.

Spectrum Analysis as Applied to Manufactures, illustrated in the Bessemer process, and to Medicine in the Detection of Blood.

MEETINGS FOR THE ENSUING WEEK.

Mon.....**SOCIETY OF ARTS, 8** Cantor Lecture. Dr. Tidy, "On the Practical Applications of Optics to the Arts, Manufactures, and to Medicine."
British Architects, 8. Mr. Heathcote, "Notes on the Architecture of Chester."
Medical, 8.
Asiatic, 8,

Tues....London Institution, 4. Prof. Rutherford, "The Nutrition of the Body."
Civil Engineers, 8. Annual General Meeting.
Statistical, 7¾. Mr. Ernest Seyd, "On Bank of England Statistics."
Pathological, 8.
Anthropological, 8.

Wed....**SOCIETY OF ARTS 8.** Prof. Leone Levi, "On Russia, her Industries, Commerce, and Means of Communication."
Geological, 8. 1. Mr. C. J. A. Meyer, "Further Notes on the Punfield Section." 2. Mr. J. Lucas, "On the Origin of Clay-Ironstone." 3. Mr. W. Johnson Sollas, "On the Coprolites of the Upper Greensand Formation, and on Flints." Communicated by the Rev. T. G. Bonney.
Royal Society of Literature, 8½.

Thurs...Royal, 8½.
Linnæan, 8. Dr. Masters, "The General Principles of Plant-construction."
Chemical, 8. 1. Mr. E. Ludwig Mayer and Dr. C. R.A. Wright, "On the Polymerides of Morphine and their Derivatives." 2. Mr. E. Nicholson, "Analysis of Water of the River Mahanuddy." 3. Communication from the Laboratory of the London Institution, by Dr. H. E. Armstrong. 4. Mr. J. L. Davies, "On Crystallized Coffee Sulphide, &c."
Numismatic, 7.
Philosophical Club, 6.
Zoological, 4.

Fri......Philological, 8¼.

JOURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, DECEMBER 20, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL

ALBERT GOLD MEDAL.

Mr. Henry Bessemer was received at Marlborough-house by the Prince of Wales, on Monday, the 16th inst., when his Royal Highness, as President of the Society of Arts, presented him with the Albert Gold Medal, awarded to him by the Society for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the Manufacture of Steel.

This medal was instituted to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has previously been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty the Emperor of the French, "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., "in recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that scienence by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the Department of Science and Art, and the South Kensington Museum."

REWARDS TO INVENTORS.

A suggestion has been brought before the Council, and is now under consideration, whether some steps should not be taken to form a fund in order to commemorate services rendered by inventors and manufacturers to national industry and progress. It is proposed that medals should be granted to inventors, and that an endeavour should be made, by the presentation of busts, pictures, or memorial tablets to public institutions, to establish some public record of such services. Any suggestions as to the execution of the project will be gladly received by the Council.

PRIZE FOR STEEL.

The Council have resolved to offer the Society's Gold Medal to that manufacturer who shall produce and send to the London International Exhibition of 1873 the best specimens of steel, suitable for affording increased security in the construction of locomotive and marine engines and boilers, and for other engineering purposes.

The conditions of the competition and further particulars will be published subsequently.

TECHNICAL EXAMINATIONS.

The Programme of Examinations in the technology of the Arts and Manufactures of the country, in reference to which notices have already appeared in the *Journal*, is now ready for issue. These examinations will be held annually, in conjunction with the examinations of the Science and Art Department, and due notice will be given of the particular subjects selected each year.

The 1873 Examinations will be held in the technology of Cotton, Paper, Steel, Silk, and Carriage-building. Candidates, in order to obtain certificates in any of these subjects, must pass the examinations of the Science and Art Department in certain sciences, which are specified in the programme as bearing upon the particular art or manufacture. In addition to these, special papers will be set in the technology of each manufacture, by examiners appointed by the Society of Arts.

The examinations of the Science and Art Department will be held during the first three weeks of

May, the technological paper being worked on the evening of the 14th May. The dates of the Science subjects are given in the Science Directory, published by the Science and Art Department.

In order that these Examinations may really be successful in promoting technical education in this country, it is desirable that encouragement should be given to candidates by the offer of prizes and scholarships. With this object the Council appeal to the trade guilds of the city of London, to merchants and manufacturers, and to members of the Society generally, to aid them by contributing to the prize fund.

INSTITUTIONS.

The following Institution has been received into Union since the last announcement:—

Ashby de la Zouch, Young Men's Mutual Improvement Society.

NOTICE TO MEMBERS.—EAST INDIAN VIEWS.

The second and concluding portion of the Photographic Transparencies, illustrative of Indian architecture, idols, and every-day life, by Captain Lyon, will take place this evening, Friday, the 20th of December, at 8 o'clock.

Captain Lyon sends the following explanatory statement:—

Words fail me to express my gratification at the very kind manner in which my humble efforts were received last Friday night, and this has emboldened me to try a second time to find an audience who will not grudge an evening to see and hear something more of the noblest appanage of the British crown, containing, as India does, 140 millions of inhabitants.

This time let us start again from Madras to the north, and, taking the rail towards Bombay, stop at the Tarputry station, and there visit a small ruined temple, which, like Avadea, Covill, and Tinnevelly, is built of the same hard dark stone, and is, if possible, even a greater marvel of Indian patient labour and skill.

Our route from thence will take us to the Cauvery River, and as it is not much out of our way, we must stop to see the Hoginkul, or smoking rock. There this splendid river, nearly a mile wide, suddenly disappears, to emerge in a succession of falls lower down, and the spray thus caused, as seen from a distance, has exactly the appearance of a column of smoke, rising many feet into the air—hence the name. Being now on the Mysore plateau, 2,000 feet above the sea, we will visit the Deria Dowlut, the Indian Alhambra, built by Tippoo, and owned and inhabited afterwards by our great Duke. Thence a short night's journey will bring us to Bailoor, where in the temple we shall find stone so exquisitely chiselled that it is scarcely possible to believe it is not Danish wood carvings we are looking at, very small but wonderfully delicate. The more one examines it the more one is puzzled to understand how any one could have even imagined, much less attempted, such a task; and yet here before us it has not only been attempted but accomplished, in such manner that no one who had not seen it would believe it possible. Luckily this temple is most sacred, so much so that no one is admitted while certain daily ceremonies are being performed; and this has saved it from the iniquitous spoliation which we shall find at Hallabeed, twelve miles further on, where we go next. This ruin is all that remains of the large capital of this district, formerly called Dwara Samudra, a city whose walls, four miles in circumference, can, some say, even still be traced. It is only quite lately that the jungle which completely surrounded this temple has been cleared away, and access to it thus become easy. It has long been deserted by the Brahmins, and no worship is ever performed there, and it has consequently been allowed to go to ruin, loafers from all parts having for several years been its sole visitors, who, armed with hammers, have only come to break off and carry away for sale many hundreds of the exquisite little figures which formerly adorned its walls. At last, but unfortunately not in time to save much of its beautiful details, though soon enough to prevent its falling to the ground, the government have awoke, and having built a wall around it, and repaired the roof, have appointed police to guard it from further spoliation. In this temple as in that of Bailoor the one great peculiarity we shall remark is the dissimilarity between the east and west sides. The former, 710 feet long, contains not less than 2,000 carved elephants, and is covered over its whole length with friezes, scrolls, and bas-reliefs, as we shall see. The latter contains a frieze nearly six feet high and 400 feet long, in which, carved with the minutest elaboration of detail, every god of the Hindu Pantheon finds a place. Shiva, with Parvati, is repeated at least fourteen times, and Vishnu even oftener; and I shall be able to introduce to you one or two whom you have not seen or heard of before.

As a marvellous exhibition of patient human labour, I fearlessly assert the world cannot produce its equal. Nor is it for industry alone that this building is remarkable. The mode in which the Eastern face is broken up by the larger masses, so as to give height and play of light and shade, is a better way of accomplishing what the Gothic architects attempted by their transepts. If these friezes were spread along a plain surface they would lose more than half their effect, but here the artistic combination of horizontal with vertical lines, and the play of outline and of light and shade, far surpass anything in Gothic art. The effects are just what the mediæval architects were often aiming at, but never attained so perfectly as has been done at Hallabeed.

As we are now so close to the Neilgherry, or Blue Mountains, let us leave the fearful heat for a few minutes, and, ascending the excellent road up the side of the hills, find ourselves in a delightfully cool temperature, although still within eight degrees of the Equator. The succession of waterfalls, caused by the river, which falls 5,000 feet in the short space of two miles, is quite as pretty as any to be found in Europe. We will also make acquaintance with the Todas, the aboriginal inhabitants of these mountains, and I will show you the only spot in the world where the oak and orange tree may be found growing side by side. Here also you will see hedges of heliotrope four feet high and many years old; and it is a curious fact, that though I have known as many as 10 degrees of frost at night in those hills, the flowers are never killed, as is invariably the case in this country.

From the top of these hills, we must take even a greater jump than Hanooman, the monkey god, accomplished, as I explained last Friday, and we will alight in the middle of one of the most interesting spots in India, namely, the ruins of Vijianuggur or Beejnuggur, as it is usually called. This city, of which a large portion of the walls are still standing, covered an area of seven square miles, and for upwards of 200 years defied the whole power of the Mussulman armies. There we shall find a small temple dedicated to Hanooman, and it is curious as well as interesting to compare what remains of this Hindoo city with its rival, the Mahomedan capital called Beejapoor, which we will next visit. In both we note the same dreary desolation, every trace of human habitations having almost entirely disappeared. At the same time we cannot fail to remark that in the former, the beautiful stone temples alone remain to arrest our unqualified admiration, while in the latter there is nothing left of its ancient grandeur, except the splendid mausoleums which it was the custom of the monarchs to build during their lifetime, to receive their bodies after death. Further on to the north, in the Buddhist caves of Karlee, I will show you wood-work as old as the Christian era, and a wooden umbrella made 1,900 years ago.

In the royal city of Ahmedabad we shall have only time to admire the two beautiful windows in an old desecrated mosque; and I propose to ask you to be the judges whether these lovely representations of Indian foliage, cut out of hard granite, or a window at Beejapoor, or the screen of the Taj, bear off the palm in Indian sculpture. We cannot pass the Jains and their sacred hill of Shutroonije, with the many temples massed together, containing 3,600 images of marble and alabaster, without a short visit, if it is only to pay our respects to Rishabh, one of their first Tirthankars or deities. Thence, with another jump, to Allahabad, the capital of the North West, on, ever on to the Ganges, that sacred river, held in such veneration by the Hindoos that many of them prefer to be drowned in it to living away from it. We will follow it for a few miles, and rapidly see the well at Cawnpore, as well as the residency at Lucknow, places far too well known, and possessed of too real, though sad, an interest to need any further comments from me. Thence to Agra, to see the Taj-Mahal, that celebrated mausoleum of Shah Jehan, built of white marble, inlaid with precious stones, to erect which, like the Mundapum at Madura, cost one million of pounds sterling; and thus we have an opportunity of comparing how the Mahomedans and Hindoos spent their enormous wealth.

I can hardly ask you to leave India without a peep at an Indian prince; and, luckily, I have a maharajah, or emperor, who will be only too charmed to make your acquaintance, as he invariably is to receive all white people, and who, after treating them royally, informs them, as he will you, on Friday night, that you are "Fine fellows; capital fellows," to have come to see him.

PROCEEDINGS OF THE SOCIETY.

FIFTH ORDINARY MEETING.

Wednesday, December 18th, 1872, Lord ALFRED CHURCHILL, Member of Council, in the chair.

The following Candidates were proposed for election as Members of the Society:—

Colebrook, John, 15, Hans-place, Chelsea, S.W.
Dean, James, Clapham-common, S.W.
Henry, Wm. G. P., 11, Grosvenor-crescent, Edinburgh.
Lawrence, Lieut.-General Sir Arthur Johnstone, K.C.B., Fox-hill, Chertsey.
Lawson, John, Halifax.
Maynard, Frederick, 55, Old Broad-street, E.C.
Muzio, Augustus, 33, Highbury-grove, Highbury, N.
Nicholson, Vice-Admiral Sir Frederick E., Bart., C.B., 15, William-street, Lowndes-square, S.W.
Sandeman, Richard, Lenzie by Glasgow.
Scott, John Chastleton, Bickley, Kent.
Smith, Arthur, 44, Chiswell-street, E.C.
Taylor, John Edward, 12, Queen's-gate-gardens, S.W.

The following candidates were balloted for and duly elected members of this Society:—

Avery, Alderman Thomas, J.P., Church-rd., Edgbaston, Birmingham.
Baker, Richard, 9, Mincing-lane, E.C.
Barnard, Philip Augustus, 131, Regent-street, W.
Booth, James, the Grange, Ovenden, near Halifax.
Bowman, Frederic Hungerford, F.R.A.S., F.G.S., West Mount, Halifax.
Brewer, William Henry, M.A., 27, Grace's-road, Camberwell, S.E.
Chadwick, James, High-bank, Prestwich, near Manchester.
Culver, Edward, 25 and 26, Spencer-street, Goswell-road, E.C.
Dettelbach, Sigismund Maurice, Lime-street-chambers, Lime-street, E.C.
Dore, H. J., 39, Bruton-street, W.
Eck, Justus, Riga-villa, the Grove, Clapham-road, S.W.
Frölich, Theodor, 2, Park-villa, Lonsdale-road, Barnes, S.W.
Gibb, George, 19, Pembridge-square, Bayswater, W.
Hancock, C. F., jun., B.A., Hendon-hall, Middlesex.
Layton, Edward John. 2, Suffolk-lane, Cannon-st., E.C.
Le Mair, François, Osborne-lodge, Bexley-heath, Kent.
Nash, Wallis, 2, Suffolk-lane, Cannon-street, E.C.
Roche, Alfred Robert, 31, Palmerston-buildings, Old Broad-street, E.C.
Synge, Colonel Millington H., R.E., Alverscliffe, Alverstoke, Hants.
Wedekind, Hermann, 3, Great Tower-street, E.C.
West, Arthur Anderson, C.E., 62, Choumert-road, Peckham, S.E.
Whitley, John, West-house, Halifax.
Whitley, Nathan, Park-road, Halifax.

The Paper read was—

RUSSIA, HER INDUSTRIES, COMMERCE, AND MEANS OF COMMUNICATION.

By **Leone Levi**, Esq.,

Professor of Mercantile Law, King's College, London, and one of the Deputies to the International Statistical Congress at St. Petersburg.

The holding of another session of the International Statistical Congress called me to St. Petersburg this year. We met on former occasions at Brussels, Paris, London, Vienna, Berlin, Florence, and the Hague, and everywhere we were received by the government of the country with great honour and hearty hospitality. The Russian government offered every facility for our journey, and I accepted the invitation to the Congress, and attended it as one of the deputies for the Statistical Society. As for the choice of route, it practically rested between a sea route by Sweden, and a land route, either by Kœnigsberg and Eydkuhnen, or by Berlin and Warsaw. I decided to go by the land route *via* Warsaw, and to return by Stockholm, Copenhagen and Hamburg, and on Saturday, August 10, I, accompanied by my good wife and two dear friends, went from London, *via* Harwich, to Rotterdam—by an excellent boat, it may be, but with more on board than she was fit to carry with comfort; from Rotterdam to Utrecht; thence to Hanover and Berlin, and from Berlin by Bromberg to Warsaw. Utrecht is a quiet and handsome town, Dutch in character, and beautifully clean. At Hanover I saw the effects of the change of dynasty; and Berlin, since I last visited it, has become an imperial city, richer than ever in museums and monuments, but too many, alas! devoted to military heroes.

Warsaw, the ancient capital of Poland, I was glad to see, though I could not help feeling regret for the down-trodden city, where Kosciusko fought with so much valour for the liberty of his country. Yes, there she was, on the banks of the Vistula, with her palaces turned into barracks, and her monuments diverted from their intended purposes. But there is life in Warsaw, and there is a good deal of trade and industry. In 1869 the exports and imports of Poland amounted to about £17,000,000, the exports consisting principally of rye, wheat, timber, flax, and bristles. The railway has rendered Warsaw the best point of transit between Austria, Prussia, and Russia. From Warsaw our route was due north, almost a straight line to St. Petersburg, about seven hundred miles in length, and thus we had ample opportuuities of seeing a considerable portion of Russian territory. But how different from the usual English scenery! For miles and miles scarcely anything interesting attracted our notice. Before us was an interminable plain, not a hill to be seen, not even a valley. Surely nature is capricious in her gifts. Go to Italy, Switzerland, or Scotland, and you find the towering mountain, the precipitous rock, the fearful torrent, land and water, defying by their grandeur and sublimity the ability of the greatest artist to reproduce by the pencil or the chisel. Go to Russia, and travelling seems monotonous to a degree; but do not think that Russia is so uniformly flat. The Ural mountains, which form a natural frontier between European and Asiatic Russia, the Caucasus mountains also separating Europe from Asia, in the south, the Carpathian mountains in Bessarabia, and the hills of Finland, are all of considerable height.

What we noted on the road was the poor aspect of the agriculture, the sandy soil, the stunted trees, the rarity of farmhouses, and the almost total absence of sheep. How barren everything looked! For agricultural purposes Russia has been divided into seven distinct regions. The northern region, from the Gulf of Bothnia, to the northern part of the Oural Mountains, including Finland, Archangel, Wologda, and Olonetz, have very little of tillage land. The region of the Alaounes heights, or the plateau which separates the basins of the Dnieper and the Volga, is mostly forest land. The tillage land is not very fruitful; the meadow land scanty. The Baltic region, including Livonia, Courland, and Esthonia, is not very fertile, though somewhat better cultivated. The lower region, including some of the provinces through which we passed, has a very poor soil, and is principally forest land. The Carpathian region, embracing Ukraine and Little Russia, is the most fertile part of the empire. There is the region of the Steppes, including Bessarabia, Kherson, and Astrakhan—a land without trees, seldom watered by refreshing rain, yet eminent as pasture land. The Central region, comprising Kostroma, Moscow, Nijni, Wladimir, is rich in cereals. And the Oural region, including all the eastern part of European Russia, has a soil generally fertile. To show the difference between other regions and the one over which we passed, while Tula, Kursk, Vorones, Tambov, and Kief have from 60 to 70 per cent. of tillage land, the provinces on our wa have at most 40 to 50 per cent. If, then, we did not see any rich soil, or any well cultivated land they do nevertheless exist in Russia. Does not Russia supply us yearly with large quantities of grain? In 1861 only 12 per cent. of our imports of grain came from Russia; in 1871, the proportion was 35 per cent. In 1861 the total imports were 37,646,000 cwt., and from Russia 4,540,000 cwt.; in 1871 the total imports were 44,362,000, and from Russia, 15,670,000 cwt. The meadow lands of Russia are principally in Finland and Archangel, in the north, and in the Don Cossacks and Caucasian provinces in the south. In these provinces Russia has a large stock of some 25,000,000 head of cattle, and 45,000,000 sheep. As for horses, the great centre of horse-breeding seems to be at the very border of the Oural Mountains. Russia is stated to have 18,500,000 horses, when the United Kingdom has only 2,600,000. The great difficulties which hitherto have hindered the agricultural progress of Russia have been serf labour, want of capital, want of intelligence, bad roads, and great distances. Now serfdom, in principle, at least, is abolished, and the railways are providing new means of access to far distant provinces. May we not hope that, with these, capital and intelligence may also find their way thither, and that together they may tend towards the development of resources far exceeding our present expectation? It has been calculated that, whilst Belgium and the Netherlands produce 14 hectolitres of corn to every hectare of arable land, and England 13 hectolitres, Russia produces only 6 hectolitres. What if, by the means indicated, the productiveness of land could be doubled? With her immense area Russia might replenish the granaries of Europe with the greatest ease.

But fancy travelling in the interior of Russia in sumptuous railway carriages—how different as compared with the time when Richard Chancellor accidentally got into the Bay of San Nicholas, on the White Sea, landed near Archangel, then only a castle, and travelled on sledges to the Czar at Moscow! The first-class railway carriage in Russia is really luxurious. It is a saloon, with all the necessaries, and some of the elegancies, of such an apartment. It is furnished with looking-glasses, heated by porcelain stoves, and lit by lamps and candles. Along the sides soft divans are ranged, which, by a simple process, are turned into beds. But they are in no hurry in Russia; while here we travel at the rate of 30 to 40 miles an hour, there the ordinary rate is from 15 to 20 miles an hour. From St. Petersburg to Moscow, 430 miles, we employed 17 hours. The fares in the Russian railways are lower, of course, than in this country. The average fares on the five principal lines are as follows:—

—	Copecs per Verst.			Pence per Eng. Mile.		
	1st Class.	2nd Class.	3rd Class.	1st Class	2nd Class.	3rd Class.
St. Petersburg to Moscow	3·10	2·11	0·77	1·40	0·95	0·24
" Warsaw	2·96	2·20	0·92	1·33	1·00	0·46
Moscow to Nijni	4·9	2·27	1·13	1·33	1·00	0·51
Riga to Nunaburg	4·08	2·59	1·73	1·96	1·22	0·77
Odessa	2·95	2·21	1·06	1·33	1·00	0·46

The division of classes in the Russian railways is much more distinct than in the English railways. The third-class passengers are mostly peasants, clad in the most miserable manner, and many with visages almost forbidding. The stations are commodious, and the buffets well furnished, nor are the prices so extravagantly high as is often represented. On the whole, Russia is in a fair way of being largely intersected by railways. On the 1st September, 1871, there were in Russia 11,138 versts, equal to 7,351 miles of railway, and the capital employed in them was 918,000,000 roubles, equal to £122,000,000. In the United Kingdom the capital so invested in 1870 was £530,000,000. The number of passengers carried in Russia was only 12,000,000, against 330,000,000 in this country. Most of the Russian lines have a government guarantee of from 4½ to 5½ per cent. interest, and the actual dividends paid on the shares amounted in 1870 to from 5 to 7½ per cent. Two lines only seem eminently profitable, viz., the Moscow-Riazan line, which gave 17½ per cent., and the Koursk-Kiew line, which gave 31¼ per cent. The concession to the companies is generally for from 70 to 80 years. Very few lines now belong to the State. To Russia the railways are of the greatest possible advantage. From Moscow, the central *reseau*, you may now travel east as far as the Oural Mountains, north to St. Petersburgh, west to Koenigsberg and Warsaw, and south to Odessa, Sevastopol, and Astrakhan. And it is even contemplated eventually to extend the railway across the Oural Mountains, through Siberia, to China. Yet I doubt whether railway property will be profitable in Russia for many years to come, whatever be the ultimate result. The mass of the population in Russia are too poor to travel —they are not accustomed to it; the passport system interferes with it. There is nothing, moreover, to feed the lines midway, so few are the centres of population and traffic. And Russian produce consists mostly of grain and other bulky articles, which cannot stand much freight, and can as well be transported by water communication. It should be remembered that excellent means of communication exist in Russia in her enormous rivers and lakes. The Vistula, at Warsaw, looked beautiful, and the Volga, which we passed near Moscow, is more than ten times the length of the Thames. There is a canal communication, moreover, between St. Petersburg and the Caspian Sea, between the Baltic and the Black Sea, and between the White Sea and the Caspian. Only it is unfortunate that all the canals, lakes, and rivers, aye, even the seas of Russia, are closed by the ice for about seven months in the year. How important, then, to extend the railway system into the very heart of the country. In winter the railway must of necessity monopolise the whole traffic of the country.

It was a long way between Warsaw and St. Petersburg, requiring at least thirty hours of constant journeying, so we determined to rest at Wilna, the chief town of the ancient Duchy of Lithuania; but how poor did she seem to be! Wilna is well situated, in the hollow at the foot of several hills, and contains many objects of interest; but, as a rule, the towns and villages of Russia are poor and badly built. The houses are mostly of wood; the streets wretchedly paved. In many cases, moreover, the towns are not the spontaneous result of trade and industry, but the capricious plantations of civil administrators or military officers. The only towns of any importance in Russia are St. Petersburg, Moscow, Warsaw, Odessa, and Riga. In 1867 the entire population of the Russian Empire was not less than 82,000,000, and of this probably less than 5,000,000 was urban population. But why should St. Petersburg be the capital of Russia? Some cities have become capitals from the fact that the sovereign from time immemorial resided in them. Some owe their position to their favourable situation, and some to the fact of their containing the largest number of persons. St. Petersburg can claim neither of these titles. She is at the very extremity of the empire; she has none of the prestige which Moscow possesses, and she has but a small proportion of the population of the kingdom. While London has about 100 persons to every 1,000 of the population of the kingdom; Lisbon, 61; Copenhagen, 59; Athens, 55; Dresden, 55; Paris, 45; Berlin, 27; Constantinople, 22; Vienna, 14; St. Petersburg has only 7 to the 1,000. St. Petersburg is the capital of Russia simply because Peter the Great willed it; but a force greater than that of the emperor points to Moscow as the natural centre. But St. Petersburg is doubtless a beautiful city. As we entered the station in St. Petersburg an officer from the Congress communicated to us that the municipality offered to us its hospitality; that hotels had been provided for the convenience of members, and carriages placed at our disposal, so we drove at once to the Hotel Bellevue, on the Newski Prospect. And what a sight was before us in that street, more than three miles in length, full of bustle and animation. As a city St. Petersburg stands in favourable comparison with Berlin for life and cheerfulness. The magnificent Neva, which winds through the town, is infinitely superior to old Father Thames, though no forest of masts meet you at any of the quays. A pure sky and a dry atmosphere are preferable to our everlasting damp and fog. The low drowskies, with Ivan ever at hand, carry you over the otherwise tumble-down pavement with the greatest celerity. Something out of the common-place civilisation of Paris and London meets you at every corner.

It was the 21st of August when we arrived at St. Petersburg, when we found the temperature warm and genial. The thermometer was from 65 to 70 in the shade, and otherwise the climate was clear and dry; yet now and then we felt extremely cold; and I understand that, owing to such variations, the climate is very trying to health. Hence the general habit of wearing long heavy coats and closed up dresses at all times; hence the hermetically shut up windows and doors in the warmest days. But I have not seen St. Petersburg in winter, when the Neva is frozen, when snow and ice take possession of her streets for months together, when the drowsky is replaced by the sledge; when the fur clothing, the fur collar and sable hat, constitutes the costume of ladies and gentlemen. The temperature in Russia is regulated more by the longitude than by the latitude. The more eastward we go the greater is the difference between the temperature of summer and winter.

In matters of food and drink we had little difficulty. Our first care was to eschew altogether the water of the Neva, which, containing a certain quantity of magnesia, generally proves relaxing, especially to strangers. But, otherwise, no better food could be had than was supplied to us at the principal hotels. Our rouble dinner at the Bellevue was superior to any three-shilling dinner in London, and the wine was excellent. At a dinner at Moscow we had different descriptions of Russian wines, principally from the Crimea, and they were much appreciated. Mr. Beckwith, in his excellent report on fermented drinks at the Paris exhibition, said that the white wines of the Crimea are clear and dry, with a slight muscatel flavour and good body; and the red resembles very old port, bereft, however of its strength. In Mr. Beckwith's opinion these wines are very suitable to our climate. M. Tegobonski gave the production of wine at about 42,000,000 gallons, of which 8,000,000 come from the province of Stravropol, 8,000,000 in Bessarabia, 22,000,000 gallons in the Trans-Caucasian provinces, and the rest in the Crimea, the Cossacks, Khenan, Podolia, and Astrakhan. In Russia, Germany, and othern northern countries, the people generally eat black rye bread—very uninviting; but remember that, with the dryness of the climate, a portion of black bread, and other elements containing vegetable acids, are absolutely necessary to prevent scrofula, more especially among young people.

But we must regard Russia this evening from an industrial and not from an æsthetic aspect, and in so doing we must guard ourselves from considering the industries of Russia as limited entirely to the urban population. On the contrary, there are villages in Russia in which all the peasants are weavers, tanners, shoemakers, locksmiths, cutlers, &c. In Russia the peasant works for the manufacturer without quitting the village, and carries on himself the chief part of the commerce of the interior. I was informed that there is no peasantry more hard working than the Russian peasantry, and that the women are constantly employed not only in household duties, but in agricultural work, in weaving, bleaching, and many things which in England are done by machinery in factories and in manufacturing towns. Primarily, no doubt, Russia is an agricultural and not a manufacturing country. But, after all, agriculture is the greatest source of wealth to any country. England is by far the most industrious and the most mercantile country in the world. She supplies the whole world with her manufactures. She has the largest mercantile marine. Her power rests on her commerce and industry. Yet, with all this, the results of the income-tax shows that the income of all her industry is only about equal to her income from her agriculture and real property. Still greater is the supremacy of agriculture in Russia. In truth, Russia is wanting in some of the principal conditions for industrial prosperity.

Look at the map of Russia. She has no sea-coast of any importance. On the far east there are the vast plains of Siberia. On the west she has Eastern Prussia, quite as deserted and agricultural as Russia herself. On the north she has the glacial Pole; on the south none but semi-barbarous states. Add to this a population almost entirely composed of peasants; no coals in any quantity, or, at any rate, scarcely worked at all; very little capital; and every agent of manufacture extremely dear. What chance can Russia have in commerce and industry in competition with these sea-girt isles, or with well-favoured France or Italy? A mill in Russia costs double that of a mill in England. Bricks are dearer, and double the quantity is used to render the building substantial; mortar costs double, and so does all machinery. Consequently, but little factory labour is introduced into Russia. What there is, moreover, is to a large extent under the direction of Englishmen, Germans, Alsatians or other foreigners. British enterprise, British directors and overseers manage the best factories. In the south of Russia it is the same. Vice-Consul Stevens, of Nicolaieff, reported that the chief ganger at the granite quarrics at Alexandrovka is an Englishman; the director of the extensive Tchemornski sugar factory in Pattawa is the same; so are the superintending engineer of the Russian Steam Navigation Company at Odessa and his assistant; and the company's chief engineer in the Don mines; the one at Sevastopol; their boiler-master, their master-painter, and the heads of other departments are also Englishmen. The English, the French, the Germans, and the Greeks have a large share in the direction of Russian trade and industry. The Russian mind wants in power and in originality. It is better able to execute than to direct—to imitate rather than to lead. I visited a cotton printing factory in Moscow directed by an Alsatian, and I found that the labourers were Russian peasants, who come from the country when agricultural labour is impracticable, to recruit the earnings of the family. Such peasants are usually hired in gangs, the head of which assumes the management of the expenditure of the whole number. They live, I need not say, at very small cost, and at any time labour ceases in towns, they return to the country. There are not in Russia as in this country, millions of mechanics, spinners, or miners depending for their livelihood on the buoyancy of trade and manufacture. There is rather an intermingling of agricultural and industrial labour, and consequently an utter absence of the artisan class, the precarious existence of which we have so often to lament in this country.

But let us enter into some details. The first article of industry which naturally interests this country is cotton. Cotton is not produced in Russia, and her imports in 1867 consisted of about 2,600,000 poods, or about 100,000,000lbs. of raw cotton, and 150,000 poods of cotton yarn. Mr. Lumley, in his report on the trade and manufacture of cotton in Russia, gave the number of cotton spinning and calico weaving manufactories in the government of St. Petersburgh, in 1862, at 95, with 1,691,224 spindles, 16,141 power looms, and 8,040 horse power; and Mr. Michel, in his valuable report on the Russian tariff, told us that the whole quantity of cotton yarn manufactured in Russia is used as follows:—1,400,000 poods for printed calico, 200,000 poods for nankeen, red fustian, and Turkey red goods; 100,000 poods for plush, and the remaining 500,000 poods for various other cotton and half-cotton fabrics. Russian spinneries supply the weaving mills with yarn of low and medium quality; foreign yarn is alone employed for cotton tissue of superior description, such as fine calico, jacconet, and muslin. The manufacture of the common kinds of cotton fabrics, namely, calico, nankeen, red fustian, and handkerchiefs, intended chiefly for dyeing and printing, forms a branch of peasant industry, supported by the capital of manufacturers in towns, and particularly by that of owners of print-works. The consumption of cotton goods in Russia must be large. Supposing 60,000,000 peasants to consume 10 archines, or about 8 yards each, that would give about 480,000,000 yards. Add to this the consumption of 5,000,000 urban population at 20 archines each, or 15 yards each, 75,000,000 yards more, and we have a total of upwards of 550,000,000 yards. Yet, in the face of all this, all our exports of cotton to Russia in 1871 consisted only of 3,477 lbs. yarn, and 140,000 yards of goods of mixed materials, in which cotton predominated. Why do we not supply Russia more largely with our staple manufacture? Partly in consequence of a very high tariff, and partly also from want of adaptation of British goods to the taste and habits of the many races and nationalities residing in Russia. The tariff was somewhat reduced in 1868, the duties on cotton yarn from 16 to 20 per cent., and the duties on cotton manufactures from 22 to 27 per cent.; but still the present duties on the latter, of from £5 10s. to £23 12s. 11d. per cwt., must be considered as practically prohibitive. I shall not weary you with any description of the condition of other industries — of woollen, flax (on which I wished to make mention of Dr. Collier's new treatment), of leather, tallow, and metals—because, in reality, they are more or less governed by the same general circumstances.

Mr. Michel gives the following summary of Russian manufacturing industry:—

Nature of industry.	Number of works and manufactories	Number of workmen.	Value of production in roubles.
Cotton	606	69,347	71,725,459
Hemp and flax ...	225	22,259	11,405,686
Woollen	614	92,322	22,565,518
Silk	292	7,933	4,438,421
Dye works	204	3,919	4,196,603
Paper	170	13,203	5,275,816
Leather	2,471	13,245	18,164,897
Tallow	1,595	10,566	22,553,255
Wax	216	1,083	2,722,624
Pottery	289	4,178	1,321,078
Glass	210	10,744	4,402,774
Metals	713	47 379	28,688,124
Chemicals	377	6,136	23,193,817
	7,982	302,314	220,654,072*

Distillation of 27,000,000 vedros of pure spirits, equal to about 73,000,000 gallons.

Beer and mead brewed 7,900,000 vedros, equal to about 21,000,000 gallons.

Beetroot sugar produced, 3,300,000 poods.

Tobacco manufactured, 594,000 poods.

Iron raised, 15,781,000 poods.

One important element should not be omitted in any review of Russian industry. It is the possibility that ere long considerable quantities of coal may be obtained in different parts of the country. In the Don district the increase has been remarkable:—

	Tons.
In 1820 there were produced ..	350
1840 ,, ,, ..	800,000
1847 ,, ,, ..	2,860,000
1863 ,, ,, ..	6,350,000

The Moscow Exhibition gave evidence of the existence of coal in considerable quantity.

For the commerce of Russia St. Petersburg is by far the most important outpost, though Moscow is the centre of Russian industry. In both places there is evidence that the general movement of trade is extending rapidly. In 1859 the entire value of imports and exports amounted to 329,000,000 roubles. In 1869 it reached 592,000,000 roubles. Among the exports, grain, hemp and flax are by far the most important. Among the imports, cotton and metals stand foremost. An important change is observable in the foreign commerce of Russia, in consequence of the extension of railways. In 1859 the foreign exports by sea amounted to 130,000,000 roubles, and by land to 22,000,000 roubles, or about 16 per cent. In 1869 the exports by sea amounted to 190,000,000, and by land 95,000,000, or 50 per cent. Whilst bulky goods are sent by sea, lighter goods penetrate by land, chiefly from Prussia and through the Prussian frontier. It should be noted here that, while the commerce of Russia with European States has largely increased, her commerce with Asia has actually decreased of late. The Asiatic portion of the Russian trade is small as compared with the European, and yet considerable interest attaches to it, first on account of the primitive manner in which it still conducted, and secondly, in consequence of the intimate relation which exists between the extension of trade and the constant enlargement of the Russian empire. By incorporating Turkestan, Russia has come very near British India, and now she has commercial treaties with the Khan of Khokand and the Ameer of Bokhara and Dschiti Tchar. But what does it matter by what influence it is brought about, provided these States are rendered accessible to trade and civilisation?

Being in a certain sense the guests of the Emperor of all the Russias and of his august government, we were honoured with numerous invitations to receptions and excursions. One day we went to Cronstadt and Peterhoff. Another day we had a sail round the islands, and were entertained in one of the palaces of the Princess Helena, which at night was beautifully illuminated. What we most appreciated in these receptions was not so much the sumptuousness of the entertainments, as the consideration shown in making us what the English think they alone understand, but what other nations know quite as well — I mean "comfortable." To put us at ease—to anticipate our wants—to endeavour to speak our language—to put every individual and every thing in the right place, that is the perfection of hospitality.

The grandest excursion of all, however, was to Moscow, whose municipality was as courteous as that of St. Petersburg in supplying members of congress with hotel accommodation and carriages during their stay in the city. At first sight Moscow is by no means attractive. It seems an old city, badly paved, and with irregular buildings. But from such a height as the Sparrow-hill — the very ground whence Napoleon obtained his first glance of Moscow—the sight of the golden minarets and starry domes before you is quite unique and startling. According to arrangement, we visited the Polytechnic Exhibition at Moscow, an excellent one of its kind. I was not able to inspect it with any care or minuteness, especially as we visited the exhibition in great numbers, but it was apparent, first that Russian industry is by no means in such a backward state as is generally supposed; and, second, that British industry was most imperfectly represented. The exhibition — consisting of a number of pavilions alongside the garden of the Kremlin—did not seem to have much unity, whilst it was altogether destitute of a general *coup-d'œil;* yet it possessed many objects of great interest and attraction, and day by day we saw it visited by large numbers of people.

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* Equal to about £30,000,000.

At Moscow, as well as at St. Petersburg, but more especially in the latter place, I found British merchants of the highest respectability, numbering in all probably some 3,000, the living representatives, I suppose, of the Russia Company, with its agency at St. Petersburg, under the title of the British factory, founded by charter of Philip and Mary, about 300 years ago. The original charter confirmed by Act of Parliament granted that, "All the main lands, isles, ports, havens, creeks, and rivers of the mighty Emperor of all Russia and Great Duke of Musky, &c., and all and singular other lands, dominions, territories, isles, ports, havens, creeks, rivers, arms of the sea, and all and every other prince, ruler, or governor whatsoever, be or they be before the said late adventure or enterprise not known, or by the foresaid merchants and subjects of the said King and Queen by the seas not commonly frequented, nor any part or parcel thereof, and lying northward, northeastward, or northwestward, or in the said letters patent is mentioned, should not be visited, frequented, nor haunted by any of the subjects of the late King and Queen other than of the said company and fellowship and their successors, without express licence, agreement, and consent of the governors, consuls, assistants of the said fellowships and commonalty." That no such permission is now required to trade in Russia is well known, yet, singular to say, charges are still made by the Russia factory on British shipping using the port of St. Petersburg or Cronstadt, being first a charge of 3½d. per ton for the maintenance of the British Episcopal Establishment at that place and in aid of the poor's fund, and, second, a charge under the head of Company's Agent, which amounts to $1\frac{1}{10}$d. per ton. A few years ago some effort was made by the Hull Chamber of Commerce to procure the abolition of these charges, when it appeared that the tonnage duty, denominated Church Money, amounted, on an average, to only £2,200 per annum, and the agent's only to £956. But the charge, though light, is not less condemnable. The British factory has, in reality, long ceased to exist or to be needful; and I imagine that the British merchants in St. Petersburg, or such of them as are Episcopalians, should themselves pay for the church, and that the British government should pay for the agency, without taxing trade and shipping for such purposes. Generally, I need scarcely say, English merchants in Russia are as safe and protected as if they were in England. It should be remembered that the government of Russia now is not the arbitrary government that it was in former days. True, the Czar is autocrat absolute, but he does not act alone, and far less capriciously. He has a council of responsible ministers; he has a house of lords, of his own creation, doubtless, but yet able and willing to render him advice; he has a holy synod, and he has governors in every province, able to feel the pulse of public opinion, and with full power to meet the exigencies of the moment. And do not think that public opinion does not find itself vent in Russia. There are newspapers in Russia, though much under the power of the State. The silent protest under wrongs, the murmurs of the oppressed, the aspirations of the enlightened cannot be smothered even in Russia. But in truth Russia is tranquil at this moment, and the Emperor has the heart of the people with him. Nowhere did I see any parade of military force, as we are wont to see in turbulent Paris or in imperial Berlin. As for the people, it is, I fear, as yet in a low condition. The mass of the peasantry recently emancipated has scarcely risen from the position of serfdom. The industrial classes are ill-paid, ill-fed, and in the depth of ignorance. The middle classes scarcely exist in Russia. The nobles do not exercise much wholesome influence. The priests hold an inferior position to what we are accustomed to in this country. Something is, however, done for the education of the people. There are nine universities, three lyceums, 23,000 schools, and nearly 1,000,000 students in the public schools in Russia. The freedom of serfdom is a most significant fact, the fruit of which will one day appear. What may be the future of the Russian people, when free and educated, we cannot say. Meanwhile, trade is increasing, the country is progressing, and the railway opens up the country in a wonderful manner. As far as I can see, I venture to say the Russia of the future will be far different in power and enlightenment, in commerce and industry, from the Russia of the past.

Ere I close, permit me to express my own sense and the sense of every foreign member of the International Statistical Congress, of the kindness shown us by the Russian government on the occasion of our visit to Russia. Would that England received in like manner men of science from other countries when they come to her soil. It would be well if her example were more conspicuous for a liberal expenditure than for a niggard economy in all matters which concern the promotion of science and art. Would that the same co-operation on the part of the officers of State could be secured for the meeting of scientific congresses in London as is so readily obtained in other countries. Perhaps it may not be in vain that her messengers to Russia, to Italy, to Holland, and to every state where the International Statistical Congress has been held, are able to report that a reception the most courteous, the most hospitable, the most considerate, is everywhere accorded to men of science when they meet together for the elucidation of great questions, either of social economy or of scientific importance.

DISCUSSION.

Mr. Hyde Clark said it would, no doubt, be acceptable if he referred to the part taken in the Moscow Exhibition by the Society of Arts. It was perfectly true, as had been stated, that the objects sent from this country to that exhibition were very few indeed. but he held in his hand a list of prizes awarded to English exhibitors, embracing, with that liberality which Professor Levi had referred to, medals of gold, silver, and bronze to a considerable number. It was, of course, a matter of regret to all parties that English industry was not better represented; but he had hoped that Professor Levi would have dealt a little more largely with the causes of this deficiency. No doubt one great influence was the Russian tariff, and he thought it a pity that the delegates to the Statistical Congress did not take the opportunity of pressing upon the Russian government the importance of modifying their arrangements in this respect, and pointing out how seriously trade was impeded by these difficulties. One other important point had been referred to, viz., that English manufacturers and merchants were too little in the habit of consulting the requirements of the population of the various countries with which this country had commercial relations, and no doubt it was of the greatest importance that the representatives of commercial houses abroad should be acquainted with the foreign languages, so that they might be better able to observe the habits of the people, and carry home such information as would enable manufacturers here to conform to the habits and requirements of the various classes of people who ought to be all customers of England, and in this way contributaries to the propagation of civilisation throughout the world. It was, he believed, the fact that the Germans had profited greatly by the Moscow Exhibition, and had increased the amount of their trade with Russia in consequence. No doubt this was partly owing, as Professor Levi had stated, to their being better situated for getting access to Russia by through railway accommodation. To complete the brief description which had been given of the Moscow Exhibition, he might refer to the detailed account given in a recent number of the *Journal* of the Society by Professor Archer. He was informed by the Secretary that sixty-five English exhibitors had received awards, in the shape of either gold, silver, or bronze medals, which was very gratifying to all parties concerned. In conclusion, he must beg leave to object to the observations of Professor Levi with regard to the Russia Company; for, although he was always anxious to promote the cause of great principles in political science, be was afraid that some persons were too apt to carry principles so far as to forget details. Those who had been in foreign countries, where there had been any of these old factories established under the statutes of Philip and Mary, or Elizabeth, found the great benefit of them in various ways. In such cases the community had been enabled, year after year, to provide for the requirements, not only of the resident English population, but of those strangers who resorted to the place. It was said that if the merchants of St. Petersburg wanted to worship according to the Church of England they might pay for it themselves; but he did not think that was the general opinion in St. Petersburg, even of those not belonging to the denomination, and it must be remembered that the funds of such institutions were devoted, not only to religious matters, but to the support of hospitals, and to the care of the graveyards in which those strangers who were unfortunate enough to die abroad were interred.

Mr. Nicholson, as one of the few English exhibitors, regretted that the learned Professor had not been able to do something with the government of Russia to facilitate trade with this country, for, unfortunately, it took longer to get goods by sea to Moscow than to send them to Australia. In fact, three or four months was not an uncommon time for the transit of goods to occupy, and it might easily be seen that such a state of things tended not to facilitate, but to retard trade. The delay took place between Cronstadt and St. Petersburgh; but what was the cause of it he could not ascertain. He was one of the fortunate individuals who had the honour of a gold medal, which, no doubt, he would receive if he chose to pay for it, for he found that was the condition on which it would be sent to him; the explanation offered being that the Exhibition was such a severe loss to the guarantors that they could not afford to give the gold medals which they had so generously awarded. He quite agreed with the description given by Professor Levi as to the condition of the country, having traversed a great part of the same district, and it was certainly one of the most monotonous conceivable; at the same time, he believed that if he had gone south of Moscow he would have seen a vast difference in the nature of the country.

Dr. Collier said he, also, was an exhibitor at Moscow, and had remained in Russia more than five months, not staying in one spot, but travelling through the whole country, so that he was capable of forming a general opinion of Russia, the country, and its people. With regard to the scenery, it must be remembered that you could not judge of it from a railway, which was generally made in the most direct line from point to point; and the line referred to in the paper happened to pass through the least cultivated portion of the country. To judge of a country by the barren waste passed through in that way would be both illiberal and unjust. He had a very high opinion of Russia, having met there a degree of intelligence, and a class of men, which he had not met with in any other part of the world, either in England, France, Germany, or America, of which place he was a native. He there met with men who understood what they were talking about, and who possessed a degree of modesty and quietness which was not characteristic of the Western nations. He was happy to say that he had received a grand gold medal for some machinery which he had exhibited, invented by himself, through the medium of the Society of Arts. It was a design for the manipulation of flax and hemp by means of the hands, being the first, he believed, of the kind. There were two machines, one for scutching the flax by means of the feet, the other being used for breaking the flax prior to the scutching. As to the cost of the medal, he was not at all fearful. Besides, the award itself was really all that was valuable, and if a man had that he did not need the medal itself, for he did not want to wear it on his breast. He had had the pleasure of associating with all classes of the people, and of shaking hands with the Emperor. Whilst in Russia he visited probably one of the greatest sights that could be seen, viz., the great fair at Nijni, where there were collected about 450,000 persons from all parts of the eastern empire. He was happy to say that he associated with them, drinking tea and coffee with the Turks, Arabs, Tartars, and every kind of people, and with a little Russian which he picked up, a little French, and some other languages, together with the help of signs and tokens, they managed to understand one another. In fact, wherever a man travelled, if his manners were gentlemanly and courteous, he would always find friends. With regard to the Moscow Exhibition itself, he considered it a model of perfection, for though it was not very large, he saw things there which he had never seen elsewhere, though he had visited every large International Exhibition since the one in London in 1851, and had exhibited in them all with the exception of that one. The Moscow Exhibition, however, was more perfect in character, and more systematic than any he had seen, and for instruction and education, as Professor Archer had stated, stood in the first rank. With regard to transit of goods, he had had them sent to him from England, and they reached Moscow in two weeks, and he could not understand, therefore, the delay which other gentlemen had experienced. Of course, there was a certain class of people in Russia who required to be paid, as there were all over the world, and if you wanted their good offices you must put your hand into your pocket to obtain them.

Mr. James Warden said he could confirm the statement as to the delay. He had been to Cronstadt and St. Petersburg, and he believed one explanation of it was to be found in the fact that almost all the steamers were too large to go up to Cronstadt. On inquiring of his agent in St. Petersburg for some goods which had been sent off some time before he himself started, he was told it was no use to think of London expedition in Russia, for all the men who looked at the goods first would require a week to think over what they should do with them. He believed, on an average, a month's time was often occupied in the transit, and that at least three parts of that time was occupied between the two places mentioned. With regard to the Custom obstructions, it was his experience that the officials were not only paid by the government, but each one expected to be paid by every one who came in contact with them. He should like to ask, if time would allow, that the list of awards be read.

The Secretary said the list was rather a long one, but it would be published in the Society's *Journal* on Friday.

Mr. Head said he had travelled throughout the length and breadth of Russia, and had much pleasure in endorsing almost everything which had been said by Professor Levi. With regard to the difficulties of trading with Russia he did not personally think it was on account of the increase in tariff, but it arose more from the want of adaptation by English manufacture to the wants of the country. Twenty years ago a large proportion of the Russian trade was done in England; the Russians came over here, were pleased with what they saw, and bought largely; but now things are altered, and if Englishmen wanted to trade with Russia they must go into the country and mix with the people, as they did with other men of business; they must speak some language which they understood, and, in fact, suit themselves to their customers. The Germans had taken a great deal of trouble to adapt their manufactures to the country, and in this respect, no doubt, they had stolen a march upon England. He had been also present at the Moscow Exhibition, which was certainly a very interesting one, although he could not quite endorse all that Dr. Collier had said. For instance, he did not think the Russians were equal to some other nations with regard to the trials which took place and the awards made. No doubt that arose in a great measure from their not having so much practice and experience; at some future time, probably, this would be improved. It certainly behoved England to cultivate trade with Russia, as far as possible, for he believed there was a great similarity between the two nations. Each was a trading people and an aristocratic people, and each, he believed, had a great future before them. It was very pleasing also to find that an Englishman, wherever he went in Russia, was received as well, if not better, than any other foreigner.

Mr. Christopher Cooke asked if it were the fact, as had been been stated, that when an Englishman arrived in Russia his books and papers were taken away by the police, and that, in fact, only a certain kind of books were admitted at all. It had also been said that if a person even had anything wrapped in newspapers to form a parcel, the papers were destroyed as a matter of course. If such was the case, it was very desirable that it should be known.

Mr. Warden said he believed it was not so.

Mr. Nicholson said it was impossible to get an English newspaper in Russia. He had one forwarded to him every day while he was there, but not one reached him.

Dr. Collier said he saw the *Times* every day.

Sir Charles Dilke, M.P., said the fact was newspapers could not be obtained by private individuals in Russia, but they might be got through a recognised agent. Under such circumstances foreign papers were seldom interfered with, though it did sometimes happen that a whole column or more would be obliterated. A strict censorship was exercised over books also, but occasionally a few were allowed to pass. As a general rule, however, they were rigidly excluded, and if a traveller had any quantity with him, they would be taken away at the frontier, forwarded to St. Petersburg for examination, and probably returned to him on application. He should like to ask on what authority the statement was made of there being 1,000,000 scholars at school in Russia, as he considered it rather doubtful. In 1866 there were only 300,000 children at school, and in 1869, 800,000, and any statistics from the Russian education bureau must be received with the greatest suspicion. There had never been any real educational census, and no adequate returns were received from the Russian parishes. He very much doubted, from an examination he had made in many villages and towns, whether there were so many under instruction now as there were before the abolition of serfdom. Previous to the change, a large, number of schools were kept up by the great proprietors which had now been abandoned, whilst very few new ones had been established in their place. Unless, therefore, Professor Levi had some private information to corroborate the government returns, he must take leave to doubt their accuracy.

Mr. Clay, having resided some years in St. Petersburg, as the representative of the United States, said the course of trade was altered from what it had been. Formerly the English trade was almost all in the hands of British merchants resident there, but now he understood that Russians in the interior ordered goods direct from England.

The Chairman, in moving a vote of thanks to Professor Levi for his valuable and interesting paper, said there was no doubt that Russia, like all European nations, had a great future before her. She had enormous resources and an enormous extent of territory, including about three-quarters of the northern portion of the globe, and, therefore, seeing the influence which she could bring to bear on the trade and policy of the East, it was of the utmost importance that everything connected with her should be thoroughly known and ventilated as far as possible. Great thanks were therefore due to Professor Levi for the paper he had read, and many of the statements it contained were of rather a startling character. For instance, it appeared that the importations of grain from Russia to England had increased from 12 to 35 per cent. of the whole since 1860, which was a most remarkable fact, and showed how much we depended on Russia for our food supply. Again, it was shown that the produce in coal had been very largely augmented, and seeing that the last return was nearly ten years old, there was no doubt that a still greater increase would appear if later figures were accessible. Now, wherever coal was abundant, it was a sign of prosperity, cheap fuel being the life and soul of manufacturing industry. No doubt, therefore, as the supply of coal increased, so would Russian industry; and, according to the principles of free trade, by which every nation ought to produce that which it could most favourably, she would supply England with goods which would be paid for in manufactures, which the latter country was better calculated to produce. It, therefore, would augur well for the peace of the world that the prosperity of Russia should continue and increase.

The vote of thanks having been passed,

Professor Levi replied to the various observations which had been made. With regard to Mr. Hyde Clarke's observations, he had only to say that the delegates to the Statistical Congress went to Russia for a specific purpose, and could not properly mix themselves up with political or other questions. But in any case, seeing that England continued to raise about twenty-five millions by customs duties, which impose so many restrictions on trade, she did not offer a very good example of free trade to others. Speedy transit was no doubt of great importance, and he sympathised with Mr. Nicholson's complaint in that respect, and, indeed, even in the case of passengers there was often a great deal of delay. A new route had been suggested, which might eventually prove to be of importance. Cronstadt is closed for four or five months in the year, by reason of the Baltic being frozen, but it has been suggested that goods might be sent to Gothenburg, in Sweden, which port was always open, and thence by rail to Stockholm. A little beyond Stockholm there was a small place, in salt water, which was always free; and, again, a little beyond Cronstadt, there was another small place, also in salt water, between which an open communication might be had throughout the year. It was proposed to make a good harbour at each of these places, and establish a line of communication, so that goods might go direct to St. Petersburg or Moscow without stopping. With regard to the tax now levied by the so-called Russian factory on British shipping, what he objected to was the levying of a tax at the present day on all traders for purposes which ought to be provided for in other ways. If it was an old foundation, as Mr. Hyde Clarke had said, it would be different. With regard to books and papers, his own experience had been most favourable, not having received the slightest annoyance in that respect, but then he was travelling under exceptional circumstances, having an invitation from the Russian government, which smoothed away all difficulties; but a friend of his, who did not possess this advantage, had met with the same civility, and his books were not interfered with. It was said that you could not leave Russia without a permit, but neither he nor his friend had found this to be the case, Warsaw being the only place, indeed, where their passports were inspected, and that was rather an exceptional locality. No doubt the passport system was a very bad one, but it existed in other places as well as Russia. He should be very glad to see it abolished, particularly the internal passports, which was a great hindrance to progress and improvement. He could not answer Sir C. Dilke's question as to the educational statistics satisfactorily, the figures given being from official sources, and he could not, therefore, vouch for their correctness; but, after all, a million scholars out of a population of 80 millions was not a large proportion, Britain having probably as many out of only 24 millions. He had himself seen many schools in Russia in factories, where the priest came to instruct the scholars. Those who had been in Russia, even a few years ago, could not well realise the altered position of the country at the present time.

PROCEEDINGS OF INSTITUTIONS.

Westminster Working Men's Club. — The twelfth annual meeting of this club, established (in connection with the Society of Arts) in Old Pye-street, near Victoria-street, Westminster, was held on Tuesday evening, under the presidency of Sir R. W. Carden. Among those present were the Rev. Dr. Barclay, the Rev. Dr. Paterson, and Miss Cooper. A report was read, which spoke in most satisfactory terms of the condition of the club, and the work it had effected during the past year. Courses of gratuitous lectures had been given, and the various institutions in connection with the club were all in a flourishing state. After addresses from the Chairman and other gentlemen present, a very satisfactory meeting was broken up.

The trigonometrical survey of Palestine is now in active progress in connection with the Palestine Exploration Fund. Contributions towards its completion are urgently requested by the managers of the fund.

A trial trip was made, on November 22nd, in New York, of a Remington street traction engine and car. It is said that the horses everywhere were greatly frightened, but that otherwise the trial was very successful.

ANNUAL INTERNATIONAL EXHIBITIONS

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

His Royal Highness the Prince of Wales presided on Monday, at Marlborough-house, over a meeting of her Majesty's Commissioners for the Exhibition of 1851. There were present—His Royal Highness the Duke of Edinburgh, his Royal Highness Prince Arthur, his Serene Highness the Duke of Teck, Earl Granville, Mr. Ayrton, Sir William Anderson, Major-General Sir T. M. Biddulph, Sir Francis Grant, Sir Francis Sandford, Mr. Edgar Bowring, Mr. Cole, Mr. Gibson, Mr. Hawksley, Dr. Playfair, Mr. Thring, and Major-General Scott, secretary.

The second meeting of the Committee for Carriages was held last Friday, at Gore-lodge, Mr. Peters in the chair. Applications for the exhibition of 127 carriages were laid before the Committee. It was announced that the time during which cabs intended for competition for the prizes offered by the Society of Arts must have been running, had been reduced from three months to one month. The Committee resolved to fix an early day in January on which to meet the Committee appointed by the Coachmakers' Company to assist her Majesty's Commissioners. Mr. Cole, C.B., and Capt. Clayton, R.E., attended the committee.

The Committee for the class of Cooking held its third meeting at Gore-lodge, on the 14th December, and recorded a recommendation that her Majesty's Commissioners should provide a kitchen, with an adjacent refreshment-room, and set them apart for the sale and consumption of those descriptions of cooking prepared by the advice of the Committee, and that a competent superintendent of cooks should be engaged for the purpose. The following gentlemen were present—Mr. James Bateman, F.R.S., Dr. Thudichum, Mr. F. B. Alston, and Captain Horne, R.E. Mr. Henry Cole, C.B. was present on behalf of her Majesty's Commissioners; and Captain Grover, R.E., and Lieut. H. H. Cole, R.E., attended the meeting. It was decided to hold an adjourned meeting on Saturday, the 18th of January, next.

On Tuesday the third meeting of the Committee for Silk and Velvet was held. The committee recommended the formation of a sub-committee of ladies, who would interest themselves in obtaining a collection of old silks. A number of applications from manufacturers at Derby, Coventry, Leek, and Leicester, was laid before the committee. There were present, Sir Daniel Cooper, Bart., in the chair; Mr. Blakely, Mr. Cassells, Mr. Hyde Clarke, Mr. Cobb, Mr. Corbière, and Mr. Lintilhac. Mr. Cole, C.B., and Captain Clayton, R.E., attended the committee.

The second meeting of the Committee on Recent Scientific Inventions and New Discoveries took place on Wednesday last at the offices, Gore-lodge, South Kensington. Mr. C. B. Vignoles, F.R.S., was voted into the chair, and among those present were Mr. F. A. Abel, F.R.S., Major Frank Bolton, Professor E. Frankland, D.C.L., F.R.S., Professor T. M. Goodeve, M.A., Major-General H. D. Harness, C.B., Mr. J. Hick, M.P., Dr. D. S. Price, F.R.S., and Mr. C. W. Siemens, D.C.L., F.R.S. Major-General Scott, C.B., Secretary to Her Majesty's Commissioners, attended the meeting, and Captain Grover, R.E., was present as secretary to the Committee. The Committee considered the applications received since their last meeting, and suggested certain recent inventions of importance and interest, which should, if possible, be represented in the London International Exhibition of 1873.

The return of fine art sales in 1872, registered through the official price clerks, has been published as amounting to £10,000. But this does not include what was effected through the French and Belgian commissions, or privately by artists. The total amount of sales is estimated as amounting to over £30,000.

EXHIBITIONS.

MOSCOW POLYTECHNIC EXHIBITION, 1872.

The following is the official list of Awards to English exhibitors:—

Earl of Tankerville—Honorary Prize of the 1st Class, with the Signature of H.I.H., the Grand Duke Constantine.
J. Colman, Norwich—Honorary prize 1st class.
Macclesfield Chamber of Commerce—Honorary prize, 2nd class.

William Blews and Sons, Birmingham—Grand gold medal.
J. and T. Brocklehurst and Sons, Macclesfield—Grand gold medal.
J. E. and W. Christy and Co., Stockport—Grand gold medal.
Clayton and Shuttleworth, Lincoln—Grand gold medal.
Barnet Solomon Cohen, London—Grand gold medal.
J. and J. Colman, Norwich (for rice starch)—Grand gold medal.
Dr. R. H. Collyer, London—Grand gold medal.
Dickins and Co., Manchester—Grand gold medal.
James Dalziel Dougall, London—Grand gold medal.
English Condensed Milk Company, London—Grand gold medal.
John, Charles, and John Field, London—Grand gold medal.
R. Garrett and Sons, Saxmundham, Suffolk—Grand gold medal.
Greenwood and Batley, Leeds—Grand gold medal.
The Kirkstall Forge Company, Leeds—Grand gold medal.
Langton and Bicknells, London—Grand gold medal.
D. Leonardt and Co., Birmingham—Grand gold medal.
Merryweather and Sons, London—Grand gold medal.
C. Mitchell and Co., Newcastle-on-Tyne—Grand gold medal.
Piesse and Lubin, London—Grand gold medal.
Platt Brothers and Co. (Limited), Oldham—Grand gold medal.
Price's Patent Candle Company (Limited), London—Grand gold medal.
Ransome, Sims, and Head, Ipswich—Grand gold medal.
Thomas Tapling and Co., London—Grand gold medal.
Whitley Partners, Leeds—Grand gold medal.
Wouldham Cement Company, Wouldham, Kent—Grand gold medal.
William Younger and Co., Edinburgh—Grand gold medal.

M. J. Valente Allen, London and Oporto—Gold medal.
The Broughton Copper Company (Limited), Manchester—Gold medal.
C. Budde and Co., Birmingham—Gold medal.
Clarke and Dunham, London—Gold medal.
Allen Everitt and Sons, Birmingham—Gold medal.
John B. Gausby and Co., Birmingham—Gold medal.
Jenson and Nicholson, London—Gold medal.
Frederick Smith and Co., Halifax—Gold medal.
William Soper, Reading—Gold medal.
Swainson, Birley, and Co., Manchester—Gold medal.
Watts, Blake, Bearne, and Co., Newton Abbot—Gold medal.
Wood and Ivery, West Bromwich—Gold medal.

Bryant and May, London—Grand silver medal.
Samuel Clarke, London—Grand silver medal.
J. and J. Colman, Norwich (for corn flour)—Grand silver medal.
W. W. Cornes and Co., Macclesfield—Grand silver medal.
Critchley, Brinsley, and Co., Macclesfield—Grand silver medal.
Enghert and Rolfe, London—Grand silver medal.
Fortnum, Mason, and Co., London—Grand silver medal.
Grant, Chambers, and Co., London—Grand silver medal.
J. O. Nicholson, Macclesfield—Grand silver medal.
Potts, Wright, and Co., Macclesfield—Grand silver medal.
John Rabone and Sons, Birmingham—Grand silver medal.
Josiah Smale and Son, Macclesfield—Grand silver medal.
Charles Sandford Windover, London—Grand silver medal.

Baxter Brothers, Dundee—Silver medal.
J. and H. Bermingham, Leek—Silver medal.
— Blight—Silver medal.
W. Bullock, Macclesfield—Silver medal.
Cox Brothers, Dundee—Silver medal.
J. S. Fry and Sons, Bristol—Silver medal.
J. and F. Howard and Sons, Bedford—Silver medal.
Donald Nicoll, London—Silver medal.
William James and Henry Thomson, London—Silver medal.

J. H. Burke, Dublin—Bronze medal.
H. S. Cropper and Co., Nottingham—Bronze medal.
A. A. Davis and Co., London—Bronze medal.

The Vienna Exhibition.—It is stated that great prebarations are now being made at Vienna for the reception of foreign visitors to the Exhibition. A conference of representatives of the Austrian and foreign railways has recently taken place, with the object of arranging a special reduced scale of railway fares to and from the Exhibition, and it is intended to open offices at the different Vienna railway stations for providing visitors with lodgings. It is also said that a special department is to be set aside in the Exhibition for women's work. It will be divided into four sections; one for work from women's schools, one for household work, one for industrial and artistic work, and one for literary work. From India we learn that the Viceroy has sanctioned an expenditure of a lac of rupees for the purpose of purchasing and forwarding Indian produce and articles of art and manufacture to the Vienna Exhibition. Bombay gets £1,500; Bengal, £1,800; Madras, £1,700; Punjab, £1,200; North-Western Provinces, £1,000, and so on.

Santiago Exhibition.—The interest which was taken in this Exhibition in Chili is increased by the fact that about 2,000 persons arrived over the Southern Railway daily to visit the Exhibition. The indefatigable Intendente of Santiago, Don B. V. Mackenna, encouraged no doubt by the brilliant success of this festival of talent and industry, had decreed two other local shows to be held, one in December, of flowers and plants of ordinary and hothouse culture, the other of fruits and vegetables, from March to April, 1873. The National Society of Agriculture is preparing to send a collection of the various agricultural productions of Chili to Vienna next year.

International Exhibition in Philadelphia in 1876.—In an official notice, issuing from Mr. W. P. Blake, Executive Commissioner, Philadelphia, it is notified that the anniversary of the independence of the United States in the year 1876, is to be celebrated by an exhibition of the products, arts, and industries of the country and of the world. This is in accordance with an act of congress approved March 3rd 1871. By this act the task of preparing and superintending the exhibition was imposed upon the United States Centennial Commission, consisting of two members from each of the states and territories. The Commissioners have twice met in general session, a permanent organisation has been effected, and the chief outlines of the plan for the exhibition have been agreed upon. This exhibition is to be international and universal—international inasmuch as all nations will be invited to participate in it, and universal, because it will include a representation of all natural and artificial products, all arts, industries, and manufactures, and all the varied results of human skill, thought, and imagination. The outlines of a simple yet comprehensive classification have been adopted. There will be ten departments, each sub-divided into ten groups, and these again into classes. The details of this classification are now being elaborated, and will be published in due season, together with such rules and regulations as may be found necessary for the proper conduct and management of the exhibition. It is intended that ample space shall be assigned to each state, territory, and foreign country for a just and proper display of their products. It is believed that not less than fifty square acres of floor space under roof will be required for this purpose. A site, combining the advantages of a sufficient extent of level ground, with picturesque and cultivated surroundings, easy of access by rail, water, and by ordinary roads, has been assigned for the buildings and grounds at Fairmount-park, in the city of Philadelphia. The exhibition will open in April and close in October. Each state of the union will be expected to send its peculiar products, illustrating its resources, both developed and undeveloped. A complete exhibition of this kind by all the states will afford the means of comparing their industrial condition and capabilities. The products of mining and agriculture will occupy a large portion of the space allotted to each State, and will receive their just share of attention in this universal display.

NOVELTIES AT THE SMITHFIELD CLUB SHOW.

Amongst the immense mass of agricultural machinery shown, and the great number of new and improved forms of implements that are yearly brought forward, it is somewhat difficult to pick out the greatest novelties. Amongst them, however, may certainly be noticed Hughes' laid corn-lifters, intended to be added to reaping machines. They are meant to raise laid, wet, or tangled corn, and bring it fairly under the cutters. Long prongs are set in front of the knives, so that they can insert themselves beneath the crop, pushing it up the inclined planes. On being cut from the ground by the knives, the corn is landed on the platform clear of the cutting apparatus. There is a fixed wooden lifter for flat land, consisting of a long, sharp prong, projecting in front of the knives, and secured to the platform. For very uneven land, a small cast-iron chair or shoe is fastened to the platform, on which is hinged, upon a pin, a similar wooden point, assisted in its action by a coiled spring placed under its heel. The lifters creep close to the surface of the ground, and work independently; they can be fitted on or removed as required. The advantages of the invention are derived from the fact that, without lifters, the cutting apparatus must be lowered and brought within the range of stones and clods, and the fingers and knives must be driven close to the ground, through all the creeping weeds and loose stuff.

Not perhaps so great a novelty, but equally ingenious, is a form of cow-milking apparatus, the invention of Mr. Keevil. It consists of a small, double-acting force pump, the india-rubber suction pipe of which is fitted with a number of silver tubes, closed at one end, but with openings at the side. Into each teat of the udder is inserted one of these tubes, and the pump is then worked by hand, the milker sitting on a stool behind. It is stated that twenty cows per hour can be milked by it. Most of the previous machines of this sort are of American invention, and in the States they are, we believe, used to some extent. The great objection to them has been that they tend to exert suction on an empty udder.

An invention that supplies a much-needed want is the self-acting railway cattle drinking-trough, exhibited by Messrs. Rushton, Proctor, and Co. The apparatus takes up the whole length on one side of an ordinary cattle train, and consists of a series of troughs, each about 20 feet long. The trough is slung upon one end of a pair of beams, each supported in the centre, and fitted at the other end with a weight, so proportioned that. when the trough is empty, it is slung up vertically. The upper end of the beam is below, and it communicates with a pipe-joint which turns in trunnions. On water being let on, it flows into the trough up through the hollow arm, destroys the balance, and brings the trough to the side of the trucks, within reach of the cattle.

We may mention also the ingenious wall steam-engine shown by Messrs. Tangye, Messrs. Lawrence's refrigerators, and Mr. Hunter's potato raiser, as all showing considerable novelty of invention.

CHANNEL PASSAGE.

Last week we published some comments of the *Engineer* upon the rival schemes for the Channel Passage. Since then *Engineering* has taken up the discussion on the opposite side to the *Engineer*. Our contemporary says the Bessemer and the Dicey schemes "take the harbours as they are, and undertake—what has generally been despaired of—to produce ships capable of going in and out of those harbours in all weathers, and what should be at the same time very commodious, very swift, and very easy sea-boats. We wish the promoters of both schemes—and the public generally on both sides of the Channel will also wish them—success in their undertaking, and we are not without hope that we shall see both Bessemer ships and Dicey ships running between England and the Continent, and competing fairly and on their merits for the public favour. Such a competition would be an enormous boon to England and the whole of Europe, and we are inclined to believe that with the increased traffic it would bring, it would prove a remunerative speculation for both parties. The Dicey twin-ship scheme, and the Bessemer swinging-saloon scheme, have each distinct advantages and disadvantages of their own which the other does not possess, and if these were properly appreciated by the advocates of the respective schemes, we should see less of that spirit of antagonism which has pervaded some of the letters that have appeared in the daily papers on the rival Channel steamers."

Engineering thus replies to the objections raised by the *Engineer*:—"They correctly describe the Dicey ship as being like a long shallow vessel cut in halves along the middle line plane fore and aft, and having the two halves moved asunder, and then united by cross girders far above the water. They also give the total breadth, 75ft., correctly, in so far as that was the breadth at one time contemplated, although we believe it has since been deemed advisable to increase it to 80ft. The length, which they give (as they say, subject to correction) as about 360ft., is in reality 400ft. Then they give the distance apart of the two halves of the ship, or the interior breadth of the tunnel, as 15 or 20ft., whereas, in fact, it is 35 or 40ft. The positions of the paddles they give as one near the bow, and the other near the stern, and add, 'as to the means of propulsion, nothing can by possibility be worse than the location of the paddles, as every engineer knows.' As a matter of fact, the paddles in the Dicey ship are amidships and abreast of each other."

The writer then proceeds to discuss at considerable length the merits of the various schemes. Amongst other matters he states that Mr. Dicey's scheme resembles, in its essential features, Mr. Sedley's design, submitted some years since to the Society. The reason that the Society declined to make the award—a fact which *Engineering* considers "not to their credit"—was merely that the model sent in did not comply with the required conditions, and so never entered into the competition at all.

SCIENCE AND GENERAL TEACHING IN FRANCE.

The opening of the winter courses of lectures at the Conservatoire des Arts of Paris affords a fitting opportunity to speak of some of the means of scientific education offered to the working classes amongst our nearest neighbours. The programme includes courses by such distinguished professors as MM. Mangon, Tresca, Trélat, and Becquerel, on mechanics, chemistry as applied to the arts and to agriculture, spinning, weaving, and dyeing, ceramic manufacturers, physics, the value and applications of materials, &c.

All these courses of lectures are public and gratuitous, and the attendance of workmen and apprentices is very large. M. Trélat, architect, who lectures on the strength of materials and their value as regards durability, elegance, and art, has an audience of five hundred persons, almost all of the working classes. M. Mangon attracts a considerable number to his lectures on agricultural labour and the management of animals. M. Becquerel's course is the most attractive on account of the physical experiments, the great amphitheatre in which it is given, capable of holding a thousand persons, being completely filled. Lastly, the lectures on geometry and other exact sciences are well attended by smaller but serious bodies of listeners. All these lectures are delivered in the evening, and the professors have the use of all the apparatus in the Conservatoire, and the use of several well-furnished laboratories.

Bordeaux is following Paris in the wise course of scientific instruction for the masses. Its municipal council has adopted the conclusions of a report drawn up by Professor Raulin, who has for a long time insisted on the necessity of establishing special scientific classes in all the schools of the city, whether clerical or lay, and recommended that one professor should be appointed who should give lessons of one hour each in two or three schools per day. The municipal council adopted these proposals without one dissentient voice, and voted the necessary funds, namely, £96 for the payment of the professor, who is required to possess a diploma of the Normal School of Cluny, or the degree of bachelor in science; £24 for laboratory expenses, and £16 for each of the fifteen schools in the city, for the purchase of scientific material, &c. It is proposed that this system of scientific teaching shall also be applied in the schools of small towns and villages by means of travelling professors, whose lectures, it is well said, will be as valuable to the schoolmasters as to their pupils. Further, it is argued that the presence of such a professor, with his stock of apparatus and other necessaries, will give rise to the establishment of other courses for the benefit of those who are ready to pay moderate fees for such instruction.

The efforts made by the authorities of Paris during the past session have attracted the attention of the Academy of Moral and Political Sciences, to which body the report of M. Gréard, Inspector-General of the University, has been presented. From this document it appears that vast increase has been made in the scholastic arrangements. Two hundred and ninety five common schools, of which one hundred and fifty-two are for girls, have been opened, the city of Paris and the department of the Seine having provided new places for twenty thousand children of the two sexes, and the work of extension is still proceeding. The city of Paris has certainly set an admirable example; in spite of the condition of its finances at the present moment, it has devoted more than thirty millions to the school budget, a sum three times larger than that voted in former years, and it is engaged in establishing a primary normal school for female teachers, a project set forth some time since by M. Jules Simon.

The opening for the session is just announced of the Ecole Libre des Sciences Politiques, which deserves notice. This consists of a course of lectures by some of the first professors in France, MM. Levasseur, Bousset, and Janet, of the Institut of France, amongst others. The subjects announced for this session are:—Geography and ethnography, the history of diplomacy, comparative statistics, comparison of military establishments, comparative penal legislation, administrative and financial organisation and practice in France, political economy, and history of theories of social reform.

CORRESPONDENCE.

THE SANITARY CONDITION OF BERLIN, AND WORKS FOR ITS IMPROVEMENT.

Sir,—I had recently occasion to visit Germany, and to view the sanitary condition of Berlin, and examine some plans for its improvement. As a member of the First General Board of Health in England, and a former Metropolitan Sanitary Commissioner, I was requested by the chief magistrate to give my opinion of them, which I did—submitting, however, the facts on which my conclusions are based for competent and independent examination. As neither of the chief principles involved — that of constant removal of putrescible matter from amidst habitations, or that of the stagnation of such matter, by disconnected works—nor their comparative expense, nor their comparative results, are very clearly understood here, except by a few practically conversant with sanitary science, who have, by very special attention, succeeded in mastering them, I am induced, by their great importance, to submit here such explanations as I was enabled to give of them in Berlin. It is to be observed that the question of the unity of well-adapted parts of complete sanitary works, which is in issue at Berlin, must for sanitary progress be soon in issue in London, where the prime agent for cleanliness—the supply of water—is in the hands of seven independent trading companies, under conditions which grievously restrict its use and lower its quality. Here there is no methodised adaptation of the capillaries of a system—the house drains—to the branch sewers, which, with the roads, are under thirty-six independent jurisdictions, those of the vestries, and where the trunk mains are under another body, the Metropolitan Board of Works, with a restricted and inadequate area and incongruous functions—under conditions utterly detrimental to efficiency and economy.—I am, &c.,

Edwin Chadwick.

East Sheen, Surrey.

I am confident that, on competent and independent examination, it will be found that sanitary science has in late times been so far advanced as to enable safe contracts to be made for the attainment of large results by sanitary works. As a rule, local conditions of disease may be inferred from death rates, as comparative death rates may certainly be inferred by those acquainted with them from comparative local conditions. The citizens of Berlin cannot be aware of these conditions. Let me call attention to the chief statistical methods of determining them. The local conditions press most heavily on infantile life, as children feed, as it were, principally on air; and as their conditions and death rates are to the least degree influenced by occupations, by migration, immigration, and other causes which affect the death rates of adult life, the death rates of children who die within the first year after birth, serve as the most important primary indications of sanitary conditions. Such sad death-rates for a whole city as have been furnished to me by the able chief of the Statistical Department, Dr. Schwabe, I never before met with. In the least unhealthy rural districts of England the death-rates of children in the first year of existence are not more than 1 in 12, or 1 in 14. In the least unhealthy urban districts in England there dies 1 in 8, and 1 in 9 within the first year after birth. It has been a reproach to Manchester that 1 in 5 dies within the first year, and that half of all born there are dead soon after their fifth year; but in Berlin 1 out of every 3 dies within the first year, and half of all born are in their graves within two years and a-half after their birth. In 1871, 31,262 children were born, and 10,072 died within that year. In the year before that the death-rate was 1 in 3·5, and in the year before that 1 in 3·1.

I know that various contributory causes may be specified as to this excessive infantile mortality, and amongst others remiss parental habits and treatment of children. But, looking at the epidemics and the death-rates which are the results of local conditions, it is very certain that any young newly-married couple entering into them, however unexceptionable their habits may be, will lose half their children by foul-air diseases before they have attained the age of maturity. In such air the mother's danger in childbirth will be increased, and if a serious accident, requiring a surgical operation, befall the father, or he is stricken with disease, his chances of recovery will be full one-third less than in a pure atmosphere. And after the more weakly children have been shorn down and the survivors have attained maturity, the insurable mean age of death of those who survive their twentieth year is 47·28 years—more than ten years less than that under less unhealthy urban conditions. The pressure of the lethal causes upon the population of Berlin appears to be increasing. The mean age of all who die in London, men, women, and children, is 29 years, and the proportion of deaths to the population, 23 per 1,000. As illustrative of this statistical measure of the intensity of lethal forces—the mean age of death—I may state that the well-observed mean age of death of all who die—men, women, and children of one entire middle class community, cleanly, frugal, and well-to-do, residing in moderately good habitations—the "Society of Friends"—is fifty-two years. But the mean age of all who died in Berlin (which has a better natural site than London) was, in 1866, 22·47 years; in 1867, 21·63 years; and last year it was only 19·54 years; whilst the proportion of deaths to the population was 39 per 1,000. The death rates prevalent in the ill-conditioned sub-districts of London, exclusively occupied by the wage-classes, have been 30 per 1,000; but in the model workmen's dwellings, in which rudimentary sanitary principles have been applied, the death-rates have been reduced to 17 per 1,000, with much yet to do even there against surrounding lethal influence.

In two towns, Croydon and Bedford, where works on the system of constant removal of refuse, and its direct application to the land on the system adopted at Dantzig, have been in operation, I find that at Croydon, before the improvement, the deaths of children within the year were 1 in 7. After the improvement they were, according to to the last return, 1 in 10; and at Bedford, where they were 1 in 6 before the improvement, by the last return they were 1 in 12.

The medical officers and managers of large institutions for the reception of destitute children in our metropolis testify that as the drainage, paving, and sanitary conditions of the lower districts have been improved, the type of the children received from them has also improved. They are more healthy, stronger, and more easily trained to productive service, and of a more promising future.

Now, looking at the death-rates in Berlin, and the large proportion of them due to foul air and miasmatic diseases, and to diseases of the respiratory organs—considering what might be done compared with what has been done, by sanitary improvements—it may be confidently averred that, with the aid of such sanitary measures as have been carried out in London for the regulation of common lodging-houses—especially for the prevention of overcrowding and the discontinuance of cellar dwellings—the reduction might be extended fully one-third, or, in other words, a saving might be effected of ten thousand lives annually in Berlin, and that, too, with a reduction of existing pecuniary charges upon the population. For it is to be noted that every preventible death represents, on an average, full twenty cases of preventible sickness, involving excessive and premature disability and loss of wages on the part of the working hands, involving also the cost of medical treatment, whether paid by them or not, and also the cost of multiplied burials.

On an estimate of these private expenses attendant on heavy death-rates, similar to those of Berlin, in several of the least healthy towns in England, it appeared that not less than from two to three pounds per annum per head of the population would be required as insurance to cover them all. Making every allowance for lower rates of wages and of expenses, I believe that some ten thalers (or 30s.) per head of the population per annum would be found to be below the total and collateral expenses of the excessive sickness and death-rates in Berlin. The heavy death-rates involve such loss of civil productive force, as there would be in a military force if two recruits had to be reared and kept from infancy in order to obtain one effective soldier, and the one effective soldier reared lasted little more than one-half his time before he died or was permanently invalided.

The proper test of works for sanitary improvement is their reduction of the death rates. Whilst England may well be consulted for examples of success obtained under the guidance of sound sanitary science, examples may be presented there, and in London particularly, of great waste incurred without any equivalent sanitary results. This has arisen from the fact that sanitary science is a new science, which has not hitherto entered into the education of engineers and architects, who do not pretend to any knowledge of it, and who are apt to lead towns to the prosecution of works separately, which separately are at best only of partial efficacy; for sanitary results are only to be obtained by works combined for action as one machine working on one master principle. This principle is, immediate removal and constant circulation, against stagnation and intermittent removal, occasioned by disjointed work. Thus additional supplies of water, often equal to an additional rainfall, are carried into houses by steam-power and pipe distribution, but the houses are there left without suitable provision for the removal of the foul or waste water, and thus the evils of damp foundations are aggravated by it, and also by the disuse of pumps which had served to keep down the subsoil water. With the introduction of such supplies, the water-closet system has been extended as a means of removing putrescible matter. But, for want of suitable self-cleansing house drains and sewers, putrescent matter is commonly detained and spread beneath the houses and streets—into which the noxious products of decomposition escape. In London we found putrescent matter detained in ill-made house drains, and in upwards of a thousand miles of large, ill-made sewers, giving off the noxious products of decomposition into streets and houses; and from these extended cesspools the putrid water is yet for the greater part only removed annually to prevent their being choked up. In Paris the putrescent matter is retained mostly in fixed fosses, which act as bulbs of a retort, giving off the products of decomposition through the neck of the retort into the houses or the streets. In this condition nearly three-quarters of a million of cubic metres of matter are constantly detained there, and only removed annually after it has been rendered comparatively useless as a manure by excessive decomposition. But in Berlin the putrid matter is spread in the channels of the streets, which make it, and my courier, as well as all the other couriers accustomed to conduct travellers over the Continent, declares it to be the most stinking capital in Europe, the one in which they and visitors the least desire to remain. An inhabitant of the newly-built portion of Hamburg, where the new system of house purification has been carried out, declares to me—and I can well believe it—that they can smell by their clothes any person who comes from Berlin!

I find there are many persons in Berlin strongly opposed to the extension of the water-closet system, as being an aggravation of the existing evils — an opinion which would not be unreasonable if the condition of stagnancy and putridity were a necessity. But my colleagues of the Metropolitan Sanitary Commission of Health, and of the First General Board, agreed with myself that any such stagnancy was not a necessity, and we obtained by trial works demonstration that, by properly-adjusted tubular drains and canals, everything is removable immediately and constantly before decomposition can commence, and that where land may be obtained for its reception, the fresh, or undecomposed manure of the morning may be distributed in water upon the soil before noon. This principle of constant circulation in place of stagnation—long defended by the old engineers, may now be seen in action, with varieties of adaptation, at Rugby, Croydon, Romford, Bedford, Watford, and especially Aldershot, on sands less promising than those in the vicinity of Berlin. In all these places, where the work of internal "canalisation," as it is called, is completed, and well done, there is no stagnation, and no smell of decomposition, and there has been a marked reduction of heavy sickness and death-rates from foul-air disease.

The work of the sanitary engineers may be tested by the smell. Wheresoever there is the smell of putridity there is stagnant deposit, and defective work. To an extent, the work may be tested by the recurrence of typhus and some other forms of disease. It has been declared positively, at Croydon and several places where works on this principle have been constructed, that wheresoever there has been an outbreak of typhus, or some other forms of the miasmatic diseases—that kill upwards of 8.000 persons annually at Berlin—it has been invariably found that there had been some stoppage or stagnation in the drainage of the house or the sewer, from defective work, or carelessness, and that traps were chiefly needful to guard against accidents or occurrences of this kind. By the constant removal and the direct application of the fresh manurial water to the land from the outfall, the canalisation defect of the old method of irrigation being avoided—namely, supersaturation of the surface or evaporation and waste—there is much less smell than even from ordinary kitchen garden culture, and unprecedently heavy production is obtained. From the sands at Aldershot (which appear to me to be inferior to those near Berlin), with high and diverse culture, heavy and superior kitchen garden crops are obtained, and that land, previously not worth ten, or even five, shillings an acre, has been let in portions with the manure at twenty two pounds an acre.

Several years' action of an internal system of "canalisation" on correct principles in the newly-built portion of Hamburgh had disproved the allegations of the inapplicability of that system in Germany during its long winter. And now the sanitary improvement of Dantzig, based on the principle of constant circulation, in supercession of the old system of stagnation, designed by the engineer, Mr. Weiber, and adopted, through the wisdom and firmness of Governor Winter, and executed by Mr. Aird, the contractor, has provided a demonstration of the practicability and superior eligibility of the water system of removal for Germany. The working of the measure, as stated to me, is in its chief points in exact coincidence with the examples to which I have referred. Between two and three thousand water closets have been connected with the canals in the streets, and foul smells, instead of being augmented, are reduced and the air greatly purified, and the people are impatient to have the house connections completed. There has not yet been time for a full manifestation of sanitary results. The narrow old streets, the construction of the old houses, and the privation of light and air, would prevent me from looking forward to that city as a foremost example of sanitary improvement. But I am happy to learn from a friend, an officer of the army stationed there, that so marked have already been the results obtained, that General Manteuffel has sent to thank the governor, Von Winter, for the improvement the works have effected in the health of the soldiers, especially of the recruits. And there can be no doubt that in these works Governor Winter will have erected powerful defences or mitigations against the future ravages of the cholera. The external distribution of the manurial matter by engine power is proved to be available throughout the winter, and on mere sand, which has heretofore yielded little, five heavy crops of Italian rye grass have been obtained, and a sixth is anticipated. The distribution of the manurial liquid (though I do not think the best method has been selected) is reported to be inoffensive. When we talk of fresh sewage, and sewage without smell, it is understood that we mean without the smell of decomposition, which is distinct from such smells as those which all effete matter has more or less. In England, the decomposition of such manures received in water is only found to commence, in ordinary weather, in about four days, but with properly instructed works, the manure of Berlin would be as it is at Rugby, Croydon, Watford, and now at Dantzig, on some portion of land, generally amidst roots, in half a day.

Such are the illustrative facts, which I might greatly extend, to which I would refer, and would gladly see examined, as justificatory of the opinion I feel bound to express on the plan prepared by Mr. James Holbrecht, the chief officer of works, for the improvement of Berlin, as being sound in sanitary principle, excellent in general design, and calculated, perhaps, with some improvements in detail, to render Berlin the foremost in sanitary administration in Europe. I think he has done well in treating it in five sections; each of which may be said to be as it were an enlarged and possibly improved Dantzig. Berlin being very much of it on a dead flat, the convergence of the main sewers or canals to five pumping stations will give the command of almost any inclinations and powers of rapidly cleansing; sweeps may be found necessary for it, whilst the radiation of the delivery of the manurial water in different directions will favour diverse cultures of different species of food under different aspects. If the principle of constant circulation be duly carried out, it will do for the health and strength of the population what it has done in such instances as those to which I have referred in England.

I think it due to observe that it marks the lamentable ignorance prevalent on the subject that the principle of constant removal by "canals," as they are called, should be opposed by the old one of the retention of stagnant deposit and its periodical removal by hand labour and tubs in carts—a system which is elsewhere considered barbarous and is being abandoned. Apart from all sanitary or other objections to it, the advocates of this system cannot be aware of its comparative expense. In Paris the expense of such removal is more than three francs per head of the population per annum. In London the contract price of similar work, performed once a year, was more than three shillings per head of the population. In epidemic periods, when we of the General Board of Health had absolute power, we found it necessary to order that all excrementitious matter should be removed daily, notwithstanding the great increase of labour and expense. In Paris the expense of the tub system proper, or of the removal of such matter in tubs at long intervals, is sixty francs per house per annum. Can the advocates of this tub system be aware of the annoyances of the periodical removal of sixteen thousand tubs? In Paris regulations are made for the prevention of the escape of the noxious products of decomposition, but they never succeed. Calling at the office of a railway department, I felt oppressed by the horrible smell pervading the place, and on inquiring what operation of vidange could be going on there, I was informed that the smell was regular and inevitable there, from the removal of the *cabinets inodore!* The operations of the vidange at night there, notwithstanding all the regulations for the application of disinfectants, are noxious and most detestable, and it is surprising that any people pretending to refinement can submit to them.

As established principles it will be found that there are no means so convenient, so simple, of checking the decomposition and waste of putrescible matters as its immediate reception and diffusion in cold water—that there are no means so cheap and so effective for its removal as immediate removal in water through self-cleansing drains, even with the addition of steam-power; and that there are no means of applying it and diffusing it in land so economical and efficient as in suspension or solution, in water. And, further, that the means of a direct application to land being available, all detentions for manipulations, for precipitations, dessications, solidifications, disinfections, have been mere waste and failures, as proved in the evidence and reports of official commission after commission. As against direct applications, the greater part of such schemes are proved to be mere quackeries.

As to the expense, water being carried into houses, and provision being made, as is necessary, for removal by canals of the waste or foul water, the connection of the water closet with the street sewers, the completion of the system may commonly be well accomplished for about a shilling per annum per head of the population. The estimated expense of the system of canalisation, and of the direct external distribution proposed by the Berlin chief officer of works, is ten thalers per head of the population, which would, I presume, entail an annual charge of eighteen pence or half a thaler per head of the population. It is stated that at Dantzig the expense of the house connections has been "inconsiderable." I do not know what that may mean, but one of our sanitary engineering inspectors who examined the present system of drainage in Paris reported that the new system might be applied there, and everything be carried away not monthly, or daily, or hourly, but instantly, at a less cost than that of the existing system. This has been done in England and at Hamburgh, and is doing in Dantzig, and I have no doubt may be even better done in Berlin.

It is to be observed, on the financial question, that whilst incomplete sanitary works impose additions to local charges, which are fruitless in sanitary economy—complete and effective works conduce to the improvement of house property. Thus, in the instance of the city of Salisbury, where the mortality had been once nearly as high as in Berlin, some incomplete works left it with a mortality of 28 in a thousand. By complete works of canalisation, the death-rate was reduced to 16 and 17 in a thousand. It was recently announced publicly by a landlord of some house property there, that his rents, and those of other owners there, had been advanced twenty-five per cent by the sanitary improvement. Much of this improvement in the value of house-property attendant on complete sanitary works is due to the less frequent non-payment of rents, to less frequent expenses of excessive premature and protracted disability, arising from less frequent sickness, fewer cases of destitute orphanage and widowhood, and fewer funerals. What may be the expenses of funerals in Berlin I do not know, but certainly the eventual saving of eight or ten thousand of them annually would add a large contingent of money saved for complete works of prevention.

To these general statements I must add that, where all beneath has been cleared of putrifying matter by a system of constant cleansing, and reductions in death-rates have been effected, fever has still lurked in those ill-paved and ill-cleansed districts where putrifying filth has been allowed to remain on the surface. Advances are now being made in London, as in Paris, in the use of impermeable and smooth asphalte pavements, which at once save horse-power and reduce the dust of abraded stone and iron, and by better cleansing reduce the dung dust, which is so injurious to the lungs, and also keep down damp and the miasma of excrement-sodden subsoils. Hygienists testify that where the new asphalted pavings have been laid down and kept clean, as they ought to be, by water, large contributions are made to the public health, and especially to the health of children. The appropriate drainage of such roads offers new and economical facilities for the improved drainage of houses. It will also be found, on examination, that this material affords, by asphalte tramways, cheaper and better means of transit, open to all, than iron tramways, and provides means of relief, by improved suburban transit, to the great evil of internal overcrowding.

For the efficient action of complete works for the cleansing of a city, the entire public control of the water supply of the city as a public service, unclogged by questions of trading profits, or the clashing of an independent authority, is found to be necessary. I advise the Berlin municipal council that the earliest steps ought to be taken for bringing the whole of the water-service under direct public control, by the compulsory purchase of the rights conceded to the water company, which has performed a public service now no longer needed.

It is to be earnestly hoped, for the sake of the example to other cities of Germany, and in the interests of sanitary progress and civilisation, that the seat of the Government of the new and great German Empire may no longer be allowed to be distinguished amongst the capitals of the civilised world as a seat of filth and pestilence.

Since my return, I have received, in answer to some inquiries, the following polite communication, and, as to results already achieved, most important information, from the chief magistrate at Dantzig:—

"Herr Ober Bürgermeister Geheim Rath von Winter presents his respects and high esteem to Mr. Chadwick, whose great efforts and successful agitation in favour of the amelioration of the sanitary condition of populous places in general, and the introduction of the present system of drainage of large towns in particular, by which all putrescible matter is constantly and effectually removed out of the boundaries of towns and cities, and directly applied to the land, is well known to me.

"Herr von Winter regrets exceedingly that Mr. Chadwick, on his recent tour through Germany, was unable, from want of time, to visit his good old town of Dantzig, and would have been very glad to show to Mr. Chadwick what progress towards the amelioration of the sanitary condition of this town has been made, by the introduction of the system of canalisation, now nearly completed.

"Mr. Chadwick says, with truth, that 'execution of a good design is laborious and difficult,' and more particularly is this sentence applicable to places like Dantzig, in which not only narrow streets and peculiar construction of the houses render the execution of the design most difficult, but where also climatic impediments of a severe nature have to be overcome.

"Herr von Winter is aware that the removal of the sewage from towns through a system of canalisation is only *one* item in the sum of the general improvements of the sanitary condition of such towns, and expects, therefore, from its introduction into Dantzig, no more than a great amelioration of the same; but his constant endeavour is to adopt all available means which may offer to accomplish a radical alteration in this highly important matter. He will therefore be glad to receive, from an authority of such experience and standing as Mr. Chadwick, any hints regarding the subject.

"In answer to the questions asked by Mr. Chadwick, Herr von Winter begs to state—

"1. It is already an established fact that quarters in houses and streets, into which the canalisation has been introduced, are much more in demand, and command in consequence a much higher rental, not only on account of the great comfort they offer, but also from the often-acknowledged fact, that the higher rental is more then compensated for by the improved health of the residents.

"2. The system is only too short a time in operation to allow us to judge of its effects upon special forms of diseases; but it may be stated that, although cholera has several times been imported into Dantzig, yet it has not taken the form of an epidemic since the opening of the canalisation.

"3. The public in general is now so much in favour of the introduced measure, that now, at the end of the first year of its operation, there are already 2,252 houses discharging their sewage and fœcal matter into the street sewers. (It was opened on the 16th December, 1871, on which day only twenty houses were connected with the sewers.) It was only with the greatest difficulty that sufficient labour could be obtained to carry out the above house-fittings and connections with the sewers. It can be stated, without fear of contradiction, that the whole population of Dantzig is in favour of the system, and the most vehement opponents are now most urgent in their demands to have their houses joined to it.

4. As regards the application of the sewage to the land during the frost, experience is as yet wanting. The first crop of rye-grass was sown on the 2nd of May of this year, upon a barren piece of sandy soil close to the sea-shore; from it has been taken six crops during the summer.

"5. Storage reservoirs for the sewage are as yet not thought necessary, because the extent of the irrigation fields, and the nature of the soil on them do not seem to require them.

"Dantzig, November 30, 1872."

COAL IN THE FARO ISLANDS.

Sir,—In reference to the notice in the *Journal of the Society of Arts* of the 13th instant, on "Coal in the Faro Islands," I may mention that many years ago (in 1821) I visited those islands, and gave the Royal Society of Edinburgh a short notice on their mineralogy, with sections of the coal beds, printed in their "Transactions" (vol. ix. 161, and plate xxix). The coal was only slightly worked at that time by some of the neighbouring inhabitants for their own use. The thickness of the seam in Suderoe varied from a few inches up to five or six feet; it was associated with a good deal of petrified wood of coniferous trees. There were also thin beds, but not worth working, on the islands of Myggenæs and Tindholm. According to Landt "(Description of the Faro Islands," page 71), the coal bed of Suderoe has been several times explored since the year 1709, when he finds the first notice of it, but it seems never to have been extensively worked, whether from its being of inferior quality or for other reasons. It evidently is of a much later date than the coal fields of the North of England, and belongs to the Miocene period.—I remain, &c.

W. C. Trevelyan.

Wallington, Newcastle-on-Tyne, 16th December. 1872.

CERTIFICATES UNDER THE ELEMENTARY EDUCATION ACT.

Sir,—All who are concerned in the work of primary education are well aware of the difficulty which exists in obtaining "certificated teachers," and that this difficulty is likely rather to increase than to diminish for some time to come. It will hardly be denied by those who take a practical view of the subject, that some valid test of the fitness of the teachers whom it recognises for the important duties which they undertake, should be applied by the executive government, and the chief question is how far the tests required by it are fitting, reasonable, and fairly within the reach of the classes from whom elementary teachers must be drawn.

The growing conviction of the paramount importance of the special faculty of teaching, including the power of keeping order and commanding the attention of pupils, has caused great changes to be made in the revised and subsequent codes up to that of 1870, which have tended much to increase the misapprehensions which prevail on the whole subject. My object is to state as clearly and briefly as possible the various ways in which certificates can now be obtained, premising generally that government does not ordain any specific course of education. Responsibilities of this nature are laid upon local boards, or may be assumed by private individuals. The education department tests the work done, and in the case of schools under regular inspection awards a grant *in aid* for specific results.

There is not at present any government college for the training of teachers, but the last blue book showed thirty-six of such institutions in England and Wales under inspection, to all of which must be attached (sec. 83) a working school as a practising department. The final examinations, which are conducted by government, are in no way "competitive". The successful candidates are arranged in *four* divisions. All in the first *three* of these are considered as having given proof of adequate attainments, and though their relative proficiency is fairly recorded, all alike are eligible for certificates of the second class, but these are not granted till their special competency as teachers has been proved by actual work. Two favourable reports must be earned on a school which must have been under their charge for not less than three months at the time of the first inspection, the second being held a year afterwards. No one can by any means at first get more than a second class certificate for ten years, which can be raised to the first class by good service only, as proved by results—of course not taking merely the "passes" of pupils. It is the especial duty of an inspector to weigh all advantages and disadvantages under which a teacher may labour; still, upon the capacity shown for ruling and teaching a school his report must be based. Those placed in the fourth division are considered as deficient in personal acquirements, and can receive only a certificate of the third class; they are not qualified to take "pupil teachers" or apprentices, and thus are practically confined to small or subsidiary schools: but many valuable teachers, especially for small country schools, may find their place in this class.

Although these examinations are held at the training colleges, they are open, not only for those who have been one (or two) years in residence, but equally so to any one, not less than twenty-one years of age, who has either served with credit an apprenticeship as "pupil teacher" in a regularly inspected school, or been a teacher of an elementary school upon which a good report is obtained from H. M. inspector, (sec 47). All are alike qualified to sit for examination who can give valid proof of aptitude for the special work of teaching.

Again, as regards the admission into training colleges as far as government are concerned in the matter. Not only pupil teachers who have successfully completed their engagements, but any one, over eighteen years of age, intending, *bona fide*, to follow the profession of teaching, may sit for the entrance examination. Pupil-teachers may be apprenticed for five to two years to certificated teachers of the first or second class provided that at the last year of their service they are eighteen years old, and for the shorter term pass the annual examinations prescribed for the later years. Their capacity for teaching and school keeping is an essential part of the annual reports on their progress.

This "entrance" examination may serve also other purposes than gaining a right of admission into training colleges. Those who pass it are qualified to act at once as *assistants* in public elementary schools earning an annual grant in aid (reckoning on the school staff as equal to two pupil teachers), without being subject to annual personal examination (secs. 79 and 80). Further, if their work in this capacity is favourably reported upon by H. M. inspectors in their annual inspection of the school in which they are employed, they may, on attaining the age of twenty-one, sit for their examination for certificates as before explained.

Till the end of 1873 (sec. 59), teachers over thirty-five years old, who have been engaged in teaching for ten years, may obtain a third class certificate without personal examination, simply on the favourable report of H. M. inspector on their school, which, of course, must have been for some reasonable time under their charge, and they must obtain also good certificates of character, &c., from the managers of it. For teachers of infants only, thirty years is accepted as the limit of age. It would be a great mistake, however, to suppose that any one can teach infants. This early training is most important, though a very moderate amount of mere learning may be requisite for it. Some valuable teachers will be secured for public elementary schools under this section, and though the certificate of the third class does not enable them to take "pupil teachers"—which is on the whole a reasonable restriction—there is no reason why a teacher of old standing and character should not have the aid of "assistants." It may be worth considering whether this door of admission should not be kept permanently open. The tests at present imposed are so low as not to justify more than the qualified certificate which only is granted without personal examination. But there seems no good reason why any one who can show a thoroughly well-taught school should not get a corresponding certificate for the results shown. Probably few only would come in by these means, but these few would be of the best of those beyond the limits of ordinary training, and would be a valuable element in the educational community.

It would be quite unfair to compare such as these with the least favourable specimens of certificated teachers. Looking broadly to average results testimony is very strongly in favour of some special training, even more as regards the interests of good order and discipline than of merely learning. It is the individual examination of children—now required for all over seven—that most strongly shows the comparative weakness of the majority of untrained teachers. Apt children are easily taught; success with a large average of pupils, their previous condition being duly considered, is the great test of the efficiency of the teacher of a public elementary school.

There is no doubt a tendency for all examinations to run into grooves, but it will be seen that any one who shows competent knowledge and aptitude for school keeping may in one of the ways explained obtain a certificate without any great difficulty. In the very nature of things any examination must be prepared for with a certain amount of care and trouble, but the attainments, especially for third class certificates, are of a very moderate kind. It is indeed possible that a good teacher may fail through want of nerve, but surely there can be very few who are really efficient who could not fulfil the conditions required, and of these it may very truly be said that "hard cases" would make very bad law.

One word in conclusion as to the standards laid down in the code (sec. 28). They comprise little more than reading, writing, and numeration, but let no one suppose that even these can be well taught by merely mechanical means. The ultimate failure of those who teach down to the lowest letter of the standards is as certain in this as it would be in any other profession where real work was evaded in such a spirit. Children merely "crammed" for the first standard will be crammed with still more difficulty and uncertainty for the second, and so on. The school system is as yet half formed. As soon as proper means of registration are established every man's work will be traceable. Children can no more be taught even to read, write and cypher efficiently, without developing their general intelligence, than so many automata can be made to do these things. The code merely lays down certain standard tests. The mode of teaching, so as to enable children to pass these tests, is left to the free discretion of teachers and managers. Their very simplicity renders evasion for any length of time all the more certainly impossible if inspectors do their duty, and though no system can always succeed in keeping bad workmen out, the periodical examination of "results" will tend more and more every year to drive out workmen of such a character.—Yours, &c.,

R. H.

GENERAL NOTES.

Arctic Exploration.—On Monday afternoon a deputation had an interview with the First Lord of the Admiralty and the Chancellor of the Exchequer, at the Admiralty, Whitehall, with reference to the renewal by England of North Polar exploration. The deputation included Sir Henry Rawlinson, Sir Henry Holland, Dr. Carpenter, Dr. Hooker, Sir George Back, Admiral Collinson, Admiral Richards, Admiral Ommanney, Captain Sherrard Osborn, R.N., Mr. Clements Markham, and Mr. Major. Mr. Henry Rawlinson, President of the Royal Geological Society, read a memorial, showing the great advantages that would accrue to science from the proposed expedition. He produced letters from several scientific societies, referring to numerous questions in physical geography, geology, natural history, terrestrial magnetism, anthropology, and meteorology, which would in all probability be settled by it; and alluded to the excellent effects such expeditions had had, and would have, upon our fleet and seamen. In the discussion which followed, it was stated that two steam whalers would be ample for the purpose contemplated, and that a contribution of 120 men would be sufficient. The ships would be provisioned for three years, and, according to Captain Sherrard Osborn, about three summers and two winters would have to be passed in the Artic regions. The Chancellor of the Exchequer promised to consider with his colleague all that had been urged, and to read over the papers and documents which had been left with them for consideration.

Factory Act in Switzerland.—The following, according to the *School Board Chronicle*, are the principal clauses in the Factory Bill presented to the Cantonal Council of Lucern:—"No child under twelve years of age may be employed in factory labour; children over fourteen no longer than six hours a day; those of schooling age may not be employed at all during school hours; no infants are to be admitted into factories where poisonous matter is used; no night labour of any kind shall be permitted in any factory, except by the express permission of the Cantonal Council; a day's work for adults will consist of no more than twelve hours."

Paris Academy of Sciences.—At the last meeting of the Academy of Sciences the president spoke of the part proposed to be taken by France in the observations of the approaching transit of Venus. Astronomers are to be sent to Palestine, to the banks of the Red Sea, to Pekin, to Jeddo, to the Isles of Bourbon and of Saint Paul, Campbell's island, New Caledonia, and, probably, to Honolulu and Noukahiva The Lalande prize has been awarded to Mr. Huggins, for his remarkable spectroscopic studies, and especially for his application of the spectroscope to the analysis of the movements of the stars. The president also enumerated at some length the services which Mr. Huggins has rendered to science by his studies of the stars and comets, and the discovery of the existance therein of several metals and gases.

Salmon From the Pacific States.—According to the *San Francisco Bulletin* there continues to be an active demand for salmon, especially in tins. The export trade in this article has assumed an important character. In the first nine months of the year there were 27,000 packages shipped hence by steamers and sailing vessels, valued at 195,000 dollars, against 23,000 packages, valued at 168,000 dollars, for the same time in 1871. The shipments to Eastern markets by railroad amounted to 2,249,000lbs., against 545,000lbs. last year. The markets supplied were never so numerous as now. There is a regular demand for this fish in Australia, England, and several of the Atlantic States cities. A consignment of 100 barrels was sent to Peru a short time ago. To-day the Panama steamer took 50 cases for Kingston, Jamaica, a new market. The future of this trade is quite flattering.

The American Seal Lock.—This is a new lock, in which the key-hole is covered by a seal which is a small square piece of glass, held in position by grooves in which it slides. The "seal" covers the hole through which alone the spring catch is accessible, and this cannot be released until the seal is broken. The "seal" itself is a piece of common window glass, marked on the back with a letter and number, and also with various irregular dots and splashes, in a sort of chocolate colour. The lettering and numbering are conducted on the same principle as on the Bank of England notes, so that no duplicate of a seal will ever be made; and the dots and splashes are accidental in shape and position, being sprinkled on at hap-hazard. Before the seals are cut the entire sheet is photographed, and the printed photograph is perforated like a sheet of postage-stamps. The purchaser of the seals is supplied also with photographic *fac-similes*, so that he can send one of these to any person whose business it may be to verify the security of a package.

A Remarkable Test Plate.—One of the devices used by microscopists to test the correctness and power of their lenses consists of a glass plate, upon which lines of exceeding fineness are engraved by the diamond. For this purpose a small ruling-machine is used, all the parts whereof must be made with unusual nicety. In Europe the test plates made by M. Nobert, of Prussia, have long been celebrated for the fineness of their ruling, and in this country those of Mr. L M. Rutherford, of New York city. The expense of the best Nobert plates have been 100 dols. each, and the finest rulings heretofore done have been 120,000 lines to the inch. There are few microscopists who have ever been able to see or resolve the lines of those plates, owing to the difficulty of properly lighting the plate. Dr. Woodward, of the United States army, is amongst those who have succeeded in doing so. He has not only seen them but he has photographed the fine lines. Professor F. A. P. Barnard, President of Columbia College, in this city, has lately received from Nobert a new test plate, ordered some two years ago, at an expense of 200 dols. which surpasses in fineness of its ruling anything heretofore produced. It is slip of glass 3½ in. long and 1¼ in. broad, in the centre of which the unassisted eye may discover what appears to be a mark perhaps the fiftieth of an inch in width; but when placed under the microscope this mark is found to be composed of a great number of parallel lines. The plate, in fact, contains twenty test bands, that is to say, twenty series of lines. Each series contains such a number of lines as will occupy, or more than occupy, the field of view of the microscope. The fineness of each band or series varies from a ratio of 3,000 lines per square inch up to 240,000 per square inch; this last band contains double the number of lines ever before ruled on a test plate. Nobert is said to have remarked, on sending this plate, that if the microscopist, on seeing these lines, found that they were not sufficiently fine he would engage to rule a still finer plate. When Professor Barnard succeeds in seeing them, doubtless he will let us know.—*Scientific American.*

Cape Diamonds.—In relation to Mr. Tobin's recent paper on the "Diamond Fields of South Africa," Mr. Streeter, of Conduit-street, sends us word that he received a collection of diamonds, some in the matrix, which he will be glad to show to any members of the Society.

NOTICES.

EXAMINATIONS, 1873.

The attention of candidates is drawn to an error in paragraph 55 of the Programme. After the words "accidence," the words "and in passages" should be inserted.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

THE LIBRARY.

The following works have been presented to the Library:—

Our Work in Palestine, being an account of the different expeditions sent out to the Holy Land by the Committee of the Palestine Exploration Fund. Presented by the Committee.

Catalogue of the British Contributions to the Moscow Polytechnic Exhibition. Presented by Messrs. J. M. Johnson and Sons.

The following works have been purchased for the Library:—

Theory of Heat. By J. C. Maxwell, M.A.

Liddell and Scott's Smaller Greek-English Lexicon.

Grasse's Italian Dictionary.

Flügel's German and English Dictionary. Compiled from the London edition by C. E. Feiling and J. Oxenford.

CANTOR LECTURES.

The first course of Cantor Lectures for the present Session is on "The Practical Applications of Optics to the Arts and Manufactures, and to Medicine," by C. Meymott Tidy, M.B., Joint Lecturer on Chemistry, and Professor of Medical Jurisprudence at the London Hospital. It consists of five Lectures, the last of which will be delivered on the following evening, at eight o'clock:—

Lecture V.—Monday, December 23rd, 1872.

Spectrum Analysis as Applied to Manufactures, illustrated in the Bessemer process, and to Medicine in the Detection of Blood.

MEETINGS FOR THE ENSUING WEEK.

Mon.....SOCIETY OF ARTS, 8. Cantor Lecture. Dr. Tidy, "On the Practical Applications of Optics to the Arts and Manufactures, and to Medicine."
Medical, 8.

Fri......Quekett Club, 8.

Sat......Royal Institution, 3. Professor Odling, "On Air and Water."

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FRIDAY, DECEMBER 27, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

LECTURE ON INDIA.

An exhibition of views of Indian temples, idols, and illustrations of every-day life, photographed by Captain Lyon, and shown by means of the magic lantern, took place before the members of the Society, on Friday evening, December 13th.

Captain Lyon, in describing the various views, said:—Ladies and Gentlemen,—I beg to ask your assistance this evening in what I am going to do. I want you to use your imagination, and fancy yourselves on board ship, and—so that it may be pleasant and agreeable—in one of these new Bessemer ships, where you have no sea-sickness to endure. We will go down the Mediterranean, through the Suez Canal, down the Red Sea—where the heat is frightful, and the thermometer 120° on deck and any number below, in fact perfectly suffocating—to Aden. We will not stay there, but press on to Ceylon, where we shall arrive in ten days, and where the beauty of tropical vegetation is seen for the first time—lovely beyond description. Thence we go on to Madras; but before we arrive I will show you the god Ganesa. There he is, in all his glory. He is the god most worshipped of all the Hindoo gods—a beauty, you see. His history is as follows:—For certain reasons it was considered necessary that Shiva should marry, and as he was an old bachelor he did not like it. However, the marriage took place between him and Parvatee, who unfortunately gave birth to a son. Parvatee had a brother, called Vishnu, who was always upbraiding her, and Ganesa, who was a most lovely child, always took his mother's part. At last, Vishnu one day began upbraiding her again, and Ganesa threatened to thrash him, and the result was that they had a fight, and Ganesa got a tremendous thrashing instead, and Vishnu, with one blow of his scimitar, cut off his head. Parvatee took a fit of the sulks at this; but in the end Shiva was asked to restore Ganesa to life. Shiva at last consented to do so; but on looking for him they could only find his body, but no head. Here was a difficulty. The gods were consulted as to what was to be done, and the result was that a god was sent to bring the head of the first animal he saw and put it on Ganesa's body; and this animal, unfortunately, was an old elephant, with one tooth. They took his head and stuck it on to Ganesa's body, and you see the result. Parvatee did not like this, and in return, to pacify her, Brahma said that Ganesa should be most worshipped of all the gods. Before a Hindoo builds a temple, or a house, or goes a journey, he prays to Ganesa, "And so I say, O Ganesa—glorious and honourable Ganesa—grant me success this evening. May I please all this people. All reverence to you, Ganesa."

I will now go back to our steamer, and we must fancy ourselves coming into Madras. There is the steamer just as she appears soon after daylight off the roads. Madras has no harbour whatever, and so every captain arrives as early as possible to get away before night; as soon after daylight as he can he casts anchor in the roads, and if you come on deck in the morning you will see round the vessel the boats in which you will be expected to land, one of which you are now looking at. I leave you to imagine the effect when an English lady sees for the first time 20 or 30 of these fellows in the morning. The boat is called a catamaran, and it is the only chance you have of landing if the surf is high. You are lashed to this thing, and they bring you to shore. The sea washes right over you, but, as the water is warm, except that you do not like the ducking, it does not much hurt you. These fellows are off the boat, and in the water, and on to the boat again in a moment. Although they say the sea abounds in sharks, they are never eaten, and they actually say the sharks will not touch a black man.

Well, the first thing you do, having landed, is to go to an hotel, and find yourself a carriage. There are three kinds you can choose from. There is the old palanquin, put upon wheels, called the palanquin coach, which is what Europeans generally use. The horse looks sorry, but he can go; every horse has his ghora-walla to attend him, and a woman too. You buy the ghora-walla and the woman when you buy the horse. It is the man's business to clean and feed the horse, and the woman's to cut grass for him. The next carriage is called a shigrampoo. You pay 1s. 6d. an hour for this, and have to pay beforehand, and whether the pony goes or not it is all the same. The Hindoo has no idea of time; he prefers that the pony should not go, and so Europeans seldom use this. The next is a bullock bandy—no springs. The bullocks come from Mysore, and are admirable goers. The native standing by the side is the owner, and the other is the fellow that drives. The natives are all vain, and want to be photographed, and are sure to stand wherever they see a camera. Now we start on our way to the hotel, having chosen one of the conveyances. We shall not have gone far before we see something of this sort at the corner of nearly every street—an almost naked barber, engaged in the act of shaving, all for one penny. They say they are most wonderful fellows at it. They actually shave people while they are asleep. I found them very indifferent hands. If they are not engaged in that, these very fellows are shaving the natives' heads. It is wonderful to relate that, although there is the most intense heat, the natives invariably shave their hair off. They say it cools them. You never hear of a *coup de soleil.*

We will now turn into the main street of Madras. The large building to the left is a sort of emporium, where everything is sold. The building on the right is the Bank of Madras. Passing through this, at the end we come to the bazaar, and we will just pass through a corner of it and see one or two of the shops, such as everybody is obliged to use if he is not prepared to go to one of the few Europeans in the place. There you see the cap used by the natives as a substitute for a hat—it is nothing but a piece of linen folded in a peculiar shape You see the two men who are making these caps are wearing similar ones. Another shop is that of a native tailor. The natives themselves never wear much that requires any shaping, and, consequently, there is little for them to do in the way of cutting out. But they are wonderfully good hands, nevertheless. They are also good imitators; give them anything and they will copy it. The story is told of a cricket match which was played at Government-house, Calcutta, at which all the great people and the ladies were present. One of the aides-de-camp who was to play thought he would have a new pair of unmentionables, and so he sent off for a native tailor, and told him to make him a pair exactly similar to his old ones. Next morning, when they came home, true to time, they were unpacked, and he proceeded to examine them. There were the old ones and there were the new ones, too, and the native had made them exactly the same as the others; there was a patch on one knee, and every splash of dirt, and everything exactly the same.

Having passed these, we soon get to the hotel, hoping to find peace and rest. But when the Peninsular and Oriental steamers come in everybody knows it, and hundreds of the natives are on the look out to get money. They see what hotel you go to, and then begins the cry for backsheesh—nothing but backsheesh. But first of all let us look at the picota, the machine that is used for drawing water. There it is, and the natives run along the top of the long pole to press it down, and then they turn round and run backwards and forwards, keeping the machine at work all day; and in the rice season it is very disagreeable, and even perfect purgatory, to live near where one of these machines are, and hear the two bits of wood rubbing together, and going on "cah, cah" all night and all day. It drives you almost mad. Woe betide the unhappy fellow who gets a bed near one of these picotas.

Arrived at the hotel, you find a lot of fellows asking for backsheesh, and playing drums. You give them some money, only too glad to be rid of them. They are succeeded by fellows who play tricks with some stuff dipped in turpentine, through which a man jumps backwards and forwards. When they are gone, they are succeeded by a conjuror who shows you the way to get rid of your wife if you have got one, or, if you have not, the way you can if you get one and don't like her. He ties the woman up tightly in a net first, and, when he has done that, he puts a basket on the ground. He then takes the top off, and proceeds to put her into the basket. There is the unhappy wife in the basket. The little boy plays the tom-tom, beating it all the time, the fellow standing looking on. As soon as the woman is packed up, he covers up the basket, and seizing a sword, he plunges it in. The woman shrieks and yells frightfully, the blood pours out in torrents, the ladies who are looking on faint, and the gentlemen curse and swear, and pull him away. When they tear open the basket, they find it empty, and the woman comes out of the house where you are staying and asks for backsheesh. This fellow is succeeded by two other jugglers, who spread a cloth before you over the sand, and in some mysterious way cause a fine large branch of the mango tree to appear, and grow up under the cloth. It is a curious fact, that in Egyptian history we read of the same trick with the lotus tree as this with the mango tree.

Now we come to the snake charmers, the most wonderful race of men in the whole of India. They take up a cobra, the most deadly of all reptiles, and still hardly ever are bitten. There is the photograph of these snake charmers before you. The snakes are never still. The poison-bag is in the roof of the mouth; and, by certain means, this bag is pressed, and the poison ejected. But when you remember that two hours is about the limit one lives after the bite of a cobra, you cannot help wondering at the carelessness of these fellows. And though now-a-days they say that by injecting certain alkali, ammonia, or something of the kind, into the blood, the bite can be cured and the poison destroyed, yet still, in the wilds of India, who would be able to do this in the short space of time allowed to live after having been bitten? There is one little animal alone that enjoys exemption from the fearful bite of the deadly cobra. It is a favourite amusement to some people to watch the struggle. They will turn a large cobra loose in the room, and then immediately place a mongoose before it. The mongoose instantly attacks the cobra, and a desperate fight ensues, the cobra bites the mongoose over and over again, but the poison seems not to have the slightest effect on it, and the battle will certainly result in the death of the cobra. If the mongoose dies, it is from sheer loss of blood and exhaustion, and not from the effects of the poison, as thousands can testify. Dr. Short has held for many minutes the mouth of a cobra fixed on to a mongoose, but it has got up and run away, without any hurt. What peculiar antidote he possesses science has not yet been able to discover.

Having now taken a cursory view of Madras and its people, and the jugglers, such as they are, we pass on to consider their religion and their temples.

First, I must tell you that the word temple does not exist in India. It is merely a word imported by us. The word they use is Devila, and means the House of God. A temple does not consist of one, but four component parts. What we generally call a pagoda is nothing but the gopurum, answering to the Egyptian pylon over the door. The four parts of each temple are the *gopurum*, or door; the *mandapum*, the *teppa kolum*, or tank; the *vimanum*, or sanctuary.

Now, I propose to show you these, and give you some idea of what they are. We will take the train at night from Madras, and at twelve next day we find ourselves at Trichinopoly, close to which is one of the largest and finest temples in all India. The view is taken from the gateway at the south entrance. The pyrmids are called the gopura, and mark the entrance into each separate court. The houses are inhabited by 8,000 Brahmins, who are not all necessarily priests; but, like the tribe of Levi amongst the Jews, from whom the priests were taken, so among the Hindoos the priests are taken from among the Brahmins. The others hold their shops in the temple. There are 21 of these gopura, the large gopurum to the right is 300 feet high. The next view gives the gopurum more in detail, and shows it exactly as it is. The lower part is of stone, the upper part of brick, and this is covered with figures, representing different scenes in their holy history. Sometimes these gopura are very much more ornamented than others; but they are always for the same purpose, that is, to cover the entrance into the different parts of the temple.

We now come to a mundapum. A mundapum may be composed of simply eight stones. Take four stones and put them upright in the ground, about eight feet high; put the other four along the top, and you have got a mundapum, and such exist in thousands all over India; and, whether elaborate as this is, or perfectly plain, whether square, or round, the result is the same, and you have a mundapum. In this case each pillar is one single block of granite, out of which those figures 15 feet high have been carved; it is covered with a flat stone roof. It constitutes one of the finest mundapa in India.

We next proceed to look at a teppa kolum, or tank, as you see here. The god not only is treated in every way like a human being, but he must have his excursion in the water, and his ride in the car—21 times he goes round that centre pavilion you see in the middle. On the left and on the right you see mundapa, and the small gopurum covers the entrance into the sanctuary.

I may as well tell you that the sanctuary is nothing but an oblong building, perfectly plain, dark as pitch, not the smallest glimmer of light being admitted. No European is ever allowed to enter it, except a prince of royal blood, and he must enter it alone; and if any other European, or heathen, or low caste man, dares to put his foot inside the sacred portals the temple must be abandoned, or the man must die. Such is the rule of the Hindoos.

I will just show you, in passing, the interior of a mundapum—that is a very plain one—one of those we just saw the outside of. That curious thing in the middle, called a flag-staff, was used formerly to mark the distance a man was allowed to approach towards the sanctuary. He was not allowed to pass nearer than that. But gradually it has fallen into disuse, and now he may walk within three or four yards of the sanctuary door. It is so dark, though, that nothing can be seen.

Passing from Trichinopoly we here leave the railway, and have to choose the way we will travel. There are three ways before us. We can go on horseback, and, starting an hour before sunrise, and galloping all the time till the sun rises, accomplish 12 or 14 miles at the outside. The next way, which is more comfortable by far, is by the palanquin, carried by men on their shoulders, and you go along very easily. But if you are heavy it is a great misfortune, for more bearers are required to carry it, and, consequently, more money to pay them. But this is now almost obsolete, except in the native states, and so you are obliged to fall back upon the bullock coach, which I will show you. That is the vehicle in which you have to travel all over the south of India, except on the few spots where there may be railroads. This one is occupied by natives; turn them out and get in, and be sure you sleep with one eye open, or you will not travel very far. If you close your eyes the man will immediately stop, and the bullocks will lie down and go to sleep too, and the man will get under the carriage, and you will be lucky if you get over two miles instead of twenty. I have known a native go three times round his own village, and come back to his own door, and when you awoke, thinking you were 20 miles on the road, and routed him out from his own house, and asked him where it was, he would tell you it was a village eight or nine miles off, but you saw it was the same man and the same bullocks, which you ought to have changed long before getting that distance.

Nominally, there are plenty of roads in India, and good ones, too. The government pay enormous sums to keep them in repair. The contractors are natives, and they keep them in good order for five or six miles out of the town where the Europeans are likely to drive, because if they saw bad roads they would make a row; but nothing is more execrable than they are further on, there are holes big enough and deep enough to bury a man in; you will often be 24 hours doing 12 miles.

However, we go on to Madura, the Rome of India. It is one of the largest and most noted places, and has one of the richest temples. The first building we are going to see is a mundapum. Opposite the entrance to all these mundapa are what are called the guardians of the gods, of which you see one here. There he stands, carved out of a single block of granite 15 feet high, beckoning with one hand, and with the other warning you not to come unless you are properly prepared, with his foot on the head of a cobra—whether typical of the triumph of the Hindoo religion over the worship of the serpent, is a question I dare not go into, for it is enough to mention that one subject among *savants* and you set them all arguing. However, passing in beyond this, we see one of the most beautiful buildings in the whole of India. It is a mundapum, and was built by the last king of Madura before we took it. It cost one million of money, and took 22 years to buld. The story is, that the reason of his doing so was that he asked the god to come and pay him a visit. The god said he had no objection, but he had not a house fit to receive him in. So the king at once set to work and built what you see, and though he is long since dead and gone, the god is brought ten days every year to pay a visit to this mundapum. It is 333 feet long and 84 feet wide, and is considered by all to be one of the finest in India. It is built of pure grey granite. Every pillar in it to the right and left is whitewashed. The natives always whitewash them to a certain height. On each side are representations of the king and his successors. You see him on the right under his canopy, and beside him his two wives. The story goes that Trimul Nayak married a daughter of the Rajah of Tanjore. The day after he brought her home he took her to see this magnificent building, which was just completed. After walking through it, as she did not say a word, he asked her why she had not spoken, and what she thought of it. She answered that her father had a better stable for his horses. In a fury he drew his dagger and stabbed her in the side, and it is said that when the pillar was cut, and they sculptured the figure of the wife, that the hole appeared in the side; and although they changed the pillar three times, every morning after they found the hole still there, as a warning to passionate husbands to keep their tempers. One of the pillars outside this temple, being very much exposed to the weather, is consequently much damaged, It represents Vishnu giving his sister in marriage to Shiva, and every year there is a ceremony of marriage performed. But while the ceremony is going on a Brahmin invariably sneezes, and as that is an omen of bad auspices, the marriage is postponed, and as this has been going on year after year, it probably will to all eternity. That sneezing puts a stop to it.

The outside of this celebrated mundapum is similar to that we saw before at Trichinopoly, the two side pillars being carved differently, the one on the right being Ravana, the celebrated giant, who was condemned to bear a mountain on his back in punishment for his sins. Exactly opposite is situated the celebrated temple of Madura, the richest in India, with an income of £4,000 a year, and an enormous quantity of priests. The difference between this and the other at Trichinopoly is that this is all covered over, while that is uncovered. That one is very poor, while this is enormously rich. I ought to have said a few words here respecting Hindoo worship. There is not a single Hindoo temple dedicated to the worship of the one God, and they have no representation of Him. He is something too awful for that. They never address Him except through a priest, or one of his personifications, Brahma, Vishnu, and Shiva. These are the three principal deities. Brahma is Creation, Vishnu is Preservation, and Shiva Destruction. And although it is said that there are 330,000,000 gods in India, yet the simple truth is, all these are only names given to one or other of these in any particular place where the god is worshipped. He is always named for some act or other which he is supposed to have performed at or near the place of worship. One or other of these three is the god, and there are 330,000,000 names of these gods. That is the whole secret of the Hindoo religion.

Passing into this celebrated temple, we come to the golden lotus-tank, one of the most celebrated tanks in India. It is supposed that in this temple originally there was no tank, and so Shiva was obliged to make a passage under the sea to allow the water of the Ganges to come a thousand miles and supply this tank with water. Alongside this tank there was a bench, and there was a sect of holy men who had a right to sit upon it. This bench had the peculiar faculty of elongating itself at pleasure, or becoming shorter, as the case might be, and therefore, when anybody applied to be admitted a member of this holy sect he was ordered to sit on the bench. If the bench elongated he was to be received as a member; if the bench became shorter he went head over heels into the water, and could not become a member; and as the water was in a very foul state he did not have a very pleasant bath.

Our next view is of Yali. In every temple you find that monster personified. What he is or what he means nobody seems to know. The Brahmins may know, but they will not tell you. They simply say "That is a Yali."

Now we come to the palace of Madura. It formerly covered a square mile of ground, and was a most splendid building. Every pillar you see is 50 feet high. There is very little of it left now, and what little there is, is used as a court of justice every day in the season. The next view will give you a better idea of this wonderful place. It is taken from the inside, looking outwards, and gives a side-face view of the square, three sides of which still stand. The interior of one of the colonnades also gives a very good idea of the grandeur of the place.

Leaving Madura, we start on our real trip to the south where we are quite out of the region of civilisation, and where we can get hardly anything to eat but eggs, or murghi, or fowl.

The first place we halt at is Secundermali. Here is one of those rocks of granite so frequent in the south. The story goes, that this was a place dedicated to the god Subryamanya, who was a son of Shiva, and when he was born, he showed such a restless spirit and created such a disturbance in heaven that Shiva gave him this mountain to live upon.

Leaving here, we have 20 miles further to go, and shall arrive at another sacred temple, where we shall see the Juggernaut car, the finest in the south of India. It is 30 feet high, and all made of ebony. You must imagine that you are encamped under tents, not far from the temple, when you find the whole place one mass of living beings, before daylight. Let us accompany them. You see the women in gala attire, and the men dressed in every imaginable costume, the children yelling, and the dogs barking. Arrived at the temple, you first see the nautch girls dancing away, and throwing themselves into all sorts of attitudes. The door of the temple opens; the Brahmins come out bringing their god blazoned with jewels. They pass underneath the car, and then appear on the top; thousands of people are surrounding it on every side; the rope is thrown to the people, and hundreds catch hold of it, tugging away till the ponderous mass begins to move. The yelling and screaming is tremendous, and no words of mine can give you the smallest idea of the scene as the car starts. Ascending the hill it slowly works its way, the whole mass of people following, till at last it arrives at the top where the descent commences; and at this spot it was that formerly the fanatics, wrought up to a frightful state of enthusiasm, as the huge machine began to descend the hill, on the other side of the temple, and before anybody knew of their intention, would throw themselves down on their backs, and opening their legs, received that ponderous mass right over their bodies. The whole scene is one which no words of mine can give any description of, and although the government sends a large body of police, it is even now almost impossible to prevent the suicides, so sure do the people feel that they thereby secure to themselves an entrance into their heaven.

This view shows the car more in detail, and gives you a better idea of its size and shape, and how it was made. Every bit of it is carved into a god, and is most beautifully executed in the ebony wood. It is made out of eight or ten old small cars which existed before. One Hindoo asked leave of the Brahmins to take all these and break them up, and make this splendid car out of them.

Passing on, we come still further south, to a place called Kaloogoomulla, another of those extraordinary rocks rising perpendicularly from the plain, common in the South. The temple is quite modern, and of no great merit, the beautiful one being on the other side of the hill; though very few have seen it, for you are told that is the only temple. Nine-tenths who go here firmly believe there is nothing else to see but what you see there; whereas, there is in reality one of the most beautiful little bijous in the whole of India. You see how the granite has been cut, and that square block has been finished into a temple out of the hardest granite that is known. It is one of the most remarkpieces of labour the world can show. There it stands. Nobody knows of it, and the natives will not let you see it if they can possibly help it. And still it would be impossible to imagine anything more lovely than that solid block of granite. Nobody knows by whom it was done or why it was done, or if they do it is impossible to get them to tell you. The story is told of a rich native who commenced building the temple on the other side, when his son was so disgusted at the slowness of the work that he disappeared one night, and when the father came round the rock in the morning to look for him, found that in one night, unaided and alone, he had cut out the rock and built the temple. "There," says the son, "that is what I call work;" and the father was so furious on seeing that his son had surpassed him, that with a blow of his hammer, he felled the son to the ground. The gods sent a cobra to destroy the father, but the son seized the cobra and saved the father's life. No worship is ever performed in it. It lies almost unknown, and yet is one of the most beautiful pieces of workmanship in the whole world.

We go still further, to Tinnevelly, where we stop to look at Kama Deva, the Indian Cupid. When he was born he had a quiver and five arrows born with him. On his asking the old god Brahma what the arrows were for, he was informed that to him was given the power to shoot at people, and wound their hearts with love, and so populate the world; that everybody he shot at would be inflamed with love. So he shot at old Brahma himself before he could get far away from him, and, of course, hit him, and 149,000 children were the result. Brahma became so furious at this—for who would like to have that number of children?—that he told Kama Deva that the next god he shot at he should be slain; but afterwards, this being forgotten by him, he shot an arrow, and no sooner had he hit Shiva, than Kama Deva died.

In the same temple is another god; but I must stop for one moment to describe the pillars at the entrance to the temple. There are four, each twenty feet high, carved out of a stone so hard that no chisel can be got now to touch it. The natives tell a ridiculous story in connection with it, and say that they used to put a leaf of a certain plant to it, and the stone became as soft as clay, and could be moulded. However, the fact remains, that our chisels will not touch this stone, which many years ago theirs carved this temple out of. It has the peculiarity that, if we take Josephus's history of the Temple at Jerusalem, and compare it with this, we could almost fancy that we saw before us the Temple of Jerusalem as described by Josephus. Every court in it and every part of it is precisely and identically the same, but, unfortunately, this is very low, and infested with rats and bats, which makes so overpowering a stench that you are glad to get out of it.

We now strike across to the sea-shore, and on going a little to the north we cross a small arm of the sea, and come to Ramisseram, which has the most celebrated temple in the south, if not in the whole of India. This temple is dedicated to Rama, as the name signifies, and is considered by some to be more holy than Benares. The story goes that Rama was prime minister to one of the Ramnad rajahs, and for some reason or another he was banished across the water with his wife and brother, and he built himself a hut on this island. Ravana then governed Ceylon, and his sister proposed to Rama that she should become his wife, and she pestered Rama to such an extent, that at last he cut off her nose. She went back to her brother and showed what had happened, and her brother sent an army to attack Rama. However, he soon disposed of him and his 14,000 giants. Ravana, on hearing this, got one of his people to assume the form of a deer, and told this deer to pass close by the hut where Rama lived, and tempt him to pursue him while he stole Seeta, Rama's wife. Ravana appeared and carried off Seeta. Rising in the air like a bird, with Seeta in his arms, he met "Tutayoo," the sacred bird. The result was that there was a conflict to recover Seeta, and an army of monkeys was sent to seek for her. The monkeys met the giant, who told them he had seen Seeta. Ravana seized the monkey by the tail till he told him where Seeta was gone to. Rama then called a council, to know what he was to do, and he was advised to send Hunooman, a monkey god, who had the wonderful power of jumping 500 miles at one leap, into Ceylon. He went and asked to be admitted into the presence of Ravana. This was denied him, and he was immediately seized, but he killed the people who were sent against him. Ravana in a rage ordered his tail to be set fire to, and then Hunooman in revenge jumped from house to house, setting all the place on fire as he went. After doing it he found Seeta, and told her that Rama knew where she was, and asked her in return how he was to put out his tail. Seeta told him to spit upon it, and in attempting to do this he blackened his face, and said that when he got home with such a black face all the other monkeys would laugh at him. Whereupon Seeta promised him that all the other monkeys should have black faces too. Well, he went back, and assembled all his army of monkeys, and Rama assembled an enormous army too, but was at a loss to know how he was to lead his army across the sea, and he was told to pull up the neighbouring mountains and cast them into the sea. Hunooman collected five mountains, each sixty-four miles in circumference, carrying one on his head, one on each shoulder, and one under each arm, and plunged them into the sea. Then he collected all the stones, and put them on the bank, and every stone was marked RAMA, and the stones fitted into their places at once, and thus the bridge was made. Having got across, the battle began, and a more frightful battle was never fought. At last, having destroyed a great many giants, one came 4,000 feet high and 2,500 feet round. Rama at last managed to defeat him, and get possession of Seeta, and when he got into Ramisseram, by some wonderful means two shadows appeared, a mark of guilt of the deepest dye, and he was ordered to offer up some being to appease the gods. He immediately offered up Seeta, about whom he had made all this fight, but she came out scathless out of the fire.

These corridors are considered the finest in the south. The door at the end marks the entrance to the sanctuary. They are 300 feet long, each pillar is one block of solid grey granite. Unfortunately, from its being whitewashed, much of the beauty is hidden. If at any future day it should be cleaned, it will, of course, be in a better state of preservation thereby.

This gives an idea of the strange way the Hindoos sculpture the pillars in their temples. The figure is nothing but that of a juggler, and yet he is carved out of one of the pillars in one of the most sacred temples in India. The side aisle of the temple of Ramisseram is 700 feet long; the window at the end is five feet high, and gives some idea of its length. When we consider that the pillars are of granite, and the enormous time it must have taken to build such a temple, and carve such a wonderful corridor, I think you will agree with me that it is a work which the world can hardly excel. Four thousand feet is the aggregate length of the corridors. The temple is situated at the edge of the sea, and receives the pilgrim after his long and toilsome march of 3,000 miles from the north. Only those who know what Indian travel is can conceive what he must have gone through; when he leaves the Ganges he is laden with bottles, one of which he is bound to leave at every temple till he arrives here, and leaves the last, and here he hopes for rest. But he has no rest yet, for the Brahmins take him to the sea, and the actions they make him go through at daylight are very absurd. Then, between here and Ceylon, is a long sand-bank, seven miles long, which formerly was a portion of the land, and through this the pilgrim is condemned to wade to a temple built on a rock. At last the Brahmins have done with him, and he finds rest and repose here. He wanders through the splendid corridor late in the evening—in the dark night—and knows he has earned the right to remain. He feels that he has insured to himself beatitude hereafter, and, he hopes, prosperity in this world.

Here we will leave him, and turning north again, following the coast-line till we arrive at a very small temple called Adavea Covil, but on first arriving we hardly know that we are at the temple. It is cut out of nearly the same stone we saw at Tinnevelly. Here are some more curious figures, and among others there is the figure of Vishnu in one of his incarnations, and the story is that there was a very wicked king who did not believe in a god, and who was always saying that there was no such thing as a god. He had a very good son, who always told him that there was a god, and everlasting discussions took place between them about it. At last one day, when the discussion was very hot, the father in a fit of fury kicked a large rock, and said "If there is a god let him come out, and then I will believe in him." The god immediately appeared, seized the unhappy father with his many arms, and made cords of his entrails. He is supposed to be Vishnu in his seventh incarnation.

Alongside of these are two more pillars, with sculptured figures, one of a woman, supposed to be a celebrated dancer. So proud did she become of her powers, that she offered to lay a wager of 100 rupees that no one could compare with her for dancing. The day was appointed, and the judges assembled, and she danced to their perfect satisfaction. There was a pause, and everyone was waiting to see who would come to claim the 100 rupees, when the figure you see there appeared, and placing himself in a certain attitude, challenged the woman to do so too, when she declared herself vanquished. He then married the woman. He could do no less.

Leaving this temple, we get a view in the distance of the beautiful goparum, or gateway, with which it is adorned. There is only one spot at which it is possible to get a good view of it. It is justly considered one of the very best in India, though rather stout for its height.

We now approach Tanjore, the next richest after Madura; but it has this peculiarity, that, whereas the Madura temple literally swarms with people, Tanjore temple is quite deserted. Roaming through its enormous enclosure you never meet or see a soul, and it always remains exactly as you see it there, without an individual near it. It is justly renowned for its riches and beauty. On the right, under that mundapum, is a large bull. It is the bull of Shiva, and the finest in the south of India, of 80 tons weight, and is cut from one single block of hard granite, and said to have been brought 500 miles in a pilgrim's pocket. The story goes that he came in the shape of a pebble, and being put there, began to grow, and grow, and grow. He was in the habit of going out every night and doing so much damage that Shiva was asked (Shiva always had a bull) to prevent it, and he drove a nail in his head, and he there remains fixed for ever. Another story is that when the English came they took it and stopped his growth. However, the fact is certain, our engineers have measured the bull, and have declared that that stone is 80 tons in weight, though by what means it came there is a mystery to everybody; for probably in the 11th century it must have been a difficult matter to bring a stone now weighing 80 tons, which must have weighed more before it was carved, for 500 miles.

The globe on the large goparum of Tanjore is said to be a solid block of stone, and the only means known to the natives in the 11th century by which they could get a block of stone such a height, was by an enormous earthwork, up which they rolled the stone; and they show you a field seven miles off, and actually tell you that was the spot where the earthwork began. They say that was built because the Rajah of Tanjore was in the habit of going to Trichinopoly to worship there, and one day they tried to poison him, so he said he would not go any more, and consequently built that temple.

The next view is one of the prettiest little bijous to be met with. It is dedicated to Subrymanya, and the carving on it is just as sharp as if it had only been done nine days ago, instead of in the 11th century. The trough is a most beautiful piece of workmanship. I should have told you that every god is treated exactly as a human being; he is washed and dressed, and laid down to rest, anointed with oil, and so on; and the oil runs by that spout into the reservoir, where the pilgrims either come to fill their bottles and carry it away, or it is dried up by the sun.

Passing on, we come within a short distance of Madras to the Seven Pagodas. Nothing excites one's astonishment so much as this place. The rocks have been carved here, but why they were done, or by whom, nobody has any idea, nor can anyone form a conception for what purpose the whole work was undertaken. Nothing is finished. No worship is performed there, and indeed the place is visited but by very few. So wonderful is the apathy caused by the climate, that though it is within a few miles of Madras, and the canal enables us to go there in one night, still you would be astonished at how very few have seen it. The natives have a story of the cause of this place being sculptured, and left in its present state. They say that a rajah in some distant country got workmen together to build a temple, and did not intend to pay anything to the men. They *en masse* rebelled, rushed to the sea-shore, seized a lot of boats, and went to sea, when the waves drove them ashore at this spot, and here for twelve years they remained, and to keep their hands in they amused themselves by carving these stones. At last the rajah, finding out where they were, sent an army and brought them back. It may have been by the rajah dying, but that is the story how the whole thing ceased. Everything is begun —nothing finished.

Here again we have a large rock carved, 40 feet long and 20 feet high, on which are certain representations, and these, it is said, show that serpent worship existed here. Here is also a figure which is a personification of Vishnu. Passing from here, we will go to the sea-shore, to take a more general view of the whole thing. You see the rocks as they appear from the sea-shore. The sides and backs of the caves are carved into the most beautiful bas-reliefs, one of which I will proceed to show you.

As we go in, this curious carving appears on the right. The story goes that a certain giant performed a penance, and lived for 100 years on water, 100 years standing on his head, 100 years with one leg in the air, and 100 years with one arm in the air. After that he asked Brahma to grant him his request. Brahma said he would do so, and he asked that he might be omnipotent, and that no animal of those he named should be able to destroy him. Brahma granted his request, and he immediately ascended to heaven and turned out all the gods, and sent one this way and another that, and turned the whole thing topsy-turvy. When Brahma came to examine the contract he found that a pig had been forgotten to be named, and Shiva was asked to assume the form of a pig and destroy him. The next bas-relief is Vishnu, supposed to be lying at the bottom of the sea, for it is said that when the Deluge came on, Vishnu was lying at the bottom of the ocean, and a lotus sprung from his body, out of which came Brahma.

The next bas-relief, which is considered one of the most beautiful in India, shows the goddess Parvatee killing the demon Doorga—from which she afterwards assumed the name of Doorga. He came over Brahma also in a weak moment and obtained from him supreme sovereignty. He turned all the gods out of heaven —the sun would not shine, the moon would not shine, rivers would not run, clouds would not rain, and everything went wrong. The result was, the gods applied to know what was to be done. Shiva said he would send his wife to kill the demon. The demon had an army of 100,000,000,000 elephants, 100,000,000 chariots, and 10,000,000 horses, and with these she had to fight. But at the end, by great good luck, she overcame them, one after another. The demon then assumed a man's form, with a buffalo's head, and hurled stones and mountains at her, but she advanced too quick upon him, hurled her arrow at him, and killed him.

Close by is the temple on the edge of the sea which Southey has immortalised in verse. This temple gave rise to the legend of the submerged city of Bali, of which there is not the slightest shadow of foundation. It is terribly destroyed by the sea—winds and waves are reducing it to ruin as fast as possible.

Close by are the celebrated rocks supposed to be the only ruins of the Buddhist temples. There are five large boulders of granite, an elephant 14 feet high, a lion 10 feet, and a large bull, carved out of one block of this beautiful grey stone.

Before finishing, I must ask you to understand what Indian caste is. It is compared to our society, but in reality is very different from it. A high caste man, no matter what his position, though he may be a beggar and perform the most extraordinary offices, still always has the right of *entrée* into the houses of the richest natives, and is welcomed wherever he goes, and always received well. On the other hand, a low caste man, though with millions of money, is never allowed to enter a temple. Among the high caste are the fakirs. There is one, such as I saw him. He confessed to me that water had never touched his body, his nails had never been cut, he had never been shaved, and his hair was bound up with rags, and was a solid mass of dirt and filth, and yet this man was received with open arms in the magnificent palaces of the rich natives, where he was always welcome. Such as I saw him I show him to you. Ladies and gentlemen, I have the honour to wish you good night.

A vote of thanks was then proposed to Captain Lyon, and carried by acclamation.

CANTOR LECTURES.

The first lecture of the first course of Cantor Lectures for the present Session, "On the Practical Applications of Optics to the Arts and Manufactures, and to Medicine," was delivered on Monday, Nov. 25th, by C. Meymott Tidy, Esq., M.B., Joint Lecturer on Chemistry, and Professor of Medical Jurisprudence at the London Hospital. After a few preliminary observations, the Lecturer said:—

I will turn on my electric lamp, which we shall use principally in the course of our lectures, and allow a beam of light from it to pass through the room. There are two points to which I am anxious to draw your attention about the beam of light which issues from the lantern. The first fact that you will notice is this, that every ray comes out of our lantern that can possibly get out. And the second point is, that the rays, as they issue from the lantern, appear like a divergent cone of light. You see the rays, as they pass from the lantern, come out like the vanes of a fan, the light being the centre from which the vanes radiate. Those are the two great facts for you to notice with respect to the beam of light from our lamp.

I need not tell you that the amount of light given off decreases as the distance from the source of light increases. The nearer you are to a light the more light you get. I think that is fairly well known. If you have not light enough, you draw the candle nearer to you, and I think, at any rate, you will see the explanation of this fact when you look at the rays from our electric lamp, in the divergent character of those rays. You noticed the large space that was occupied by the light from the electric lamp when it was thrown on the opposite wall, and the comparatively small space that those rays occupied nearer the centre from which the light proceeded.

But now we must go a step further. It is not enough that we should state that the amount of light decreases as the distance increases; we must examine the exact law which regulates this decrease of light, with regard to distance. It observes a definite law—a law perfectly independent of the source of light, for it matters not whether the light comes from the sun, whether it comes from our electric lamp, or whether it proceeds from a candle, the law regulating the decrease of light in regard to distance is perfectly definite. It is expressed thus:—

That the intensity of the light diminishes as the square of the distance from the luminous source increases. And I would say, with respect to this law—this law of inverse squares—that it is not in any respect peculiar to light, but that it is a law which governs all radiant forces. In nature there is a very strange unity of plan. I put a candle, for instance, one foot off my paper, and I get a certain amount of light. I take my paper two feet off, and I have not half the light which I had at one foot from the candle, but only a quarter of the light. Or, to put it in another way, I have a certain amount of light from the lamp at a distance of say two yards from my paper. I bring the paper within one yard of the light, and I have just four times as much light on my paper as when I was two yards off. I want to make that law perfectly clear, and I will endeavour to do so in another way. I have here the lime-light. I will turn it on and get a beam from it, as it will answer our purpose for this experiment better than the electric light. I have here two cards, which are exactly the same size, about one foot square. I will hold one card as nearly as I can half way between the light and the screen, and the size of the shadow that I obtain is just four times the size of the card. If I hold the card one-third of the distance from the lamp, I then obtain a shadow nine times the size—three times the size each way. As you see, again, it is the square of the distance. But this is the point I want you to remember—when I hold the card half way the shadow is four times the size of the card, but the amount of light thrown upon the card in that position would be the amount of light that, in the other case, would be spread over a part of the screen four times the size of the card, if the card did not intercept it—so that, you see it is inversely—the shadow is four times the size, but the amount of light is only one-fourth. I hope that is quite clear. The same thing may be shown in a variety of ways. For instance, if I took a card four times the size of that one I used before, and hold the small card half way between it and the light, you will find that the shadow of the small card exactly covers the large one. So much then for the law itself.

But we must go a little further than this, and must now examine—and it is most important that we should do so—not merely the law, but the application of that law, which is our subject. It is most important that we should be able to measure the exact amount of light in a flame. You know that complaints about gas are very numerous. We are constantly being told of the bad gas, of the bad smell, of the bad light. Some old-fashioned people will even venture to tell you that it does not give the light of a dip. Now I think, bearing in mind the law that I have stated to you—the decrease of the light, as the square of the distance increases—it must strike you that we put our gas lights in a very ridiculous position. If we had candles, for instance, do you think we should put them up there at the top of the room? Do you think, bearing in mind this law of inverse squares, we should put our candles in our drawing-rooms half way up towards the ceiling? I am very much disposed to think that if coals continue at their present extravagant price, we shall before long be bringing our gas on to the table, and trying a little economy in that way. Now, I want to examine, as far as time allows, the various forms of apparatus which have been contrived from time to time for the purpose of measuring the relative intensity of light. They are known under the name of photometers—not in any way a good name. The fact is, we can only measure the relative intensity of light, not the absolute. It is the relationship between one light and another that we examine; and I must say this, that there must always be a certain amount of discrepancy in the results; for this reason, that it is very rarely that two persons are found who in any form of photometer find that their observations exactly coincide. It seems to me that a real photometer would be such an instrument as enabled us to examine the products of the action of light; but in the present state of our knowledge I suppose this is perfectly impossible, because, as I shall endeavour to show you in my third lecture, it is not the luminous rays with which we are at present concerned that produce anything like ponderable results.

Now then for photometers. The first and simplest was that proposed by that celebrated man, Count Romford. He measured the intensity of light by the relative depth of shadow; and the way he did it was this. He took a candle and a lamp, or any source of light that he was about to examine, and threw a shadow of some object on to a screen from both these lights. Each shadow, of course, is illuminated by the opposing light, so that the illumination of the screen due to each light will be the same. I have represented it to some extent on this diagram. Here is a candle, and here is a lamp, and there is the shadow of a stick on the screen from both the lamp and the candle. He takes care that those two shadows should, with regard to the depth, be identically the same. He then measures the distance of the candle from the stick, and also the distance of the lamp from the stick, and then, in accordance with this law of inverse squares, he is able to say for a certainty the illuminating power of that lamp relatively to the candle. For instance, if that candle is one yard off and the lamp is three yards off, when the shadows are the same, in obedience to the law of inverse squares the lamp gives the light exactly of nine candles. I have contrived here a method of showing this. I have a transparent paper screen, and I have placed behind it a stick, and you will notice I am able to throw the shadow of the stick by means of a gas-light, and also by means of a candle, on that screen. You see that if I raise that gas-lamp to its full height one of those shadows will increase in intensity. Now, I will lower the gas-flame very much, and you see the shadow of the candle is more intense than the shadow from the gas flame. Thus, by the relative intensity of shadows Count Romford was enabled, to a certain extent, to calculate the relative intensity of light The next step in the history of photometry was an instrument designed by Ritchie. He calculated the light-giving powers of the flame, not by the depth of the shadows, but by the intensity of the illumination. I will try to illustrate this method by a large apparatus which I have here, designed by my friend Mr. Hart. I have here two paper discs, and I place a light behind each. On the left we have a candle, and on the right we have a gas lamp. We will bring them now both to equal distances from the screens, and you see how very different the intensity of the illumination appears on those two screens. It is perfectly clear, therefore, that the gas lamp on the right gives a great deal more light than the candle. Now let us try to equalise them. What must we do? We bring our candle nearer, until we get it to a point where these two discs are illuminated as nearly as possible to the same extent. I grant you we should probably disagree, a great many of us, as to where that point is *exactly* situated, and there is the difficulty I mentioned just now, that you cannot get two people to agree exactly. I want you to notice the difference in the distance of these two lights. Let us suppose that these two screens are illuminated alike, and now, by taking down the screen, and showing you the lights themselves, you see what a long way off the gas lamp is compared to the candle, which is very near to the screen. That shows you that the amount of light depends in a great measure on distance. If I measured, as I could do, the exact distance of those two lights, I should be able to calculate with the greatest ease possible, very nearly the relative amount of light that the gas flame gives in comparison with the candle. The latter is about seven inches from the screen, and the candle about 35.

The next photometer was that designed by Wheatstone, which consists of a silvered bead, or rather a little convex mirror, placed on a little disc, and so contrived that it can be rapidly rotated. If you hold a candle near it you see a little picture of the flame of the candle, a very small image of the candle in the bead, and when it is rotated rapidly, this little image of the candle forms a most beautiful and most curious line of light, owing to the power possessed by the retina of retaining an image for some time after the object is removed. If you have two candles, one on one side and one on the other, instead of one image you get two images, and if one candle gives more light than another, or if you have a lamp on one side and a candle on the other, the lamp giving more light than the candle, you get one of these little images when you rotate it, very much more intense than the other. This is represented on a diagram which I have here. It is a drawing of Wheatstone's photometer. There is the little bead, and there is the handle by which we rotate it, and you also see represented the lines of light formed by the little bead as it rotates. They are represented there as one being more intense than the other, and therefore we should have to move the apparatus near to that light which gives the less intense image, and bring it to such a point that the two images should be precisely the same. Then on measuring the distance of the candle and the lamp, and again bearing in mind the law of inverse squares, we are enabled to tell the relative intensity of the flame. Sir Charles Wheatstone suggested this mode for the purpose of studying the vibration of rods in that marvellous instrument of his which we know as the kaleidophone.

I now pass on to another photometer of more value, for, I am sorry say, these are not of very much practical use; they are difficult to manage, and, as I said before, there is a great deal of disagreement between people as to when the light is placed at such a point that the illumination on the one hand, or the shadow on the other, are identical. We come now to the photometer of Bunsen. When you take a piece of paper and make a grease spot upon it, and then place a light in front of that grease spot, you seem to see the grease spot as a dark spot on a light ground; but if, instead of that, you place the candle behind the grease spot, you see it as a light spot on a dark ground. Thus you see the difference between reflected and transmitted light. Now, supposing I have exactly the same amount of light on each side of that grease spot, I should not see it at all. That is Bunsen's photometer; and I must tell you that this is the form of photometer that is ordinarily employed now-a-days, or some modification of it, in testing gas. I have here, by the kindness of Mr. Sugg, one of the Bunsen photometers, which you may see in all its details. It is a form which has been improved and modified by my colleague and friend, Dr. Letheby. It consists of a running car, carrying a piece of paper with a grease spot on the middle and two little mirrors, one on each side, by which you are enabled to see both sides of the paper. But I will show it you in a different way, and on a somewhat larger scale. Here I have a long piece of board, and a large model of Bunsen's photometer; you see the grease spot in the centre. This apparatus fits on the board so that it will move along freely. On each side there is a large mirror, by which you can see the exact state of the paper on both sides. Now I am about to iluminate this on the one side with the lime light, and on the other with the electric light, and I want you to see whether we can calculate, on a somewhat large scale, the illuminating power of our two lights. You see at once, when it is in the centre of the plank between the two lights, how much more intense the electric light is than the lime light, so that I have to move it a very long way before the grease spot disappears. I cannot get it to disappear entirely, for you cannot, on this large scale, perform the experiment exactly, but you see the principle well illustrated. You see in one mirror the reflection from one light, and in the other the reflection from the other; and when you lose this spot altogether, and nothing more is seen than the reflection of a plain piece of paper, then it is that the point is reached at which the same amount of light exists on both sides of the paper. There are several other forms of this photometer. Our standard in gas testing is a sperm candle burning at the rate of 120 grains per hour. Mr. Crookes proposed a lamp, because it was perfectly certain that candles are often very unsatisfactory in practical working, and that it is very difficult to obtain candles that burn accurately. Therefore Mr. Crookes proposed burning a mixture of five parts of alcohol and one of benzol, both of a given specific gravity, for comparison. No doubt the idea was a good one, but alas for the imperfection of all things human, if the fluid of the lamp was thus rendered invariable, how enormously difficult, how practically impossible, it is to construct a lamp the light of which should be invariable, and it is no use having the fluid invariable unless you have the lamp invariable too. Several other things have been proposed from time to time for photometers, as, for example, allowing light to pass through a certain number of glasses, the amount of light being determined by the number of glasses through which it would pass. Here are a number of pieces of red glass, of different length, and you might be able to see the light of a candle through six of them, but not through seven. That of course might be made a mode of testing illuminating power. I may say also that polarised light has been suggested for photometric purposes, but I hope to describe the method of testing the illuminating power by means of polarised light in another lecture.

I suppose a tallow candle was the first kind of beacon-light ever used. For half a century after the Eddystone Lighthouse was built, twenty-four candles were the only light employed. Then we read of blazing faggots of wood, burned in an open chaffer; then of open coal fires; and here is a diagram, taken from a very old book, showing how it was used at the Isle of May, just at the entrance of the Frith of Forth, up to 1816. Here you see the coal for the fire being drawn up in baskets. But these methods were inconvenient. No light was ever visible in the direction in which it was most wanted, because of the wind blowing; and any light that did show was best seen on the land or in the sky, where there was no occasion for it. Then what did science do? A given light being taken, science could not increase the quantity of light, but it could direct those rays which when in a wrong direction into a right one. A candle, for instance, is in a window; I cannot increase the quantity of light given by that candle, but inasmuch as its rays are being given off in every direction, I can take the rays that are on the side where they are not wanted, and make them go in a direction where they are wanted. This is what science can do.

If I allow a light to fall upon a mirror, you know very well that that light is driven back, just as in the case of a billiard ball, which rebounds when it strikes against the table. Thus I allow a beam from my electric lamp to fall upon this mirror, and, as you see, the light darts off into another part of the room. That is the old Jack o'Lantern. There is the reflection of the light, and I need not tell you that the law of reflection is that the angle of incidence, or the angle that the incident ray makes with the perpendicular, is equal to the angle that the ray of reflected light makes with the perpendicular.

Now there are different kinds of mirrors. I have just used an ordinary plain mirror, and you saw how the light was driven off. But if I take a different kind of mirror—a convex mirror—notice how the rays will be spread out, and what a large surface I can illuminate—in fact, nearly the whole room. That convex mirror spreads the rays out; drives them apart. But suppose I take another form of mirror; as for instance, this concave mirror. In this case I get a squeezing of the rays together into a focus. Thus, you see, the rays from a concave mirror are squeezed together in a most beautiful manner, whereas, with a convex mirror, they are spread out. But remember, when these rays come to a focus, as they do with the concave mirror, they then spread out again; there is a divergence after they have met.

I have already pointed out that the loss of light is due to the *divergence* of the rays; that is to say, to the rays spreading out; and it is because the rays spread out that we have such a loss of light at a distance. What we want to do is to get the rays sent off parallel—neither diverging nor converging; and this is effected by another kind of mirror, termed a parabolic reflector. This is a concave mirror, whose surface is generated by the revolution of the arc of a parabola about its axis. Here is one of these reflectors, and you see it is very different to an ordinary concave mirror. In fact, it is very much more concave than our concave reflector. This has the property of sending the rays parallel, as you see illustrated in the case of a candle on this diagram. Here is a candle with its rays being given off in all directions, and this parabolic reflector takes all the rays given off on one side, and sends them off parallel. That is the great point. You see, therefore, that, inasmuch as the principal cause of light being weakened is the divergence of the luminous rays, by the use of this parabolic reflector we can, to a certain extent, at any rate, destroy that divergence. We have brought the rays parallel, and, as a matter of necessity, we shall maintain, to a far greater distance, the intensity of the light. I have several parabolic reflectors on the table, which have been kindly lent by the Nickel Plating Company. It is stated that nickel when plated does not oxidise so readily as other metals, and certainly these are very beautiful specimens.

Now we have to take another law of light, and it is one of great importance. Those materials which allow of a ray of light passing through them we call transparent; but when it passes obliquely from one medium to another it is bent out of its course; and we know this result by the name of the refraction of light. Not when it passes straight through, as I will show you directly, but when it passes *obliquely* from one medium to another, then we get this peculiar effect which is called refraction. I will endeavour to throw upon the screen, with our lime-light, a picture of an arrow. "As straight as an arrow" is a proverb. I think, therefore, we cannot suggest anything better to illustrate our law of refraction. Now I will place a piece of glass in front of this arrow, perfectly flat, so that the light comes through it perfectly straight. You see that there is no deviation of the arrow. Now I will so place the piece of glass that the light comes through it obliquely, and you notice at once how the arrow gets out of its true course—it is almost entirely divided or broken. That is a very good illustration of optical refraction. The light striking that piece of glass at an angle is bent out of its path, and thus divides the arrow, which, by bringing the glass square to the lamp again, I can at once restore to its proper straight appearance.

Now I want to show you another instrument which is a very important one for refracting purposes, but in this case, instead of the picture of an arrow, I will throw upon the screen a small slit of light. This is an instrument which is called a prism—a piece of glass having three sides. I bring that into the path of the rays, and what will happen? My slit of light will instantly disappear, and by changing the position of my lens I find it is much higher up, right above the top of the screen. If I take the prism away I get the slit once more on the screen in the first position.

From this prism, which, as you see, is a refracting instrument, we are able to build up a variety of lenses. For instance, if I take two prisms, and hold them base to base, and if I make the surfaces curved, I produce a double convex lens, and you are, therefore, to regard a double convex lens as two prisms base to base. If, on the other hand, I place them edge to edge, and then curve the surfaces, I produce a double concave lens. Either way lenses are combinations of prisms, and inasmuch as a prism is a refracting instrument, it follows that lenses also are refracting instruments. That is one point at which I wish to arrive.

Now the lens is, of all instruments at our disposal, the most powerful with which we are acquainted for sending rays in the direction in which we want them to travel; infinitely more powerful than our reflector. For instance, if I bring the electric lamp in front of the screen, and place in front of it a large lens, I shall be able with no very great difficulty to build up an image of the light that we are using. Or I may do the same thing in a much simpler way. For instance, I may take an ordinary lens, such as I have here, and build upon the screen an image of the flame of the candle, in front of which I hold it. Here we have the lens gathering together the rays which are being given off from the candle—a portion of them rather—and forming them into an image of the candle on the screen. You thus see what a powerful means the lens is of taking the rays that would otherwise be lost, and making them travel in the direction we wish. I will give you one more illustration employing a photograph on glass which has been sent me by a somewhat celebrated photographer. Placing it in the lantern and throwing a light upon it we can, by means of a lens held in front of the photograph, so guide all the rays of light as to build up on the screen a beautiful, exact, and magnified image of the photograph in which every line and shade is duly represented.

This shows the power of the lens in directing the rays of light as if they were our slaves. The practical applications of the lens to different forms of lighthouses and such like, and in particular to medical purposes, I propose to bring before you in my next lecture.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

Her Majesty's Commissioners have resolved to include in each Annual Exhibition of the Fine Arts a representation of the works of one or more artists who have died in the preceding ten years. Special space will be set apart for such a representation. It is resolved that the works of Messrs. Phillip and Creswick shall be exhibited in 1873.

The second meeting of the Committee for Utensils for Drinking, and Implements for the use of Tobacco, &c., was held at Gore-lodge, on Thursday, 19th December, 1872. Numerous applications to lend ancient objects were read, and a recommendation was made to invite the contribution of modern utensils of a new character, and specially suitable for different wines, liquors, &c. The following gentlemen were present:—Mr. W. Bragge, Mr. Soden Smith, Dr. Thudichum; Mr. John Evans in the chair. Mr. H. Cole, C.B., attended on behalf of her Majesty's Commissioners, and Lieutenant H. H. Cole, R.A., was present.

The governors of the Southern American States have recently held a convention at Atlanta, Georgia, to promote the construction of a continuous line of water communication, by natural and artificial channels, from St. Louis, Missouri, to Savannah, Georgia, a distance of about 1,300 miles.

The question of coal explorations continues to excite a good deal of interest in Victoria. The Argentine Republic has also offered a reward of 25,000 dollars for the discovery of a workable seam of coal.

EXHIBITIONS.

Exhibition at Milan.—The National Industrial Association propose holding an Exhibition at Milan next year. The programme is not yet published, but it is probable that it will embrace silk, woollen, and cotton manufactures.

Vienna Exhibition.—We understand that a recent decree of the Austro-Hungarian Government will set at rest the doubts that have been entertained in many quarters as to the danger of new inventions, not protected by patent rights, being pirated or imitated. The director-general of the Exhibition is authorised and instructed to issue special certificates to exhibitors—certain stipulated formalities having been complied with—which shall secure to them all the legal privileges and protection required.

THE "CROPPER" PRINTING MACHINE.

In the recent report on printing machines in the International Exhibition, published in the *Journal*, we gave an engraving of this machine, but owing to the inventor's not having sent in to us full particulars, we did not give a detailed description of it. We therefore supplement the report by the following particulars, lately received:—The objections urged by printers against the platen machines already in use, are, that they are complicated in construction and fragile in build; and, further, that they do not give a perfectly flat impression, inasmuch as the type-bed has a segmental circular movement to the platen. The "Cropper" machine is intended to dispose of these objectionable features. The platen is in a vertical position, and is a fixture, so that it gives a resisting power at the moment of impression. The tympan, which is pivotted on the upper edge of the platen, rises to be fed, and falls against the platen to receive the impression. The type-bed is carried forward in parallel horizontal slides; the impression, therefore, must be perfectly flat. The impression screws are in front of the operator. A new ink-duct is also applied to this machine. It is regulated by a single screw, and supplies the ink only to the edge of the ink-disc.

VOYAGE OF THE "CHALLENGER."

As very little has yet been extensively published about the exploring ship *Challenger*, and the objects which it is hoped will be attained by her voyage, perhaps the following description of her may not be out of place. It is extracted from a very interesting article on the subject in *Ocean Highways*, to which we may refer those who wish for further details.

Of the ship itself, we learn that:—

"On the main-deck, the captain's usual after-cabin is divided equally in two, fore and aft, one side being devoted to the director as his private cabin, the other being that of the captain; from these a ladder descends to the general mess-room. Before the private cabins is the captain's state cabin, outside of which is the analysing-room and the commander's cabin on the port-side, corresponding to which, on the opposite side, is the chart-room and the cabin of the navigating-lieutenant. Further forward, and separated from these last, are, on one side, two photographing-rooms and a cabin for one of the scientific staff, and on the other side a chemical laboratory and an officers' bath-room. On the lower deck aft is the general mess-room, flanked on either side by officers' cabins, as is usual; and outside the mess-room, on either side, are cabins and mess-rooms for engineers and warrant officers as far forward as the engine-room hatch. The magazines, instead of being devoted to the usual 'vile compound,' are dedicated to more peaceful uses, although one of them will contain a scarcely less dangerous article than gunpowder itself, in 600 gallons of alcohol; the after-magazine being filled with about a hundred-and-twenty thousand fathoms of line for sounding and other purposes, that for sounding being made of the best Italian hemp, which, although only eight-tenths of an inch in circumference, is capable of bearing a strain of half-a-ton. The sinkers lie stowed well down, in the shape of 600 iron castings, of one hundred-weight each, and sixty leads of the same weight, fitted with cups or tubes for bringing up bottom specimens."

As to the scientific outfit, as it may be termed, of the ship, "for hydrography, she is furnished as if she was solely intended for surveying, the supply of instruments being ample to meet all requirements and casualties. For deep-sea investigation, the line and weights are enumerated above, the iron sinkers being for the disengaging apparatus and very deep water. They are used thus:—Each sinker is perforated, and is cast so that two, three, or four can be used, according to the supposed depth, current, &c.; a rod, having a tube at the lower end and a stiff spring near the upper end, is passed through the sinkers, and by means of an iron ring, with wire attached, is suspended to a button which passes through the spring; the weight of the sinkers keeping the spring back. As soon as the wire is slackened by the weights striking the ground, it is thrown off the button by the spring, and the rod drawn back, leaving the weights. A butterfly valve at the lower end of the tube retains the bottom specimen forced into it. The leads are fitted with a short tube with valve, or a cup with cover, for moderate depths, say under 1,500 fathoms, and are brought up. To prevent loss of leads and lines, a number of india-rubber accumulators are furnished, each being five feet long, and capable of extending to twelve feet, with a strain of about fifty pounds. A number of these are arranged in accordance with the strength of the line and the strain, so that, when in heaving-in, the ship suddenly rises to the sea, the strain does not come on the line until the accumulators are at their full tension, and in falling to the sea they acquire their normal position; they are also useful as a dynamometer. A drum and wire, as suggested for deep soundings by Sir William Thomson, is also on board, the mode of measuring the depth being by registering dials connected with the wire as it runs out. Should this mode of obtaining the depth prove successful, a great advance will have been made towards perfection in the mode of sounding, as the friction of the wire in passing through the water is comparatively *nil*. Another instrument for ascertaining the depth of the water irrespective of the quantity of line out, has been devised by Mr. Buchanan, and as it differs from the pressure guages hitherto tried, and which have proved failures, we will describe it. A large bulb and stem, similar in form to the full bulb and stem of the deep-sea thermometer, is filled with water freed from air as much as possible, and the stem fits telescopically into another stem about an inch long. At the lower end of this short stem is a round bulb filled with mercury, the water and mercury joining. The two stems are kept together by tight india-rubber tubing, the elasticity of which enables the smaller tube to move in and out sufficiently to meet the requirements of the increase in bulk of the liquids on an increase of temperature, and the contrary. A steel indicator with frictional bars is within the tube, as in the thermometer. When pressure is applied, the denser liquid, mercury, compresses the water and raises the indicator. The instrument has been tried in Loch Lomond, and also to a high pressure in the cylinder of a hydraulic press, and found to act well. A scale is engraved on the tube, the value of which has to be ascertained by actual experiments for depth, and also for correction for temperature. We believe another gentleman is also preparing one on another principle, which, it is much to be hoped, will be ready for the *Challenger*, as the importance of being able to ascertain the depth, irrespective of the measured line, cannot be over estimated where strong currents prevail, as in the Gulf-stream.

"For sub-current observations a quantity of small line and wire is supplied. The current-drag, being suspended by the line or wire, is sunk to the required depth and the line attached to a float, by which means the direction and force of the current is observed.

"We have already alluded to the self-registering maximum and minimum thermometers. These are constructed by Mr. Casella, from a design by the late Dr. W. A. Miller, F.R.S., who, by covering the full bulb with an outer glass casing, nearly filled with alcohol, removed the pressure from the full bulb, and reduced the error by pressure to so small a quantity as to render the instrument almost perfect. Three dozen of these valuable—nay invaluable—instruments are supplied.

"In addition to these thermometers there is an apparatus devised by Mr. Siemens, F.R.S., and called a 'differential thermometer,' for observing the temperature of the water at the various depths on board the ship. The nature of its action is not easy to explain; but depending as it does, on two insulated wires and the indication of a delicate galvanometer, it is to be feared that, however perfect in principle, it is scarcely adapted for shipboard, except maybe in the very calmest weather.

"The difficulty of procuring water from great depths for analytical purposes is very great. This is obvious, for any vessel sent down 3,000 fathoms for water would have to bear an outward pressure of upwards of three and a half tons to the square inch on being brought to the surface (sufficient to perforate the brass), and, without it can be so brought up, the conditions for chemically testing are not the same, as by the very expansion, portions of the gases may escape as the pressure lessens in coming up; and, although we may be enabled to obtain the water, there will still be a doubt of its constituent parts. For the purpose of procuring this water from great depths, three kinds of instruments have been devised; one is simply a brass vessel with a valve or plug at either end, which are kept open, allowing the water a free passage through on going down, but closing directly the instrument is drawn the other way. Another is an ingenious invention of Mr. Buchanan—it is a brass tube with a tap at each end, which is open on going down, but are simultaneously closed by means of pressure on a plate attached to a connecting rod of the taps when hauled the other way, and when the pressure exercised on the plate has been sufficient to close the taps, it falls, and thus prevents further resistance in coming to the surface. Provision is made for expansion on decrease of pressure.

"About three dozen dredges, of various sizes, for deep and shallow water, are on board, and a large quantity of whale-line for dredge-ropes. Accumulators are also fitted as for the deep sea-line, to prevent the sudden jerk, by fouling a rock, carrying away the line, and stages are fitted purposely for working them. A donkey-engine heaves in both dredges and sounding-line.

"Mr. Mosely has consulted one of the best authorities on fishing in England (Dr. Hearder, of Plymouth), in regard to nets and general fishing apparatus, and has been supplied by him with trammel, trawl, shrimp, prawn, and draw-nets of the best construction; also with lobster pots, fishing lines of all sizes, and every tempting species of artificial bait. Harpoons, fish grains, bird-nets, bags, and cages; butterfly and bat nets; traps for hawks, foxes, rabbits, rats, and mice. Wardian cases for sending live plants home, and hundredweights of paper for preserving them dry, have also been procured; and were we to follow the list of implements and stores for preserving the animal and vegetable world, we should require another edition of the 'Highways' to complete it. The list of articles furnished for the chemical laboratory would in itself nearly fill a page with its baths, retorts, combustion tubes, analytical apparatus, &c. Bottles and tubes are provided by the thousand, and labels by tens of thousands."

The ship is commanded by Captain Nares, an officer of experience in Arctic exploration and in surveying work. The scientific staff is composed of Professor Wyville Thompson, F.R.S., at the head of the expedition; Mr. H. N. Mosely, M.A.; Dr. Von Willempes Suhm and Mr. John Murray, naturalists; Mr. Buchanan, chemist; and Mr. Wild, artist.

THE LAVENDER COUNTRY.

Some short time since, a very interesting account of the growth of lavender in England was published in the *Journal of Applied Science*. As this forms quite a special industry, and one which has had very little attention ever paid to it, it may be worth while to extract some passages from the article in question.

It seems that the lavender country lies in Surrey, about Wallington. The plant has also been grown in Cambridgeshire, but nowhere else in England with much success. In the Surrey district, there are about 350 acres of land devoted to lavender. Only a moderate application of manure is necessary at the outset in the autumn, when the planting takes place; and, after the first year's harvesting, the plants have grown to such dimensions that every other row has to be taken out, and every other plant in the row that remains. The three years' growth are the first to come to maturity, and then the second, and then the third. The harvest takes place in August. The cutting, which is done by the sickle, appears an art of itself, which affects the crop in the future year. The labourers are followed by women and girls, who immediately pack and tie the lavender up in mats, to protect it from the rays of the sun, or otherwise the quantity of oil to be extracted would be reduced before it could be taken in hand at the distillery. The distillery process is carried on upon the spot. Beneath a brick-built shed stands a row of stills, with what are called worm-tubs attached to each still. Upon the ground-floor the furnaces are being attended, and the percolator watched, as a trickling noise indicates that the oil is being extracted by the process going on. Above the furnaces are the stills, of dimensions sufficient either to contain half a ton or a ton weight of herbs, and the building is spacious enough to admit of carts being driven in for the purpose of unloading. The still is filled thrice in four-and-twenty hours, namely, eight hours to a run. The men get upon the upper floor, remove the still-head by a lever, then take the lavender from the mats and tread the stalks down with their feet until the copper is tightly filled to the brim. Liquor at boiling-heat is then taken from the top surface of the worm-tub, although at the bottom and lower surface the water is quite cold, and the furnaces are set to work. The worm consists of piping attached to the head of the still, and passes round and round the tub which contains the cold water. The men watch the bringing over of the still—that is, the moment when the liquor begins to flow over the head into the worm. Directly it does so, they know that the oil is running, and immediately damp down the furnaces. The boiling liquor from the herbs, by passing through the tubing immersed in cold water, becomes condensed, and the oil separates from the water and runs into the percolator at the foot of the worm-tub. This bringing over is the most critical point in the whole operation; then great attention and experience are needed, otherwise the herbs, both stalk and flower, might be taken into the worm, and the oil be spoiled. So well practised, however, are the men employed, that what is called a "run foul" is scarcely known during the whole of the distilling season. From thence it is taken and placed in dark glass bottles with short necks, containing 4 lb. to 7 lb. each, ready for merchandising. When one lot has been distilled, the still top is removed by the lever, and the charge taken out with long forks. The steam and vapour that arise are very great—for the uninitiated quite overpowering; and what is termed the "walk" being very heavy, the men themselves have to labour hard to get out the refuse, which is thrown just at the back of the building for manure. The coppers are filled up again with herbs, fresh water is pumped into the worm-tub to supply what has been taken off the surface for the still, and to replace what has passed off in the evaporation that has always been going on, and the process again goes on. The quantity of oil extracted from a ton of lavender varies according to the influence of the season; from 15 lb. to 16 lb. is considered a fair average, very seldom it reaches 21 lb., sometimes not more than 10 lb. The distilling lasts about two months, from the first week in August to the second week in October, according to the abundance or otherwise of the surrounding crop.

GENERAL NOTES.

National Health Society.—We learn that under the above title a society has been formed, which has for its object to help every man and woman, rich and poor, to know for himself, and to carry out practically around him, the best conditions of healthy living. The steps at present proposed are the holding of monthly meetings for the reading of papers; the establishing of classes for instruction in various branches of sanitary science; the delivery of free popular lectures; and the formation of a reference library and an information office.

Indian Money Orders.—We take the following from the *Asiatic*:—"We have heard of the disagreeable hitch that seems to occur periodically in the money-order system between England and India, and now it appears that a conference has been held at Simla on the subject of amalgamating the Indian Telegraph and Postal Department. We understand that Mr. Monteith has already submitted to government a report in which, while admitting the utility of the measure so far as expenditure is concerned, he has observed that the success of the scheme in England furnishes no guarantee of its success in India, the circumstances of the two countries being quite dissimilar. There are, no doubt, many difficulties in the nature of the proposed changes, but if effected, it is to be hoped that the present defects in the postal service between England and India may not be paralleled in the new department of the public service."

New Zealand Institute.—The last number of *Nature* gives an account of this society. It was established by an Act of government, in 1867, and is at the head of all societies in the colony devoted to the promotion of "science, literature, or art." These societies are incorporated or affiliated with it, and include the Otago Institute, the Philosophical Institute of Canterbury, the Auckland Institute, the Wellington Philosophical Society, and the Nelson Association for the Promotion of Science and Industry, representing all the leading provinces of New Zealand. The ordinary membership amounts to 600, and includes all the leading colonists residing in different parts of the several provinces. The institute possesses a museum, laboratory, and library, which, with the works therein, are so organised and utilised for the benefit of the general public that they constitute in combination an important "Technical College," located at Wellington—a formidable, but friendly, rival to the recently established "University of Otago," which aims at becoming, among other things, an eminent school of applied science. The college is also the head-quarters of the Government Geological Survey, the chief members of the staff of which are professors to the Technical College, the lectures being of two kinds, general and practical. The former include natural history (zoology and botany, with their relations to physical geography and geology), and the elements of experimental science (physics, chemistry, and mineralogy). The practical are, in the meantime, confined to mineralogy and chemistry. Since the New Zealand Institute was established, in 1867, i has published no less than four bulky annual volumes, containing papers mostly of a scientific kind, many of which contain substantial contributions to science.

Coal in Dalmatia.—The coal mines of Monte-Promina, situated at a short distance from Sevenico, in Dalmatia, have recently been purchased by the Public Works Committee of Turin, who propose working them at once. The annual production is estimated at 200,000 tons. The committee propose laying down a railway from the mines to the coast, and the coal will then be shipped for the ports of Ancona, Ravenna, Venice, or Trieste, in steam colliers belonging to the company.

Paper from Bamboo-stems.—The culms or stems of the bamboo have now become an important paper material. The Americans have for some time imported these crushed, from the West Indies, so as to reduce the bulk, for use in their paper-mills. In China the bamboo is largely used for paper. In the Jamaica papers it is stated that the Bamboo Pulp Company have leased the Enfield estates, in the parish of St. Elizabeth, for the purpose of carrying on their manufacturing enterprise. The full amount of capital was subscribed for locally, and paid up in a few days. Messrs. De La Rue and Co. are said to be among the largest shareholders.

Preserving Charred Papers.—Mr. E. H. Hoskins, of Lowell, Mass., has suggested a very useful and practical way of preserving and giving toughness and flexibility to charred paper, which has proved to be of much importance to the identification and copying of valuable documents, charred by conflagrations such as the recent Boston and Chicago calamities. We have seen specimens of charred papers and bank notes, thus treated, that can be handled with impunity. The printing upon the charred bank notes can be readily discerned. The preserving process consists, we believe, in pouring collodion upon the surface of the charred paper. The collodion forms a thin transparent film, and dries in a few minutes, when the process is complete.—*Scientific American.*

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

THE LIBRARY.

The following works have been presented to the Library:—

Prisons and Reformatories at Home and Abroad, being the Transactions of the International Congress. Presented by Edwin Pears, Esq., LL.B.

Take my Advice; a Book for Every Home, giving complete and trustworthy information on everything pertaining to daily life. By the late Editor of "The Family Friend." Presented by James Blackwood and Co.

A New Decimal Metrical System. By W. Wilberforce Manu.

A Table, giving the Relative Values of Different Articles of Food in Common Use. Compiled by Chas. Ekin, F.C.S. Presented by Messrs. J. and A. Churchill.

MEETINGS FOR THE ENSUING WEEK.

Tues....Royal Institution, 3. Professor Odling, juvenile lecture on "Air and Gas."

Thurs...Royal Institution, 3. Professor Odling, juvenile lecture on "Air and Gas."

Sat ......Royal Institution, 3. Professor Odling, juvenile lecture on "Air and Gas."

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

LECTURE ON INDIA.

On Friday evening, December 20th, Captain Lyon delivered the second and concluding lecture on "Indian Architecture, Idols, and Every-day Life," illustrated by photographic transparencies with the magic lantern.

Captain Lyon, in describing the views, said:—Ladies and Gentlemen,—Please imagine yourselves on board that steamer. Having entered Malta harbour on our way to India, let us look for one moment at Malta. It is a curious little island, and it is the fashion now-a-days to call it a mushroom. It is a large rock, which they say the sea is gradually wearing away below; when this process is finished the whole thing will collapse. The streets are all very steep, as you see, scarcely any portion of them being traversable by carriages. It is very much like the back of an elephant, sloping down towards the sea. When the fleet is there the town is remarkably gay. The sailors love the Maltese, and the Maltese love sailors, or rather their money. Perhaps owing to the water in the harbour being so very deep close up to the quay, is the reason of the story of the mushroom.

Leaving Malta, with one jump we find ourselves in Egypt. This time we will stop for a minute, taking the train at Alexandria, go as far as Cairo, and from there the distance is very short to the desert, where we shall see the Sphinx. All about Egypt is so well known that I need not repeat it. There is the Sphinx. Not very long ago, a lady, on seeing that view, asked what it was, and on being told it was the Sphinx, she said, "Oh, yes! I know; it's on the right-hand side of the road from Geneva to Chamounix."

The next view is the large pyramid. Every stone you see, although they only look the size of bricks, is four feet high, and 20 to 30 long. The entrance is on the left. The large pyramid occupies a space about equal to Lincoln's-inn-fields, and is 450 feet high.

Starting from Egypt, we arrive at the north of Madras. Last time we went to the south. We shall first visit a temple 140 miles north-west of Madras, on the railway on the way to Bombay. It is called Tarputry. It is built on the banks of the river, which constantly overflows; and 18 years ago, when the river overflowed its banks, the temple was 10 feet under water, the consequence being that the whole of the brickwork gave way and came down, and the large, splendid gopurum was completely destroyed. The stone is of a hard, dark green colour, a mixture of hornblende and trap stone. The carvings are as fine as anything in India. The gateway is 40 feet high, to enable the rajah to come in mounted on his elephant when he came to worship. The southern entrance, if possible, is even finer than the northern. It is dedicated to Shiva, and is one of the places where religious ceremonies took place in honour of the god. Some 20 or 30 men, called Sunyasees, a sort of fakirs, bound themselves by vows to go through certain operations. On the first day all the people assembled, and it was made a great holiday, and the operations on that day consisted of making a bamboo stage 15 to 20 feet high. On this they mounted. Underneath were placed bags of straw, and knives and sharp-pointed spears above; and on these they jumped from the height above, of course without being hurt, as the bags invariably tumbled down. But they pretended to do it to show the wonderful power of Shiva in preserving them. On the second day they lit fires, and when the fires were in full blaze they walked through them with naked feet, stamping on the embers. The third day was a bye-day, and the fourth was the grandest day of all. They dedicated it to two very curious ceremonies. The operator was generally the village blacksmith, and the people came in great numbers to see the operation, which consisted in slitting all their tongues with a sharp lancet or knife, for which they paid the sum of two annas or threepence. Into this slit they used to put all sorts of things covered with cotton, to which they applied a light, and then began to dance. Then, in the afternoon, they went through the ceremony of making holes in their sides. Into these holes they put long pieces of bamboo; and sometimes two other people held each end of the bamboo, and then all three began to dance. At other times, they lighted each end of the bamboo, and danced whilst it burned.

The ceremonies of the fifth day our government have now put a stop to, which consisted in their prostrating themselves before the god. In the meantime a bamboo was struck in the ground at a height of 12 feet. Across this, horizontally, was fastened another bamboo, tied in the middle to the top of the pole, with the horizontal bamboo revolving round the other. While these men laid flat on their faces, a Brahmin took some flour in his hand and slapped them on the back or the shoulder, and immediately two flesh hooks were run through, one through each shoulder, where the mark of the Brahmin's hand was. To these flesh hooks were tied two cords, which were then attached to one end of the horizontal bamboo, while a cord fastened to the other end of the bamboo being immediately seized by six or seven men, they swung the man with great rapidity, in a diameter of 30 feet, round and round. You will hardly believe when I tell you that these Hindoos smoke, laugh, and sing while going round. One cannot imagine anything more extraordinary or horrible, but our government has put a stop to it, as far as possible, though if they can do it on the sly they will.

From here we must take another jump to the Cauvery, a magnificent river, about a mile wide at the spot I am going to show you. Wonderful to relate, it suddenly at this spot disappears, and completely runs under the trees of the large island, and you can walk on the ground above it, and cannot make out what on earth has become of it, and the only part that remains visible is a small fall, called the Goat's Leap Fall. This place, like everything wonderful and magnificent, is very sacred to the Hindoos, and they make a pilgrimage to it. The river in reality passes through a lot of rocks, and comes out in a succession of water-falls further down; there the spray, rising from the falls many feet into the air, causes a cloud which has the appearance of a column of smoke. Hence the name Hoginkul, or smoking rock, which the natives call it.

We next see the river as it appears just below the fall. It is impossible to get a view of the place itself just there, because the water will not allow you to approach it; but we get a view of the river as it runs down and comes into the small space you see. We are now almost on the plateau of Mysore, 2,000 feet above the sea. We follow the river, and visit a small summer palace, built by Tippoo Saib shortly before his death, called Deria Dowlut. It is considered very much like the Alhambra, and is indeed called the Indian Alhambra. It was bought by the Duke of Wellington, and inhabited by him when he was here. In those days it was not in the least unhealthy, but now it is the most deadly spot in India. The inhabitants of the place have mostly died out. No European dare sleep in it on any consideration, and yet a few years ago it was perfectly healthy, so extraordinary are the changes in the climate. Another view of it will show you that nothing can be more beautiful than the painting of this palace. It appears to be gilded as well as coloured in the most charming colours, but the combination is so wonderful as to deceive you. There is no gilding at all. It is done by an Indian method of taking paper and covering it with glue, drying it in the sun, and polishing it with a smooth stone, when it has exactly the appearance of gilding. The small portico is where Tippoo used to sit to administer justice to those few who were allowed to come near him when he was reposing in this palace. All round the palace is a handsome verandah, and nothing can be more beautiful. It is painted in the most exquisite colours possible, and besides that, in all the little panels there are pictures of different scenes in Indian history.

A short night's journey brings us to Bailoor, where we shall find one of the most beautiful, if not the most beautiful, temple in Mysore, perhaps in all India. Every part of it is quite different, and everything is very minute. It is more like the Jain Temple, and was built by a race of kings who had been Jains, but were converted to the worship of Shiva, and the temple partakes a great deal of the old religion. The small frames, with the figures inside, are cut out of solid stone in complete relief, and with nothing to support them but the base on which they stand. Behind them is another complete row of figures. They are so arranged that the hands touch the frames and the feet the bottom on which they stand. Unfortunately, the whole is covered with whitewash, which is constantly renewed, and for the carving to be seen as it ought, the whitewash must be removed. At the same time, however, it preserves it. The white mass below is in reality another wreath or roll of figures, one more beautiful than the other. All the figures are in complete relief, and pierced right through. The holes you see are in solid blocks of stone, three inches thick, pierced right through to give light to the interior. It is said that the interior is most wonderfully carved, but no other temple that I know of in India is carved in the inside of the sanctum. They are all perfectly plain, the whole of the decoration being lavished on the outside. One of the peculiarities of this temple is, that the east and west sides are perfectly dissimilar, and unlike any other we have seen. Five little shrines form the west side. Underneath, along the lower part, are elephants; above them are the emblems of the kings who reigned and built it. Inside is a small image of the god, and the opening is for the priest to enter and anoint that image in the way I described last week, which they always do. The whole carving, both of this and every other part, more resembles ivory than anything else, and if one does not handle it, so exquisitely is it chiselled, it is scarcely possible to believe that it is not wood, so wonderfully small and delicate is the carving. The natives always put the elephant at bottom, next to them that nondescript animal which is always considered next in strength, and then the other animals rising in strength according to their idea, whether they are able to support the incumbent weight or not.

We now arrive at Hallabeed. This temple was so buried in the jungle that it was almost impossible to get near it. The jungle is infested with tigers, elephants, and serpents, and it was almost a matter of life and death to approach it, and the only persons who visited it were a lot of loafers, who used to come around with hammers to break off the exquisite little figures and carry them away, and sell them in different parts of India. 700 feet is the length of the friezes on the eastern side (which contains not less than 2,000 carved elephants), 400 on the other. The Parthenon friezes are only 550 feet long. Here, again, we have the elephant at bottom—above the men originally mounted on horses, and you see the way they have been mutilated and the horsemen disappeared—in fact, the men and the horses themselves in some places have gone. Above that is a procession of men; above that, again, high up, are birds; next, under the balcony, very much like those at Bailoor, but not nearly so well executed, are some beautiful frames; and just above that, again, are the holes cut to admit light and air to the interior.

Now see the western side of this temple. Here, again, we have what we saw at Tanjore, the trough and the spout, and the hole where the lingum or image of the god was placed—the spout to bring out the oil, and the trough to catch it—there to remain till dried up by the sun, or carried off by pilgrims. It has long been deserted by the Brahmins, and no worship is ever performed there, and the government has built a wall round it, and appointed police to look after it, and prevent further spoliation. The effect that the natives have produced here by the curious sinuosities is very beautiful, and no doubt better than anything the Gothic architects attempted by their transepts. If those friezes had been put on a flat surface they would have lost an immense deal of their effect, but placed there, the artistic combination of horizontal and vertical lines, and the play of outline and shade, far surpass anything in Gothic art. Every god of the Indian Pantheon finds a place in this temple. Some gods, such as Shiva or Parvatee, are fourteen times represented, and Vishnu seventeen times.

Here we shall make acquaintance for the first time with Krishna, who was a very wonderful god, and about whom the natives are never tired of telling stories. One story about him is, that he slew a giant who had 16,000 wives, all very beautiful. Krishna appropriated every one to himself, and began by keeping them all together, but found that did not answer, so he built a house for every one of them. He had that wonderful power of being able to go everywhere at the same time, and he visited them all, so that every wife thought Krishna was her faithful spouse, and belonged to her alone. One day a friend of his asked Krishna whether he, having 16,000 wives, could not spare him one, and Krishna said by all means he might go and take his choice. His friend went to the house of one, and found Krishna and the lady sitting comfortably drinking tea. He then went to the next, and found Krishna again seated with that lady, and so he went to about one thousand of them, when he gave the thing up in despair, as he saw he had not a chance.

From here we make a very long jump to the Neilgherry hills. They are quite at the far end of the plateau of Mysore, and rise 3,000 feet higher on the side we shall go up, that is to say, Coonoor is 5,000 feet above the sea. It is impossible to give those who do not know what India is any idea of the delight one feels on getting up to the hills, after the heat and closeness and fearful horrors of the plains below. As we wind up, if we keep to the road, every step your pony takes the air feels cooler, until, when we arrive at the top, the sense of relief with which we draw our breath and our lungs expand, only those who have experienced it can know what it is. Instead of following the road up, I will ask you to leave that and take the river, and, by dint of tremendous climbing, we shall be able to follow it, and find a lot of beautiful water-falls, until we arrive at the top and see Coonoor.

On our way up we find a curious rock, called by the name of the native who is supposed to have discovered it. Like all wonderful things, it is worshipped by the natives. There it stands; nobody knows anything about it, except that it is called and worshipped as a god. Consequently, no one is allowed to attempt to ascend it. The first waterfall, or rather the last before the river reaches the plain, and joins the larger river is called Ben Hope fall, from an English gentleman, who bought the land and turned it into a coffee plantation. The fall followed the land, and became known by the name of the estate. Scrambling along up the river, not very far off, we shall see the Falls of the Caves, so called from the cave under the rock, which goes in some considerable distance. The river makes a sharp turn from behind the rock, and comes into the pool in the manner here shown. The Law fall was called from an engineer who cut the road up the face of the hill, and in doing so discovered it, naming it after himself. The fall, or rather the cascade, is called the Bandyman's Grave. Bandy is the name of the Indian cart which carries all the goods in India, and the man is called the bandyman. Some few years ago, on the top of the Ghauts, the river rose enormously, and in the night carried off the bandy, the bulls, and the bandyman, and their bodies were not found for some considerable time after, and then they were found in this pool; hence the name—the Bandyman's Grave. The river on the left passes underneath the large hill, and comes out about 100 yards lower down, in very much the same manner as we saw the Cauvery some little time time ago. That place is called Leechfall. It was a place celebrated for pic-nics by the English for many years, but the leeches took possession of it, and the English were obliged to give it up, as they were not pleasant companions at a picnic, and they literally swarmed there.

Arrived on top of the Ghaut, we get our first view of Coonoor. The hedges are of heliotrope, four feet high, which blossom all the year round, and consequently, as you may imagine, very fragrant. Not ten yards from that spot is the only place in the world where the oak and the orange tree can be seen growing side by side. There is no other place in which the two will thrive together. The oak was brought there and planted by an Englishman; the orange grows on the spot.

Coonoor is a very small place, and is situated just on the top of the Ghaut, 5,000 feet above the sea. The air here is deliciously cool, and you really begin to enjoy the luxury of the hills.

The best idea of the station is given in the next view, where you will see the houses scattered all over the place. Every house has its compound or enclosure, the small church being to the left. The hill in the distance, far to the right, is called the Droog. When Tippoo overran this country, he took possession of that place, fortified it, and made it his head-quarters. From there he used to send out his soldiers, who took the people prisoners, and every morning, before his breakfast, Tippoo had some of them blindfolded, and made to walk on to the edge of hill, where they fell down a precipice, 2,000 feet, into that the plain below.

A road, 12 miles long, brings us to Ootacamund; we will have a peep at the house, or small cottage, of one story, which Englishmen use when they come up to the hills for the usual 60 days' leave. It is a curious fact that, although the English people enjoy the hills, it does them no permanent good. Even if they stay there a year the fever does not return; but the moment they go down again they lose the good effect. Although it is within eight degrees of the equator, I have seen ten degrees of frost at night, but the flowers are never killed. The climate, however, is not the same as home. One month in England is better than two or three years on these hills.

The road by which we enter Ootacamund is planted with trees. When we came there and took possession of it, there was not a tree near. A large tree near the spot is called Charing-cross, and this is the first Australian tree that was planted, forty years ago. Every other tree has been planted after it. The English hotel there, kept by an Englishman, is excellent, and as good as any in Europe, and there is not a place on the hills where you could spend your time better. The heliotropes and geraniums, and other flowers, are some of them 25 feet in circumference and 15 feet high; and although, as I have observed, there is ten or twelve degrees of frost in winter, it never seems to do them any harm. They abound with a profusion of blossom you can hardly credit. In the distance is Dodabet, the highest point, 8,000 feet high, and where the astronomers were sent to observe the eclipse of the sun that took place a few months ago.

The Lake of Ootacamund is not a natural lake. A small stream runs through it, which they have dammed up, and made the lake. A road goes round, which is the Rotten-row, and round that everybody rides. It is exactly two miles.

The highest waterfall on the hills is on the other side of those we saw just now. To all appearance the water comes out of the rock, but it is not the case. There is a natural channel behind that ridge of rock, and the water, passing through the channel, strikes the rock on the left, and consequently comes out. Not far from this is a spot most celebrated for tigers, and on which an enormous outlay has been expended, the government cutting the jungle down for the purpose of planting it with chincona. When I was staying there with the superintendent, who lives on the top of the hills, he told me that only the day before, within 150 yards of his house, he had watched a tiger playing with two cubs on the road.

The next view gives you an idea of the hills in their natural state, just as they were when we found them—perfectly uncultivated, with an immense quantity of grass. A small path winds up to the right, and passes over the hill to the plains below. The next view shows you the houses of the Todas, a most extraordinary race of men. They live in those little tiny houses you see there. The larger house to the right is the house of the servant-man, who looks after their houses, though they are all very dirty. They are round buildings, and the only aperture is two feet high, and they go in on their hands and knees. An extraordinary custom prevails amongst them in regard to marriage. On one brother marrying, his wife has to become the wife of all, and, consequently, the other brothers cannot marry until she dies, and therefore the race is fast dying out. They wear no other covering but a blanket, which they pass from one to the other, as they are excessively poor. It is said that we had robbed them of the hills; but that is not true, for we pay them a yearly sum of money for the use of the hills. They are very quiet people, and possess a magnificent herd of buffaloes, which are so fierce that it is very dangerous for strangers to approach them, and so powerful that they charge and gallop down any single tiger—and the tigers seem to know it too. A curious story is told of one of them, that he wanted a sum of money—about four rupees, or eight shillings, and he went into the bazaar, and asked a native to lend it him, and he agreed to do so on the Toda paying back two annas, or threepence, interest every week, nothing being said as to how long this payment was to continue. The man went on paying, and at last a missionary found it out, and discovered that he had actually paid 16 rupees, and that he still continued to pay it. Whereupon the missionary offered to advance him the money to pay the whole sum, but the man refused, and still preferred to go on paying, saying he liked the arrangement, and had got accustomed to it.

Here we will take leave of the hills, and take a jump right over the Mysore plateau to one of the most interesting spots in all India, and alight at the ruins of a city which formerly covered an area of seven square miles, and of which a large portion of the walls are still standing, though every sign of habitation has long since disappeared. The ground is now cultivated, few buildings being left, and those chiefly temples, except the elephant-stable, which I shall show you, though as to this there is great discussion, but I see no reason why it should not have been so used. The room and entrance-gate are large enough to admit that animal, the little room being occupied by the man who takes charge of the elephant. The very walls and masonry are something really wonderful, not a bit of mortar being used. The stones are placed one on another, and, except you see it, it is impossible to credit the work which is involved in it. Every little particle of excrescence on the lower stone has been provided for in the upper one, and the two stones appear as if they had been made into one. Not far off is a small temple, dedicated to Hunooman, about whom we heard so much the other night, and who you remember was able to jump 500 miles at one bound. When he was born he was the son of Pavana, the god of the winds. He said he was hungry, and as it happened to be in the middle of the day, and the sun was shining, he took a fancy to eat the sun, and bounded up to heaven. On arriving there the sun fled to Indra, and he drove Hunooman out of heaven. Whereupon Pavana, the god of the winds, was so furious at this, that in return he filled all the gods with wind, and gave them the colic, and turned them out of heaven, and would not let them in again till they had restored Hunooman. The other side of the temple shows the beautiful carving very minutely. The interior is completely empty, and, being deserted, one is enabled to examine it, and finds it perfectly plain. But there is one peculiarity in it, unlike every other temple. Originally all the floors were covered with enormous slabs of granite. For 200 years this city, called Vijianuggur or Beejnuggur, contested the supremacy of the Mussulmans, holding their army in check, and preventing their advance to the south. When the Mussulmans at last took it—they knew that it was one of the richest temples in India—strange to say, they could never find one particle of treasure in the whole of it. They searched every corner, and entered every place, and began by raising the enormous slabs of granite which are in that temple, five inches thick, and eight and ten feet long, but found nothing; and these enormous slabs are still poised in the air, just as the Mussulmans left them when they looked for the treasure. Afterwards some one told them that fire would effect the same purpose, and, consequently, they lit enormous fires, and split them, but never found anything, and what became of the treasure nobody ever knew. Unlike all the others, the outside walls are sculptured in a way that reminds you more of Nineveh then anything else. The next view shows you the inside of the wall of the temple, and the scenes depicted on it are from the Ramyana, the poem I told you of the other night, describing the fight between the gods for the possession of Seeta. The slabs are of enormous size, and were no doubt beautifully sculptured, but the weather in that climate is such that it has had a very serious effect upon the walls outside, even more than it has inside. The outside of the temple again depicts scenes from the Ramyana, and you observe the elephants, then the horses a little higher up, then dancing men and women higher up still. Fifty yards from the temple is a very extraordinary monolithic trough. It is 41 feet long, by three feet deep and three feet wide. The Mussulmans turned up this also, to look for treasure. Everything, in fact, in the whole place they more or less disturbed when they took the city.

There is only one more temple that is worth notice, and this is about two miles from the city. There are two mundapa, one on the right, one on the left, and in the centre is the car, and, wonderful to relate, the car is made out of a solid block of stone, mounted on wheels. The pillars of the porch are of one solid block of granite, 10 feet high, and the little, tiny, small pillars are cut out in clear relief from the other part. Equally wonderful, there are also in this temple animals with a ball in their mouth, something like the balls the Chinese cut out, completely detached from the remainder, but which it is impossible to take out. It must have been cut out of the same block of stone, and though it may be turned round any way it cannot be got out of the mouth of the animal. As to the car, whether it ever really moved is doubtful, although the wheels revolve perfectly on their axles. Underneath it has been built up, for fear of its coming down. The story is that the car really moved, and that the gods took their yearly drive in it, but it can only be a story, for it is impossible to suppose that wheels of that size could bear the weight of the car. The temple itself was dedicated to Nitoba, about whom they say that he was originally a Brahmin, or good man, who took a fancy to go a pilgrimage. He was obliged to take with him his wife, and father, and mother. He had only one beast, on which he put his wife, and occasionally rode himself, leaving his father and mother to trudge on foot. On arriving at this place, he lodged at the house of a Brahmin, and in this house he found the Brahmin making his wife take care and nurse his father and mother in a manner very different from what he had done. The night he slept there he had a vision, and it was told him that it was no use to go on a pilgrimage as long as he treated his father and mother in the way he did, that no pilgrimage would do him any good, and that the best thing for him was to ask his host what he should do. The host told him he had better live with him a year, and see how he treated his father and mother. He did, and changed his conduct accordingly, becoming a saint, and this temple was built in his honour.

From here, 200 miles to the north, we find the city of Bejapoor, the Mahommedan capital for 200 years, during the time the Mussulman armies were there, trying to get to the south, the Hindoos being determined to stop them if they could. The difference between the cities is very curious. In the one, as you have seen, nothing remains but the beautiful stone temples, every vestige of human habitation being gone. Here the only buildings remaining are the splendid mausoleums which it was the fashion of those kings to build during their lifetime to repose in after death. No doubt it was an excellent plan, but it had one disadvantage, that if by any chance the king happened to die before it was completed, there was no place to bury him in, for each king had quite enough to do to build his own before he died, and could not complete the other. Outside this town (which is the rival of Vijianuggur or Beejnuggur) with every mausoleum that these kings built, they built a small mosque alongside it, and this is the mosque of Ibrahim Rosa, and the other side is the tomb. The peculiarity of the tomb is that nobody has yet been able to discover how the dome is supported. Our engineers have actually asked the government to be kind enough to allow them to pull it to pieces, in order to discover what supports it. Of course the government objected; but, springing out of a flat stone roof, there it stands, and by what means it stands, and why it does not come down, nobody can make out. It ought to, but it does not. All round this building is a verandah, immediately outside the room in which the body reposes. Formerly nothing could exceed the beauty of that verandah. The stone is grey. The whole of the Koran is supposed to be engraved in relief on the walls. It was all gilded, and between the letters was painted a most beautiful, lovely azure blue; and the effect of the gilded letters on a blue ground and the grey stone was something beautiful beyond all conception. Unfortunately, now, except in one or two spots, which were carefully covered up, every sign of it has disappeared, but the natives there show you the blue and gold as it originally stood. Inside the room is where the body reposes. The window above is a solid block of stone, which has been carved into Arabic letters, which every one knows are difficult enough to write; but here the natives have cut away the whole of the stone, leaving nothing but the Arabic letters, and several verses of the Koran are cut in tracery over that window, each window having different parts of the Koran engraved on it. as you see there.

I will show you further on two or three pieces of tracery, which are so beautiful that I must leave you to judge, for it is impossible for me to say, which is most wonderful—this or these. The other may be more beautiful, but this is the more wonderful. They are really such as nobody but a Hindoo could carve, Mussulmans considering it far beneath their dignity to attempt anything of that sort.

Entering the city, we find on the walls immediately as we enter what was, until the Woolwich "infant" was manufactured, the largest gun in the world. A native, 6 ft. high, standing beside it gives you an idea of its size. The most ridiculous stories are told as to the fears of the natives about this gun. Not long ago the rajah ordered the gun to be fired, for the purpose of seeing what harm it would do, and every native went out of the city, and some went as far as twelve miles away. Close by was a tank, and this was filled with water, and so frightened was the man who had to fire the gun that he jumped into the tank and remained there until the gun went off, No harm happened. I should tell you the rajah himself remained twenty miles off.

Further on into the city is a beautiful building, which is so wonderfully carved that it is hard to imagine that it really is of stone. The story of its erection is very curious. One of the kings was affected with a very dreadful disease, and applied to all the doctors and magicians to cure him, but they could not. However, one of them, rather more acute than the rest, told him he would be certain of recovery if, the following morning, he gave £100,000 to the first person whom he saw, the magician of course intending himself to be the man. The king passed a restless night, and found himself at the window earlier than the magician expected, when he saw a miserable beggar, whom he sent for, and to whom he gave this enormous sum. The beggar immediately built this little building, for what purpose nobody can say. The carving is so beautiful, and the colour of the stone so peculiar, that it is much more like wood, and everybody would think of taking out his knife to cut it, so certain are they that it is wood.

A little further on is a large mosque, called the Jumma Musjid, but never finished. When the city was taken, it was very rich; the quantity of gold and silver in it was something wonderful. The whole of the floor was covered with the richest mosaic, every bit of which was taken away, and nothing remains. The large dome covers the centre of the interior, and every four pillars support little domes, which give it a graceful appearance inside. The view of the centre aisle, immediately under the big dome, also shows the peculiar effect the little domes have on the interior. It has all been whitewashed, and, consequently, looks more cheerful than if the stone had been left as it originally was.

Passing from these we take the rail, and find ourselves at Karlee, which is the first place we have seen which is really and truly Buddhist. Unless the seven pagodas near Madras is so, there is no Buddhist temple yet discovered—there are only Buddhist caves. This cave existed before our Saviour's time, and the whole of the roof is of wood; and you see there the wooden ribs, which people have tried to say have been put up since; but there cannot be a question that they were originally put before the time of our Saviour, and have stood there until now.

To go into the history of Buddha is very long and hardly interesting. The peculiarity is that it made such a wonderful stride when it first began, and always by gentle means. There is no record, of any description, that there was any religious persecution by the Buddhists. But there was a persecution against them by the Brahmins and Mohammedans, no doubt, as they were ultimately expelled from India. But the Buddhists themselves never used force, and yet, in a marvellously short space of time, after Sakya Muui, who called himself Gautama Buddha, the bulk of the population was converted to his way of thinking. He lived 500 years before Christ; but the religion did not make any great way until King Azoka, 250 years after the death of Buddha, became a Buddhist, and sent preachers all over the country. From that hour the progress was simply marvellous, until the Brahmins got frightened, and began the persecution which drove them to the east. And yet there were 400,000,000 of them, while all the other religions of Europe do not number 300,000,000.

The interior of the cave is the next view. The pillars on each side are carved out of the solid rock. Inside the dagobas are preserved relics. The form is considered to be very much like that of the first early Christian church, the dagoba occupying the place of the altar.

From Karlee, the name of the cave to the south of Bombay, we must make a large jump to Ahmedabad, a city to the north, where I want to show you two lovely windows in an old desecrated mosque. They are cut out of square blocks of granite, three inches thick, which had been built into the wall, and had been so carved that the branches and leaves of the tree have been preserved most perfectly in all the tracery. For beauty there is no comparison, except, perhaps, the screen of the Taj, in the whole of India; but whether the window you saw before is more wonderful I must leave you to judge. In the other window you saw several trees, but in this there is but one, covering the whole window. The height of the window is eight feet, the length about fourteen. Inside, originally, was a mosque, but it has long been deserted. We took possession of it, and it is now used as a court of justice.

We can hardly pass by the Jains and their wonderful temples without a few words. There can be hardly a doubt that the founder of the Jain religion was the preceptor of Buddha. The Buddhists do not allow it, as they do not like the idea of their founder requiring a preceptor. But Mahavira was the preceptor of Buddha. Out of small things what vast results ensue. Mahavira fancied and taught that to be an ascetic and found a religion, it was necessary to go about in a state of nudity. Buddha, being a wise man, saw that that would not do, and on that point they separated and founded different sects. The Jains disappeared to revive when the Brahmins drove out the Buddhists. But the Jain religion is far too good for the Hindoo. It is really excellent, and almost—if not quite—as good as anything in the Koran. The greatest sin they believe is to kill—to kill anything, it does not matter what—and the next greatest sin is to walk carelessly, as thereby you destroy much life. Their ideas of time are very peculiar. It is divided into two cycles; and they imagine it a serpent coiled up. The world, in their idea, is coming down from the head to the tail, and when it reaches the tail it is to be destroyed; but the number of million years it is to take for this purpose I really can hardly tell you.

At the top of the hill of Shutronye, which is their sacred hill, we see a view of their temples as they are massed together. It is a hill 1,500 feet high, set in the middle of the plain, and these Jains bought it; and being chiefly engaged in commerce, and many of them being bankers, they became enormously rich, and as they grow in their riches so they add to the temples which they began in their poverty. There are said to be 3,600 images of marble and alabaster in these temples.

We now get a view of one of their temples. It was a very fine temple, beautifully carved in stone, but for some reason or other they have taken into their heads lately to cover up all the temples with a coating of plaster of Paris over the stone work and they polish this, and it then becomes the *beau ideal* of a Jain temple, and very soon every temple will be hidden.

Inside this temple is one of their first Tirthankars, or deities, called Rishabh. The body is of alabaster; round it is all marble; the black spots you see are all precious stones, some of them being of immense value. The carving is grotesque, but beautifully done. On each side is an inferior deity.

Rishabh, according to them, lived 840,000 years. He was at 200,000 years a young man in all his glory, and he then became a king, and reigned for 630,000 years, and for 10,000 only was an ascetic, and now he is worshipped as the first god by all the Jhains.

We now pass from the west of India into the north-west provinces, and on arriving at Allahabad, the capital of the north-west provinces, we see the different customs among the people, and among the first things we observe is the Eka. The richest men all use it. The covering over it is so small that it is of no use for keeping off the sun.

The next view gives you a picture of the native servants, such as those who wait upon us, eating their rice. They have taken off their shoes, and uncover their feet, leaving their heads covered, unlike us, who do just the reverse. The man who stands behind is called a beesty, and under his arm is the skin in which he brings the water. Servants are divided into two castes, high and low, and the distinction is kept up in very great strictness, so much so that you have to employ two beesties for the two classes of servants; for no high-caste beesty would bring water for a low caste servant, and no high-caste servant would take water from a low-caste beesty. Consequently the multiplication of your servants is something terrible; it is impossible to break through the everlasting caste. We next see one of the shops where are sold the things which are used all over India for carrying water, and you also observe a lot of pebbles which the natives use instead of small change. Instead of giving you money they give you these pebbles. To look at, they appear to be nothing more than what you can pick up on the roadside, and which you fancy you could pass to them. But it is perfectly useless to try, for they instantly detect it, and if you were to offer them a handful, they will always pick the right ones out, though to the eye of everybody else they are exactly identical.

Among every class of men you find always some who gain ascendancy over their fellow-creatures.

The next view will show you the custom of holding a durbar to decide on the price of the different articles for the coming week. They are cloth merchants, holding their durbar. They have again taken off their shoes, and the man who has just arrived, and has one shoe off, is an excellent type of the budmaash, the men who did so much harm in the mutiny. His countenance will show you he is a man of immense influence among them. The others were waiting his arrival, and just as he arrived I was able to catch him. They are most difficult fellows to deal with, and were, in fact, the cause of the whole of the mutiny.

At Allahabad we find ourselves on the Ganges, the sacred river. There is nothing to equal the veneration in which the Hindoos hold the river. It is hardly possible to conceive it. They have all sorts of stories as to the river being a goddess, and who was the father and who the mother. The reason probably is that the river rises in a most extraordinary manner. On the top of the Himalayas it comes out a large powerful stream from a tunnel of ice, and consequently nobody knows its source, and from the time it is first seen right down to its mouth it is sacred to the Hindoos. The difficulties our government have had to contend with to put a stop to the wholesale murder which goes on here, I can hardly explain to you. Every family that has got a member of it, male or female, at all decrepid or diseased in any way, they take down to the banks of the river at low-water, and, gathering up the mud, they fill the eyes and ears and nose and mouth with it, and there leave them to be swept away when the water rises. There are many instances on record of Englishmen finding those who have thus been left, and having taken them home and got them washed, and, in fact, restored them to life again, but they have met with nothing but abuse and curses for so doing. The native says that he will be disowned by his family as having lost caste, he having been left there to die a sacred death, and if he comes back to life he is nobody, and passes a miserable life, isolated from every one.

Following the Ganges to the north, we arrive at Cawnpore, the first place of interest in the mutiny. We see the screen round the well into which the unhappy women and children were thrown. Since this photograph was taken a large figure has been placed over the well. Unfortunately, the stone it is built of, both the screen and covering of the well, is so very soft that, although it is so beautifully done, it will never stand the effects of the climate.

Leaving Cawnpore, forty miles will bring us to Lucknow, where we shall see the entrance into the Residency, called the "Baily Gate." All the history of the mutiny is too well known to need description from me. The gate is named after the gallant defender of the place, before we relieved the Residency and saved the garrison. The shot marks cover it, and the more we look at it the more marvellous it appears how so small a body of men could have held it as they did. The Residency itself is exactly as we took it, the government just repairing it to keep it from falling to the ground. It was in a room in the tower that Sir Henry Lawrence lived, and it was here, watching for aid to come, that the ball struck him down, and thus laid low as gallant and brave a man as England ever boasted of.

Time will not allow us to go further, but hurry on to Agra, and see there that wonderful building called the Taj-Mahal. The first view will show you the entrance-gate. It is situated on the Jumna. It is the celebrated mausoleum of Shah Jehan, which he built for his wife, of white marble. The other, which he built on the other side of the river, was to be of black, but, unfortunately, he died before the black marble was finished, consequently he is buried elsewhere—nobody knows where. Inside, we get a view of the Taj, which is built, as I have said, of white marble, inlaid with precious stones. The only fault found with it is that the minarets are too short, not being higher than the dome. Inside it is very dark, and I found it difficult to get a photograph of it, but by perseverance I managed to do so. Each slab of marble is six feet high, four feet wide, and four inches thick. It is another instance of the marvellous power and industry of the Hindoos. All the inlaying that is seen are precious stones, which are placed together in such a way that the first letters form verses of the Koran. It is the same with the flowers. On the tomb you see inside every bit can be read by the Mahommedans there, the first letter of each stone being used to form the verse in the Koran. It cost one million sterling, and thus we see how the Mahommedans spent their enormous wealth.

We can hardly leave India without one peep at a native prince, and so I propose to show you a Maharajah or Emperor. His father possessed a very large tract of country when we took India, and he was acute enough to see that sooner or later we must conquer the country, and as his people were nothing but a band of robbers, and lived by the depredation and plunder which they could commit on the natives, he, with his army of 200,000 men, made overtures to join us, and in those days we listened to his overtures, and promised him that when we took the country, to him should be granted his estates for ever in fee simple. I need hardly say we have kept the promise. This is his son. He is well educated, and speaks English well. He is devoted to Europeans, has English schools and teachers, and if he were not so much under the influence of the Brahmins, is really a good fellow. He treats you royally when you visit him. He has built a splendid palace, in which he lodges you, and feeds you with any amount of food you can possibly want free of all charge, and when you go away he will tell you, as he would were he here now, that you were a set of fine fellows—capital fellows—to have done him the favour to come and see him.

A vote of thanks was proposed by Lord Alfred Churchill, and passed with acclamation, to Captain Lyon for his deeply interesting and instructive lecture.

CANTOR LECTURES.

The second lecture of the first course of Cantor Lectures for the present Session, "On the Practical Applications of Optics to the Arts, Manufactures, and to Medicine," was delivered on Tuesday, Dec. 3rd, by C. Meymott Tidy, Esq., M.B., Joint Lecturer on Chemistry, and Professor of Medical Jurisprudence at the London Hospital. The Lecturer said:—

At our last lecture we examined, first of all, the law of the decrease of light with regard to distance, and we found that it obeyed the law that all radiant force obeys—the law of inverse squares. We then examined the method of calculating and estimating the relative intensities of light, by means of instruments which I said are generally called photometers, though not a particularly accurate name. Then, lastly, I drew your attention, as far as I was able, to the several methods which had been adopted for overcoming that law of the decrease of light in cases where we find it necessary. It is at that point that I take up my lecture to-day. We found the two great methods of overcoming the decrease of light were—reflection and refraction. It would have been interesting, if we had had time, to examine how nature makes a law, how she applies it to all force, and yet how, at the same time, she marks the limits of that law, and how those limits extend to all force as well.

Now, we have to consider the applications of these great principles—the principles of reflection and refraction—to lighthouse illumination, and to other circumstances where we may require them. The first method that was suggested of throwing light to a distance was by means of mirrors (the Catoptric system), made of small pieces of plain silvered glass, fixed into a hollow mould by means of plaster of Paris. I need not say that this was soon abandoned, inasmuch as it proved to be a very imperfect method. After this we find the use of parabolic reflectors. I have already drawn your attention to the principal object of this kind of reflector, and of its advantages over an ordinary one. I told you that the concave reflector, after having conveyed the rays, spread them out, whereas, by the use of a parabolic reflector, as is shown in the diagram, all the rays are thrown parallel. These parabolic reflectors, I believe, are still used in the northern lighthouses, at any rate, in some of them, the light employed being either fixed, that is to say, continuous, or else revolving, the angles being dark, whilst the sides are illuminated. Now, it is found that the reflecting or catoptric system does not answer so well as the dioptric, the system of lenses, or the refracting system. There are a great many difficulties in the use of the reflecting system, hence, in nearly all our lighthouses at the present time, we adopt the system of lenses rather than the system of mirrors.

I have already shown you the power that a lens possesses of gathering up the light rays, guiding them in whatever direction we think fit, and building up an image at a distance from any object that may be placed in its path. By means of a large lens, you see, I can throw upon the screen a most magnificent image of the coal points with which we are operating. There is the refracting system, and its power of building up rays. But, alas! for the imperfection of all things human, although the lens has a marvellous power of guiding light, it has its disadvantages. What are they? They are principally two. First of all, nature never indulges in extremes—there is nothing perfectly opaque, and there is nothing perfectly transparent—hence when we have a very large lens, as is necessary in light-house illumination, the result is that a large number of the light rays are absorbed by the glass, and we lose a great part of the illuminating power. That is the first objection—the absorption of the light rays by the glass. The second objection is of a different kind. Unfortunately, at best the lens is a very imperfect instrument. I have here, for instance, my lime light, and I will first of all throw upon the screen a disc of light without any diaphragm. You see that I obtain upon the screen a brilliantly illuminated disc of considerable size. Now I will put in front of this lens,—and a very well made one it is—a diaphragm, in order to stop out all the rays except those which come from the exact centre of the lens. In doing so, I shall scarcely in the least degree, however, diminish the size of my disc of light, although, by using the diaphragm, I shall probably cut off more than one-half of the lens. Now, let us examine this question a little more fully. First of all I will put into the lantern a picture—an ordinary view, and by focussing it carefully you notice how marvellously sharp it appears on the screen. Now I will remove the diaphragm, and you see I do not increase the size of my disc, although I am using more of the lens in its production. But you will note this, that immediately upon my removing the diaphragm I get a certain obscurity in the image—it is not nearly so sharp now as when the diaphragm was in front of the lens. The size of the disc is not increased, although I am now using the whole lens, whereas I was only using half, but I do not get the extreme sharpness of the image that I did when I only employed the rays that came from the centre of the lens. Now what is the explanation of this? I think you will see at once that the rays which come out of the centre of the lens are not working in harmony with those rays which come from the edge of the lens; in short they are antagonistic one to the other. Shut out one set of the rays, and you then get a perfectly sharp picture; allow the other set of rays to come into play and immediately we get a certain amount of blurring. That is the meaning of the diaphragm; and this antagonism between the rays of light is what we know as spherical aberration by refraction, in contradistinction to spherical aberration by reflection. I shall revert to this again, with reference to other defects in lenses.

It is in this difficulty that science is appealed to, and asked, What can you do for us? And let me say this, that when definite questions are asked of science they are very seldom asked in vain; it is the indefinite questions that science fails to answer. To compensate, then, for the evils of this spherical aberration, Buffon first, then Brewster, and afterwards Augustine Fresnel, built up these magnificent lenses, called polyzonal lenses, ring within ring, each at its proper adjustment. Here I have a magnificent lens, which has been kindly lent me by Messrs. Chance, of Birmingham. You will see at once what is its character. The dotted line in the diagram shows the size of the lens under ordinary circumstances, and you see it would be of an enormous thickness, so that a large amount of light would be absorbed, but by cutting it down and forming a series of zones, each to its proper angle, with a convex lens in the centre, you get all the advantages of the large lens, whilst you lose but little of the light. Here is the lens in the centre, and here is zone upon zone, building up Chance's magnificent lens. Here is another lens of the same kind, which has been kindly lent me by Captain Doty, which illustrates the same thing, though it is in another form; still you see it retains the polyzonal character. Here is the round part in the centre, and here are the zones building up a lens, which has the power of sending the light an enormous distance, whilst it is not to a great extent diminished. It is not part of my subject to-night to enter on the vexed question of the best oil or the best light for lighthouse illumination, whether vegetable, mineral, or animal oils are best, but certainly mineral oils, as suggested by Captain Doty, have, to my mind, very great advantages over all others; but I do think, that the time is not very far off—we may hope so, at any rate—when we shall have some cheap electric light that may be generally employed in lighthouse illumination.

Unfortunately our electric light at present is very troublesome and expensive, and could scarcely be ordinarily employed for such a purpose. But, with all our powers of lighthouse illumination, fogs have sadly interfered with lighthouses. I might have shown you how even the rays of the electric lamp are obscured by a little steam.

With respect to lighthouse illumination, I would draw your attention to the nature of a flame. Looking at the flame of an ordinary candle, you notice it occupies a very considerable space, and it is very important to determine that point of the flame which possesses the greatest intensity, inasmuch as it is necessary, in order to obtain the best possible result, to adjust that centre of intensity to the axis of the lens. It has been suggested by Messrs. D. and T. Stevenson, the engineers to the Scotch lighthouses, that this might be done by photography. If you look at a flame it is almost impossible to tell the point of the greatest intensity, but they propose to estimate that by taking photographs at different exposures. For instance, you take the flame of a three-inch burner, and you take a photograph of it by an exposure of one second. Messrs. Stevenson say that that part of the flame will appear upon the plate that has the greatest intensity; then, keeping the camera at the same distance from the flame, they photograph it again with two seconds exposure, and get of course a more perfect image. Then they proceed to take photographs with three seconds, four, six, twelve, and twenty-four seconds' exposure. That part of the flame corresponding to the photograph, taken by the shortest exposure, is supposed to be the point of the greatest intensity.

A plug in the centre of the flame is then raised to this point of the flame. The flame is then placed in the proper position in the lamp, and the operator looks through the light and the lens and arranges it so that the horizon should be in an exact line with the centre of the lens and the plug, which is in the luminous centre of the flame. But I am bound to say, I think there is a flaw in this. It strikes me that Messrs. Stevenson have mistaken the luminous centre of the flame for the centre of the actinic rays. It is not the luminous centre that they get pictured, for we know very well that the greatest actinic power does not correspond to the most luminous part of the flame. We know, for instance, that in a spectrum—and this I shall point out in another lecture—the greatest light power of the spectrum is somewhere about the yellow; certainly not where there is the greatest actinic power, and therefore it seems to me that in this process they have determined the point where there are the greatest amount of actinic rays, but I do not admit that that corresponds to the part of the flame which contains the greatest number of luminous rays.

An application of reflection has been suggested by Mr. Skelton to our ordinary street lamps, a specimen of which arrangement is on the table, and there is also on the wall an illustrative diagram Of course it is a bad system that, as in an ordinary lamp, the rays of the light should be thrown into the sky, where we do not want them, and it is advisable, nowadays especially, that we should get as many of the rays as we possibly can upon the pavement, where we do want them; and I certainly think that this lamp of Mr. Skelton's is a decided improvement upon our old-fashioned lamps. I need not tell you, with respect to parabolic mirrors, that they are very largely used in carriage lamps, and in the lamps placed in front of and behind railway trains. Moreover, in lighting staircases, we often employ a combination of parabolic mirrors, so as to throw the light in two directions at the same time.

Plane mirrors have their application in domestic economy to secure a better supply of light in dark places, and on dark days. Then, again, there is another practical application of reflection. The angles of crystals, you know, are measured by what is called a reflecting goniometer, where a ray of light is used as an index. Another practical application I can only just mention, for it is too well known to need description, and that is the reflecting telescope. Then there is one application of reflection to the arts which I think must not be entirely forgotten. It is that which is known as Brewster's kaleidoscope, and is used so largely at the present day for the purpose of obtaining patterns and so forth, that I think it certainly deserves to be mentioned as one of the practical applications of optics to the arts. I do not know whether I shall succeed very well in an attempt to throw a kaleidoscopic object on the screen, for it is a very difficult thing to do, but I will do my best by means of the lime-light lantern. You see the feather which I use is reflected over and over again, forming many very beautiful patterns.

Nor has medicine profited nothing by reflecting instruments. There are dark parts in the body, quite out of the reach of our ordinary powers of observation, and the means at our disposal for the detection of disease, such, for instance, as the back of the eye. But science has shown us how, by reflecting instruments, we can even dive into these. Here, for instance, we have that beautiful instrument known as the ophthalmoscope, an instrument for examining the eye. Here is a little concave mirror, in the centre of which is a little hole. The light is reflected by this concave mirror, and directed into the eye. The operator looks through that little hole, and by means of a lens, such as you see here, he magnifies the back of the eye (the retina), and is able at once to discover any morbid changes that are going on. Thus you see our medical knowledge becomes more accurate, as science supplies us with more accurate methods of diagnosis. And it is a well acknowledged fact now, that you must know what a disease is before you attempt to battle with it. Again, here we have that beautiful instrument, the laryngoscope, for examining the throat. Here is one which, in the hands of my friend and colleague, Dr. Morell Mackenzie, has given us a literature in a few years upon a subject about which formerly little was known. Here, again, you see a concave reflector is employed for throwing the rays of light to the back of the throat; and there is another little reflector, which we place in the throat, just under the uvula, in order to direct those rays downwards, to change the direction of the rays thrown in by the concave mirror; and in this way, again, we are enabled to discover diseased conditions of the vocal cords, and of the parts adjacent; and, what is more, by the aid of this instrument we are enabled to apply remedies to parts that were formerly out of our reach altogether—remedies, let me say, that have proved most efficacious, and that would never have been dreamt of, but for this most useful application of optics to medicine.

The most perfect refracting instrument is the eye. It is a true optical instrument. In front of the eye there is a transparent window for the rays to enter. These rays are gathered up by a magnificently transparent lens, which is more convex anteriorly than posteriorly. This lens is made up of concentric layers of different refracting power. Then we have a magnificent screen to receive the image, which is an extension of the optic nerve that conveys the message it has received to the brain, and the brain translates that message into light. You ask me how? I do not know. It is just at this very spot where the optical instrument of the Deity surpasses the optical instrument of human craft. I have here a model of an eye, which will give you, at any rate, some idea of its construction, and will enable me to illustrate its action. Here you see is the diaphragm, for nature knew about spherical aberration long before we did. The diaphragm is called the iris. Here is the pupil, through which the rays enter; and here we have, at the back, the retina, which in this case is a bit of oiled paper. Now if I place this artificial eye at some distance from where I am, and in such a direction that the screen, or retina, is towards you, and then place in front of it a candle, I shall be able, by means of a lens, to focus the image of the candle upon the retina, and I dare say I shall be able to obtain a fairly good image there, so that you may all see it. It is a small one, but it is beautifully distinct. You will also notice that the image of the candle is inverted. Now that is exactly what you would see in the eye. If you could get into my eye, for instance, you would see on the retina an image of the audience in this room, and you would see them all with their heads downwards. There are a great many questions arising out of this. How is it we see things in their proper position?—is seeing believing? do we see things in their proper position? Numerous theories have been proposed to explain this, but none of them, I believe, are very satisfactory. However, I think our artificial eye will explain to you one circumstance which I want to make clear, and that is, that it is essential to perfect vision, that the object should be accurately focussed upon the nerve screen of the eye. This candle is accurately focussed now upon the retina, but if I move the lens in the slightest degree you will notice that the candle is no longer accurately focussed, and you cannot see it distinctly. In order to have a clear image you must have the object accurately focussed on the eye screen. But sometimes we find that the lens of the eye is too good a refractor—it bends the rays too much; or perhaps the other media of the eye are too refractive—or perhaps the axis of the eye is too elongated. Several of these things may happen, and under such circumstances you do not get a perfect image of the object you are looking at upon your nerve-screen, but the rays come to a focus in front of the nerve-screen, owing to the great refractive power of the lens or from some other cause I have named. The result is, you get a blurred, unfocussed image upon the nerve-screen, instead of a sharp image. This is illustrated upon a diagram which I have here, where you see the image has come to a focus, instead of on the nerve-screen, in front of the retina. This is what constitutes short sight, or myopia. Short sight, therefore, is due to the rays of light coming to a focus before they meet the nerve-screen. Now, what is the remedy for this? First of all, the person who is short-sighted brings his paper near to his eyes, and I think the reason for that must be perfectly plain. It throws the point of intersection further back, the eye, under such circumstances, being adapted to bring divergent rays to a focus, but not parallel ones. But of course we know very well that this method of holding a book within a few inches of the eyes is not very agreeable, and we have to obviate it by other means, namely, by lenses. In the case of short sight, which we are now considering, where the rays come to a focus in front of the retina, we use a concave lens. A concave lens has the opposite action to a concave mirror. The concave mirror squeezes the rays together, but the concave lens draws them apart; and I think this will at once explain to you, the reason for the use of concave lenses in short sight. It is well illustrated on this diagram. Here the point A comes upon the lens of the eye, which is too highly refractive, and the rays are bent and meet at this point in front of the screen. But if you put in the path of the rays a concave lens, it spreads the rays out, and by means of different powers they may be made (many can) to meet in any desired spot, so as to bring them to a focus exactly upon the retina. Thus you see the action of the concave lens on a short-sighted person is to throw the point of intersection further back, so as to bring it on to the retina.

But another state of things may exist. Not only may the lens be too powerful a refractor, but it may not be a sufficiently good refractor; or, for instance, the eye might be too flat, or the eye-ball too shallow, just the reverse of what we have been considering; and here we have a different state of things. Instead of the rays coming to a point in front of the retina, they, if they could go on, would come to a focus behind the retina, further back, as represented in another diagram, where you see the rays meeting behind the retina. This constitutes what is called *presbyopia*, or long sight. In short sight the rays meet in front of the retina; in long sight the rays would meet behind the retina. This is the first and earliest sign of impaired nutrition—the impaired accommodative power—from, perhaps, most often a less yielding state of the lens. And now what is the remedy for this? Just as a boy who is short-sighted brings his paper near to him in order to throw the rays further back, the person who is long-sighted holds his book a long way off to bring the point of intersection more forward. And as in the case of short-sight we use a concave lens, in order to spread the rays further out, so in the case of long sight we use a convex lens in order to bring the rays upon the retina in front of where the focus otherwise would fall. These are the two principal kinds of lenses, and you see at once their practical application. Perhaps it may be worth while before we pass on to show you the extraordinary power of the convex lens in pulling rays together. I will do so by placing a large convex lens in the path of the rays from the electric lamp, and you see at once how powerfully they are converged. I should say that we always employ double convex, or double concave lenses; but Wollaston suggested what he called periscopic, or concavo-convex lenses. He thought that, by this means, a very much wider range of vision could be obtained—hence the word periscopic. But this is perfectly unnecessary, because, even in an ordinary convex or concave lens, a very small part of the lens is used. I believe the use of these periscopic glasses has been entirely discontinued in England, and, I believe, on the Continent also. Lenses are made of every strength, because some people are more short-sighted or long-sighted than others. On the table is a magnificent set of lenses kindly lent me by Mr. Baker, optician, of High Holborn, amongst which you will see convex and concave lenses of every size and every focal length, suitable for every kind of sight. Here is a lens which is concave to a most extraordinary degree, and there is another, which is almost, if not quite, a plain piece of glass, just suitable for some young gentleman who wants it for but one reason.

I will pass on to some few circumstances connected with the eye that are matters of very great importance. The eye, you know, has the power of adapting itself to objects at all distances, though not at the same time. It is known as the power of accommodation. In all probability, this is brought about by a change in the lens, through the action of the ciliary muscle. I believe this to have been tolerably well proved by Helmholtz. The action is best seen in the eye of a pig; but I do not know that there is any difference between that eye and the eye of a man. I suppose I need not say much to you about the desirability of having two eyes; but let me just, in passing, say that two eyes are necessary to estimate distance and to detect solidity. One eye does not see the same object as the other eye does; we see different objects with the two eyes. For instance, if I hold my hand up with the edge in front of me, and shut the left eye, I see a large part of the back of my hand; but if I shut the right, I see a large part of the front; and it is the union of these two pictures that produces the idea of solidity. That is the history of the stereoscope, whether it be the reflecting stereoscope, as was first suggested, or the refracting stereoscope, with which we are now so familiar. It is the union of these two images that produces this idea of solidity in the stereoscope; and it is perfectly certain that, when a person fails in seeing the perfect solidity of the two pictures in the stereoscope—for those two pictures are different—the stereoscope becomes a most valuable instrument for proving that there is some defect in one of the two eyes. Then, again, it is a well-known fact that the eye sees an object after it has been displaced, or after the object has disappeared; that is to say, the image lingers on the retina for some time, perhaps as much as one-seventh of a second. I might bring forward numberless experiments in proof of this. You are, probably, all familiar with the thaumatrope of Dr. Paris, in which, by turning round a little bit of card rapidly, you see, at the same moment, the images on both sides of the card. Here, again, is a large induction coil, by which I can light up this glass tube; and on turning it rapidly round, although there is only one tube, it appears as if there were several. I want to show you one or two experiments, to lead you up gradually to another point in connection with this subject of considerable importance. I have here a large disc, on which are painted a number of black balls. I will mount this on a stand, so as to throw upon it the beam of our lime-light. And you will have no difficulty in understanding at once how, when I rotate this disc rapidly, you seem to see all these balls mingling together, producing the appearance of a single shaded line.

Now I want to draw your attention to another very curious effect. Instead of throwing upon this disc the lime-light, I will illuminate it by an electric spark produced from a battery of four or five cells. Now, on rotating it once more, you will see that with the intermittent light produced by the electric spark the balls all appear separate, and you do not get the effect of the shaded line, whereas with the continuous light from the lantern you see the lines instead of the black balls. Thus, you see the difference produced by the sudden flashes of light and that produced when it is continuous. I can produce these flashes of light in another way. Instead of using a disc, I will use a large wheel, placing it in front of the screen. Then in front of the lime light I will place a small disc, in which there are two apertures at opposite portions of the circumference of the disc, through which the lime-light will illuminate the wheel, and throw its shadow on the screen. If the wheel is rotated rapidly, allowing the disc in front of the lime light to remain stationary, so that the light comes continuously through one of the apertures, you are not able to see the spokes of the wheel; but now, instead of allowing this continuous light to fall upon the wheel. I rotate the disc so as to produce rapid flashes of light through the apertures, you see all the spokes re-appear, producing this very remarkable effect. At one time the wheel appears to stand still, whilst, by varying the velocity at which the disc is rotating, it actually appears to be turning in an opposite direction to that in which it is really being driven. It has been a question of some interest in jurisprudence, and has been raised over and over again, whether a flash of lightning, such, for instance, as I had from the electric spark, is sufficient to recognise a person by. Again and again cases have occurred which have been brought before the law courts in which a person has seen a thief, for instance, merely during a flash of lightning. My own opinion is that there can be no doubt there is. It has been gravely asserted, too, that the image of a man's murderer might be discovered on the retina of the murdered man if examined sufficiently soon after death, that is to say, owing to this lingering of the image upon the retina. I need scarcely say this is a pure myth, and it is sadly to be regretted that clever men who propose such absurdities should not devote themselves to work of more importance than proposing such outrageous suggestions.

There is another peculiarity of vision which has received an enormous amount of attention of late—that is to say, what is known under the name of astigmatism. In a normal eye the curve of the cornea, whether measured obliquely, vertically, or transversely, is the same. It is like a well-made watch-glass—perfectly symmetrical. The eye, however, may be well formed and yet the cornea be unsymmetrical, presenting different curves accordingly as the anterior surface be measured vertically, transversely, or obliquely. Hence we have different refractions depending upon which meridian of the eye-ball the light rays fall, and as the result, the impossibility of these rays meeting in a focus. This abnormal state of the eye distorts objects more or less. Now I will try and see whether we can show you a picture distorted by means of an astigmatic lens, so as to try and produce artificial astigmatism. To show you how these different curvatures distort the picture, we will throw upon the screen the picture of an ordinary view. Then I take an astigmatic lens, that is, one with different curvatures, which we will place in front of the lantern, and you will see at once a amount of distortion takes place; the lines are not straight, but appear, to a certain extent, askew. In an ordinary case of astigmatism we get a certain sharpness of vision, but, at the same time, a distorted image produced by that state of the cornea. I refer to this because a paper has lately been written by a somewhat eminent ophthalmic surgeon, Mr. Liebreich, to whom, it is only right to say, ophthalmic science was, in the first instance, much indebted, endeavouring to prove that the faults of Turner (that greatest of painters) during his last years were due to this astigmatism, from which Professor Liebreich imagines he suffered. He supposes that Turner's errors in drawing were entirely due to this abnormal state of the eye. Now, with all due respect to Professor Liebreich, I cannot help thinking that he has committed a great mistake. Supposing Turner had been astigmatic, it was a matter of no importance. Turner drew and painted as he saw. Let me put a most extreme case. Supposing he was painting a man, and, owing to some peculiarity of his eye, he saw him upside down. Of course, when he painted him, he would paint him in the position in which he saw him. But, inasmuch as to my eye the subject would be in the right position, as a matter of necessity the picture that Turner drew would be in the right position to my eye, though not to his. Inasmuch as the object to my eye was not distorted, no more would the object that he had painted on his canvas be distorted. In the same way, if he saw a tree that looked to him askew, and painted it askew, I look at the tree, I see it is not askew any more than his drawing. It seems to me that Mr. Liebreich has forgotten that we do not see with Turner's eyes, and that the eye with which Turner saw was the same eye with which Turner painted. And I think precisely the same thing may be said respecting Mr. Liebreich's criticism of Mulready's later pictures, accounting for the peculiar colouring by the change of colour that the lens undergoes in some cases with age. If Mulready saw a sunset as a deep blue, he mixes his colours a deep blue, but inasmuch as to my eye the sunset is not a deep blue, but a deep red, as a matter of necessity the colour which Mulready mixed would be to my eye a deep red too. The simple fact is that Mulready saw and Mulready painted with the same eye. He saw perhaps with a different eye to mine, but if he has closely imitated the object he is painting, you may depend upon it the colour will be the same to me. I do not think, therefore, for one moment that Mr. Liebreich has thrown any light whatever on the peculiarities of style of these two great English painters. Of course, it is a very important matter to correct this astigmatism, and for this purpose we use peculiar lenses—cylindrical lenses, as they are called—some of which I have here, the axis of which is placed before the eye, so that the axis of the glass may correspond to the meridian of regular refraction, a concavo-cylindrical or a convexo-cylindrical glass being used, according to whether the patient is short or distant sighted. I have here, again, a large quantity of cylindrical lenses, which Mr. Baker has sent me. In astigmatic patients it is a matter of very considerable difficulty, and sometimes a very long process, to find out the exact glass that will suit. And in all these cases it is most essential you should not go and buy a shilling pair of spectacles, but should have something a little more accurate. It is most difficult sometimes to fit the person with proper lenses, but still, here are the lenses, and very important they are as practical applications of optics to medicine.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

Her Majesty's Commissioners for the Exhibition have resolved to exhibit next year, under the class of Food, all kinds of novel modern utensils for drinking and for the use of tobacco. In order to add to the interest of this section of the class of food, the Committee are already engaged in securing an exhibition of ancient utensils of a similar kind.

In Class 8, "Silk aud Velvet Fabrics," the following rule has been added to those already circulated for the class above named:—"Every object of New Silk Manufacture offered for exhibition must have the names of the manufacturer and of the place of manufacture attached to it."

The second meeting of the Committee on Surgical Instruments and Appliances was held on the 23rd December, at 3 o'clock, in the Offices, Gore-lodge, South Kensington. Amongst those present were—Mr. Cæsar H. Hawkins, F.R.S. (in the chair), Sir Wm. Fergusson, Bart., F.R.S., Dr. P. Allen, Mr. W. Bowman, F.R.S., Mr. R. Brudenell Carter, Mr. W. White Cooper, Dr. W. T. Domville, R.N., Dr. Arthur Farre, F.R.S., Dr. G. T. Gream, Mr. Prescott G. Hewitt, Mr. J. Hilton, F.R.S., Mr. J. Hinton, Profesor J, Marshall, F.R.S., Mr. T. W. Nunn, Dr. W. S. Playfair, Mr. R. Quain, F.R.S., and Mr. Edwin Saunders. Letters received from the Royal College of Surgeons and the Royal Medico-Chirurgical Society were read, and it was stated that many of the leading surgical instrument makers in London, Dublin, Paris, and other capitals, had signified their intention to contribute. It was suggested that the exhibition should be brought before the notice of the British Medical Association, at its meeting in August, 1873. The Committee resolved to recommend the Royal Commissioners to invite corresponding members in foreign countries, and, after the transaction of general business, adjourned till Monday, the 20th of January, 1873.

EXHIBITIONS.

Industrial and Fine-arts Treasures Exhibition at Wigan.—The opening of the new infirmary premises at Wigan, which have been erected at a cost of nearly £30,000, is to be celebrated at Easter by an exhibition on rather an extensive scale. The inhabitants of this part of the country are making great efforts in connection with the undertaking, having already raised, by voluntary subscriptions, nearly £25,000. An industrial section, to include machinery in motion, is also being formed. A special exhibition of coal-cutting machines is talked of.

Melbourne Exhibition.—The *Melbourne Argus* reports the opening of the fourth Melbourne Exhibition of Natural Products and Works of Art, on the 6th November, and gives details about this and the previous exhibitions, which show the progress made by the colony of Victoria during the last few years. The first Melbourne Exhibition was held in 1854, during the gold fever. The excited state of the country, and the consequent disinclination to steady work, were by no means favourable to the progress of arts and manufactures. The few manufactures and trades previously called into existence by the wants of a small commercial and pastoral community had been crushed by the great advance in wages, and the population, which was increasing at an exceedingly rapid rate, was dependent almost entirely on foreign countries for its articles of consumption. The contents of the exhibition had, therefore, little of a special character. The statistics of the period show that the manufactories were limited to the following list:—34 saw-mills, 5 iron foundries, 16 breweries, 17 coach factories, 40 flour-mills, 10 tanneries, 9 fell-mongeries, 1 boiling-down establishment, 1 rope-walk (in Geelong), 4 wine-presses, 1 chaff-cutting-machine, 1 steam-washing machine, 2 sausage-machines, 1 pottery, 12 candle manufactories, 5 cordial ditto, 7 soap ditto, 22 soda-water ditto, and 1 bone-dust ditto. The next Victorian Exhibition was held in 1861, in connection with the London Exhibition of 1862, and showed that a great change had been silently spreading over the country in the intervening seven years. The population had become more settled, and several new industries had started into life. The number of inhabitants had risen from 273,685 to 540,322, and the manufactories from 152 to 429, giving employment to nearly 4,000 persons. The great Intercolonial Exposition of 1866 showed, for the first time, that the foundations of a large export trade had been securely laid, and of 2,956 exhibitors 1,479 were Victorian. The present exhibition is exclusively confined to Victorian products, but gives satisfactory proofs of the continued industrial progress of the colony. From the returns of the Registrar-General, it seems that in March last there were 1,137 manufactories in the colony, employing 13,886 men and 2,630 women, and using machinery and plant of the approximate total value of £2,428,470. The list includes 43 agricultural implement manufactories, 59 iron, brass, and copper foundries, 22 meat-curing establishments, 27 boiling-down establishments, 69 tanneries, 30 clothing manufactories, 9 pianoforte manufactories, 2 cutlery works, 1 type foundry, 1 paper manufactory, 2 glass manufactories, 2 glass-works, 10 rope and twine manufactories 13 ship and boat-builders, and 18 bone and chemical manure manufactories.

Vienna Exhibition.—It is announced in the *Journal Officiel* that, besides the sum of 1,200,000 francs (£48,000) voted by the French Assembly for the expenses of the French Section of the Vienna Exhibition, a sum of 500,000 francs (£20,000) has been granted to enable the French Commission to assist the numerous French exhibitors in paying a rental imposed by the Austrian Commission for the space granted to them. It will be interesting to see how British exhibitors appear at Vienna, being practically left to their own resources, and getting no help from the British government, which has ignored the cost Austria incurred in 1851 and 1862 in London. An interesting lecture on the Vienna International Exhibition of 1873 was recently delivered, says the *Eastern Budget*, by Herr Julius Hirsch, to the Lower Austrian Industrial Society. The lecturer observed that the number of exhibitors who have applied for space in the new building far exceeds all expectation. From Germany alone there will be four times as many exhibitors as there were in the Paris Exhibition of 1867, and the number of Austrian exhibitors is 17,000—a number greater than that of the English and French exhibitors at their last exhibitions in London and Paris respectively. The applications for space at length became so numerous that it was found necessary to make the machinery department half as large again as was originally intended, to cover in the court-yards, and to build annexes covering a surface of 30,000 square metres at the eastern and western extremities of the building. A new building had to be erected for the agricultural department, which is to comprise an exhibition of horses, cattle, dogs, and even cats. There is to be a special department in the exhibition for educational objects, and the Austrian Minister of Education has directed the masters of the middle and lower schools, and of the schools for teachers at Vienna, to send a collection of the articles used by them in teaching to the exhibition. Besides these articles, which includes books, instruments, &c., there will be various models showing the construction and the internal arrangements of the various kinds of schools in Austria.

OBITUARY.

Mr. Startin, F.R.C.S.—We regret to announce the death of Mr. Startin, the well-known surgeon, of Savile-row, which took place on Tuesday, the 24th December. The deceased gentleman was, for a long series of years, more than famous in the treatment of diseases of the skin, and his practice, in this department of medicine, was perhaps the most extensive of its kind in the world. Mr. Startin, we believe, began practice in the country, but, not succeeding, he came to town, and established himself after a time in London-wall. Having decided to devote himself to the subject of skin diseases, he went abroad in the first instance, for a time, to make himself acquainted with Continental practice, and he is said to have acknowledged himself as greatly indebted to the experience which he there gained for much of his after success. He was also taken by the hand by certain of the Gurney family. Subsequently, in 1841, the Hospital for Diseases of the Skin, New Bridge-street, Blackfriars, was established, and Mr. Startin subsequently became its senior surgeon, and his filling this post at once brought him prominently into public notice, whilst his practice rapidly increased year by year. Mr. Startin was a Fellow of the Royal College of Surgeons, and a member of the Apothecaries' Company. He contributed a number of papers to the medical journals at various times, and amongst others one discovering, for the first time, the medicinal qualities and utility of glycerine. Mr. Startin was, perhaps, not so remarkable for his scientific as for his very practical acquaintance with and handling of disease. He was universally allowed in the medical profession to have treated his patients with rare success. This result was owing, no doubt, to the fact that he had enjoyed large opportunities of observation, but not less to the possession of an excellent judgment and good tact. Mr. Startin was elected a member of the Society in 1851.

Mineralogy and Geology Applied to the Arts.—With a view to facilitate the study of geology and of mineral substances used in the arts, Professor J. Tennant has undertaken to give six elementary lectures on mineralogy, adapted to a juvenile audience, at his residence, 149, Strand, London, W.C., on January 3, 6, 8, 11, 13, 15, 1873, at 2 p.m. Terms, half a guinea for the course; five shillings for children of members of the Society of Arts or fellows of the Geological, Zoological, Chemical, Royal Microscopical, Royal Geographical, Royal Horticultural Society, and the Geologists' Association. The course will commence with a description of the physical and chemical characters of minerals in general. It will be followed in the Easter holidays by a course of six elementary lectures on geology, and in the summer holidays by a course of six elementary lectures on practical geology. The lessons delivered on the subject of geology are intended to have especial reference to the important practical applications of that science to engineering, mining, architecture, and agriculture.

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

THE LIBRARY.

The following works have been presented to the Library:—

The Thirty-sixth Annual Report of the Art Union of London. Presented by the Council.

The Workman's Magazine. Part 1. Edited by the Rev. Henry Solly. Presented by the Editor.

The report of the Royal Society for the Protection of Life from Fire.

The Report of the Meteorological Reporter to the Government of Bengal. By Henry F. Blanford.

How a National Museum of Natural History might be built and arranged with advantage. By R. A. Peacock, C. E. Presented by the Author.

The Agricultural Geology of the Weald. By William Topley, F.G.S. Presented by the Author.

On the Comparative Agriculture of England and Wales. By William Topley, F.G.S. Presented by the Author.

Geology of the Straits of Dover. By William Topley, F.G.S. Presented by the Author.

The Annual Report of the Commissioner on Education for Washington, for the year 1871.

Jahres-Bericht der Schlesischen Gesellschaft. Abhandlungen der Schesischen Gesellschaft.

The Constitution, Statutes, and Examination Regulations of the School of Mines at Ballarat, Victoria. Presented by R. W. Newman, Vice-President.

Official Catalogue of the Victorian Exhibition of 1872. Patents and Patentees, vol. 5. Presented by W. H. Archer, Registrar-General of Victoria.

Statistics of the Colony of Victoria for 1871. Part 7, Vital Statistics, &c.

War Department Weather-Map. Signal Service, United States Army.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Royal Institution, 2. General Monthly Meeting.
British Architects, 8.
Entomological, 7.
Medical, 8.
Victoria Institute, 8.

Tues....Pathological, 8. Annual Meeting.
Anthropological, 8.
Biblical Archæology, 8½.
Zoological, 8½. 1. Dr. Bowerbank, "Contributions to a General History of the Spongiadæ—Part IV." 2. Dr. Bowerbank, "Report on a Collection of Sponges found at Ceylon by Mr. E. W. H. Holdsworth." 3. Mr. A. H. Garrod, "On the Value in Classification of a Peculiarity in the Anterior Margin of the Nasal Bones of some Birds."

Wed. ...Geological, 8.
Graphic, 8.
Royal Literary Fund, 3.
Royal Society of Literature, 4¼.
Archæological Association, 8.

Thurs...Royal, 8½.
Antiquaries, 8½.
Royal Society Club, 6.
Mathematical, 8.
Society for Encouragement of Fine Arts, 8.
Royal Institution, 3. Professor Odling, on "Air and Gas." (Juvenile Lecture.)

Fri ......Architectural Association, 7½.
Quekett Club, 8.

Sat ......Royal Botanic, 3¾.

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FRIDAY, JANUARY 10, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The third lecture of the first course of Cantor Lectures for the present Session, "On the Practical Applications of Optics to the Arts and Manufactures, and to Medicine," was delivered on Monday, Dec. 9th, by C. Meymott Tidy, Esq., M.B., Joint Lecturer on Chemistry, and Professor of Medical Jurisprudence at the London Hospital. The Lecturer said:—

The subject of our lecture this evening is the practical application of optics to the Arts, as illustrated in photography, that home art-science, the younger sister of the arts. I need say nothing of its importance; we are all prepared, I am sure, to admit it. It gives us pictures—pictures not of man's devising, of the earth we inhabit, and of the worlds we do not inhabit. Though all the older branches of science take advantage of its aid, so young is it that probably some remember the first publication in June, 1802, by Wedgwood and Davy, of an essay "on the possibility of producing an image by means of certain salts of silver." We are right, I think, in regarding these two great men as the pioneers of photography. They had two great difficulties to contend with. First of all they were unable to prevent the further action of light on the salts of silver, and the second difficulty was their inability to remove that which had not been actually concerned in the production of the picture. The early experiments in photography were nearly all conducted on white leather—and I can quite imagine that these experiments were suggested by a lady, whilst preparing her evening toilet, staining a white glove. You can understand how the silver came into operation. I need not enlarge more upon that. In the process of tawing, common salt is used, and this coming in contact with lunar caustic, formed the argentic chloride, which turned black under the direct influence of actinic rays.

Now in sketching, as far as I can, the history of photography and the various applications of optics to photography, I think we may fairly begin by inquiring what power it is that comes into play in the production of a picture. We have here our electric lamp, and I will place in the path of these magnificent rays a prism, when you see that I am enabled to produce a magnificent spectrum on the screen. There is our light decomposed. I shall have to speak of this spectrum in another lecture, and I shall therefore only draw your attention to one or two peculiarities of it at the present moment. Bear in mind colour is not an inherent property of a body. I mean that the true paint is light. A body is red or green, simply because the dye placed upon it has the power of absorbing all rays with the exception of those rays that produce the colour. For instance, to illustrate this a little more fully, I have here two pieces of ribbon, one green and the other red. I will place this red ribbon for a moment in the red of the spectrum, and you will notice of what a brilliant red colour it appears. Now I will place it in a part where there are no red rays for it to reflect, and instantly my red ribbon becomes black. I will repeat the same experiment with a piece of green ribbon, which, held in the green rays of the spectrum, is of a brilliant green colour; but on passing it into the red, where there are no green rays to reflect, it instantly becomes black.

But there is something in this spectrum, beyond what you see, and we must examine it a little further. You see there the light-giving power of the spectrum, but at the red end of the spectrum there is a shower of rays that you do not see; they are the heat-rays of the spectrum; and Tyndall, with the extraordinary ingenuity he possesses, has of late taught us how we can, as it were, filter these heat-rays, and obtain them apart from the light-rays. To use his own words—for I am not going further into this subject, "In the region of dark-rays beyond the red the curve shoots up in a steep and massive peak—a kind of Matterhorn of heat—which dwarfs by its magnitude the portion of the diagram representing the luminous radiations." But nature is never irregular. If she puts a shower of rays on one side she always balances it by a shower of rays on the other. That is her law; and so at the other end of the spectrum there is a shower of rays that are essentially chemical, the chemically active rays, and it is with these rays, still rays that you do not see, that we are concerned this evening. They occur in the most refrangible part of the spectrum, and are called the actinic rays.

Now, in my first lecture I drew your attention to the subject of photometry, and I told you photometry was at present unsatisfactory, inasmuch as all our photometers were relative measurers of light, and that at present we had no positive data whatever upon which we could decide the absolute illumination. I said it could not be done until we could measure and weigh the *products* of the action of light. That would give us a perfect photometer. Fortunately, however, we have made considerably greater progress in the measurements of the chemical or actinic rays. Here we get something like absolute results. It is a very well known fact that equal volumes of hydrogen and chlorine combine under the influence of these actinic rays, and this mixture of hydrogen and chlorine thus forms a true actinometer. There is another method of calculating the intensity of the actinic rays,—it is by means of a solution of oxalate of iron and ammonia. This solution is decomposed by means of the actinic rays, the salt is decomposed, carbonic acid is liberated, and the amount of carbonic acid thus liberated becomes at once the measure of the work done. A large number of actinometers have been suggested where the principle of comparison is employed, but they are very imperfect instruments indeed; still, at the same time, being very simple they are generally employed in the place of more complicated forms of apparatus. In these tint actinometers a piece of sensitive paper is gradually unwound by clockwork, and during its passage in the darkened apparatus it passes under an open slit, so that from sunrise to sunset a record is made, the paper being more or less tinted. It is a very well-known fact that the actinic power of light varies marvellously during the day. I remember some time ago, when engaged in photographic experiments, a day that was exceedingly bright, in which it was almost absolutely impossible to get a single print, and I remember drawing the attention of some other photographers to it, and they too had noticed exactly the same thing.

The chemical actinity of light, however, plays a very important part in the economy of nature. Every plant is an actinometer, if we only knew how to read its indications. I think there is very little doubt that the actinic rays are the truly active agents in the production of the green colouring-matter, the chlorophyll of the plant. You know, too, how some forms of acacia close their leaflets on the decline of light, and again re-open them in the morning. They will not do that under the influence of yellow glass. You know how many flowers will open their petals as light comes on, and close them at its departure. There is very little doubt that that is due to actinism. Experiment proves that even the power of the leaves in retaining the carbon for the tissue of the plant and giving us back the oxygen, is in a great measure due to these peculiar rays that we regard as essentially chemical. Thus, you see in nature every plant serves a purpose of an actinometer.

Just excuse a momentary digression. When I sat down to put these lectures together I made up my mind not to make them too scientific. I considered that very likely I should meet a kind of double audience—one part coming, perhaps, to catch a few stray ideas and listen to a few scientific details, and one part coming to be amused and to have their eye pleased during the hour the lecturer had at his disposal. I must ask the one class to bear with me when I enter a little into scientific details, and I must ask the other class to pardon the introduction of experiments with which they are quite as familiar, if not more so, than I am myself. In this way I hope to satisfy both parties.

I want just to show you, before going any further, the peculiar action of these rays at the violet end of the spectrum. To do this, I will take a plate which has been sensitised, and I will expose one-half of it in the red end of the spectrum. Then I will expose the other end in the violet end. I will place upon one side of this plate a small piece of paper, in order that you may know which part belongs to the violet and which belong to the red. Now we will throw our spectrum once more on the screen, and, taking the plate which I have here prepared, I expose it to the violet end of the spectrum for ten seconds. You will notice this end has a little piece of paper on it. Now I will put the other end into the red end of the spectrum, and then I will develop the plate and throw an image of it on the screen by means of the oxy-hydrogen light, and I think you will at once see the difference between those two sides of the plate. Of course, the light is a little spread just in the centre, but you see by the piece of paper which was exposed in the violet end, how the light has acted, whilst that part in the red end has not acted at all. Thus, you see at the violet end of the spectrum we get a very positive action, which we entirely fail to obtain in the red end. It is these rays which are concerned in photography.

Now let me explain to you that the electric light is loaded with these rays. I will bring the poles again in contact, and show you some peculiarities of these rays before we go any further. I will do so by bringing in the path of these rays some petroleum which I have in a bottle, and you will see a marvellously beautiful fluorescent effect due to this peculiar set of rays. The same is true of a solution of quinine, which I dare say some of you have noticed, and in both cases the effect is very much enhanced by holding in front of the light a piece of violet glass. Here, again, I have a piece of uranium glass. There is nothing very wonderful in the glass itself, but directly I hold it in these peculiar rays which are coming from the electric light, a very beautiful effect is produced. Now I want to draw your attention to one other circumstance, which is very interesting in some ways, because I have one of the very earliest specimens in illustration of this experiment. I have here a set of tubes, which are well known now as Becquerel's tubes, containing bodies that will seize these rays, and give them out at their leisure. If I hold these tubes, containing powders of various kinds, in the electric light, we are enabled to get a certain number of these rays bottled up, these powders giving out these rays at their leisure. This instrument which I am now using, and which you see shines quite plainly in the dark, I have used some hundreds of times, and still the tubes retain their power of shining in the dark. This effect sometimes lasts as long as twenty-eight minutes when using the electric light; and if you hold them in the path of the magnesium light they will continue to shine for something like seventeen minutes, so that I do not consider the magnesium light has anything like the number of actinic rays that the electric-light possesses.

I have already stated that the salts of silver were the first that attracted the attention of philosophers to the action of light upon them. I told you, moreover, that white leather was the first thing that was employed for the purposes of obtaining any discolouration. I have here a piece of common white leather, and I will take a small quantity of a solution of nitrate of silver, and with a piece of cotton wool I will write a word on the white leather. Now I will hold this in the magnesium light first of all, and if this does not answer we will try it with the electric light. You see, the magnesium light very soon darkens it, and a few seconds more will increase the effect. I believe this was the first experiment made to show the action of light upon the salts of silver. After this, chloride of silver was precipitated upon flat plates, and dried in the dark, these plates being kept in readiness to receive the picture by the interposition of a negative image. Neither Wedgwood nor Davy, however, could fix the impression, and the experiments, I believe, were abandoned. In 1814—for I do not think much was done until that year—Joseph Nicephore Niepce experimented upon the action of light upon bitumen. He was afterwards joined by Daguerre, and they together brought out the process which is known by the name of "Daguerreotyping," in July, 1839. These experimenters were the first, I believe, who produced images by the use of the camera-obscura. A great many people had tried experiments with this instrument previously, but had failed. The camera-obscura, you know, is merely a darkened box with a small pin-hole aperture to admit a pencil of rays reflected from an object. I have it illustrated in this diagram. Here is a flame—here is the aperture in the box. You get an image of the flame placed at a distance from the box upon the screen, but the image is inverted. I can show you the same experiment here. I have a candle placed in this box, in front of which is a large piece of cardboard with a pin-hole aperture, and I have no doubt you will see upon this piece of ground glass in front a fairly good image of the candle—an inverted image. Now let us see what science has done to improve this imperfect instrument, and to render it useful. The hole is enlarged, and in front of it a convex lens is placed, the object being beyond the principal focus of the lens. The lens, as I have already explained to you, guides and directs rays. The camera-obscura, modified by reflectors, is the old instrument of our schoolboy-days for tracing objects. The mirror camera, an instrument similar to the reflecting telescope, of Herschell, was patented in England by Beard for daguerreotyping. I will now introduce the lens into this darkened box, and you see we get a very much brighter image of the flame than we had previously. This was the next great improvement. All these, however, were still very imperfect optical contrivances, compared to the combinations of achromatic lenses devised and carried to a practical issue by Petzval, Voigtlander, Ross, Dalmeyer, Lerebour, Grubb, and others, who by their services rendered photographing other than still life possible.

I do not intend to trouble you with the subject of achromatism further than to say that a system of lenses constructed for photographic purposes should have the chemical or actinic rays as nearly as possible coincident with the visual rays, because when we focus an image, we focus it by means of the visual rays, but when we take a picture of it, it is the actinic rays which paint it on the plate. The camera which I have here is a fair representation of a good modern camera. In consideration of an annuity granted by the French government to Daguerre and Niepce, the process called daguerreotype was thrown open to the world, and at the present day photography is a branch of science that has been less fettered by restrictive patents in England than any other, while of all countries in the world England takes the foremost rank for discoveries therein.

The process of daguerreotyping consisted in exposing a plate of polished silver, or a silver plated surface, such as I have here, to the vapour of iodine until it acquired a film of a uniform orange tint. Here, for instance, I have a little iodine in a beaker, which I will just warm over the candle; I will place over it this silver plate, when in the course of a minute, at any rate, we shall get a film of iodine produced upon the polished silver. The plate, after having been submitted to the action of iodine, was then exposed to the action of light in the camera, and subsequently to the vapour of mercury, and the image was developed by the deposition of that metal on the reduced or altered iodide of silver. It was now treated with a solution of hyposulphite of soda, the property of its being able to dissolve the unaltered haloid salts of silver having been recently discovered by Sir John Herschell. I should like, before I go on, for it is a very important part of the story, to show you this power of hyposulphite of soda to dissolve chloride of silver. It was in 1839 that our own countryman, Fox Talbot, first published his process of photogenic drawing, but I believe he had been experimenting from the year 1834, and had published several papers between the years 1834 and 1839. Subsequently the Calotype or Talbotype, a development process on paper, by which it became possible to obtain in the camera a negative transcript of nature in a few seconds, was introduced. It was from this point the art-science rapidly advanced in usefulness, owing to the facility with which copies could be obtained from the negative image, and I will just say this by the way, that although hyposulphite of soda was used for fixing at this time, previously I believe, bromide of potassium was somewhat largely used.

The next process we have to speak of is the one that has superseded all others, known as the collodion process on glass, devised by Scott Archer and Dr. Diamond. By the action of a mixture of nitric and sulphuric acids on cullulin (cotton wool), Schönbein in 1855 showed how a remarkable change was produced on the material, one, two, or three equivalents of the hydrogen being exchanged for one, two, or three of the peroxide of nitrogen. He explained its explosive character. This immediately attracted the attention of the War Department of the government to it as a destructive agent. Strangely quickly was this new discovery seized upon. But, alas, our war-loving spirits saw in one of the pearls discovered in the very babyhood of organic chemical research an agent that has been painfully destructive in a way not anticipated. I will not trouble you with details of how the authorities were too precipitate or how many human lives at home and abroad have been sacrificed in the attempt to manufacture this newly-discovered compound for war purposes. But gun-cotton was destined first of all to play its part in the alleviation of suffering rather than its production, as my own profession in the wards of many a hospital testifies; and, before Mars entirely claimed it, it was to be the medium for the transmission of living images. In the production of collodion for manufacturing purposes, the best form is that which is least highly nitrated—that one in which one atom only of the hydrogen has been exchanged for one of the peroxide of nitrogen. Here I have a very good sample of photographic gun-cotton. I might just show you the difference between gun-cotton and ordinary cotton. I should tell you that this gun-cotton is nothing like so explosive as that in which a larger amount of the peroxide of nitrogen is substituted for the hydrogen. Here is a piece of gun-cotton, and here is a piece of ordinary cotton. On touching the ordinary cotton with a light, you see it takes a long time to burn, but if I touch this gun-cotton it goes off at once. Again, I have here a mixture of alcohol and ether, about two of ether to one of alcohol. I will divide this into two portions, and in one I will place a piece of ordinary cotton, and in the other a small piece of gun-cotton, using about the same quantity in each case. What I want you to notice is, that whereas in the one case, with the common cotton wool, we shall get little or no action, in the other case the gun-cotton will dissolve. On shaking up the gun-cotton, in the course of a minute it entirely disappears, the gun-cotton being soluble in a mixture of alcohol and ether; while in the case of ordinary cotton we fail to get a single particle dissolved. Now let us go on a little further. I want you to understand that this solution of gun-cotton in alcohol and ether is what we know as collodion, so called from the gluey character which it possesses. I add to this mixture of gun-cotton, ether, and alcohol, the merest trace of iodide of ammonium, and now I will pour a small quantity of this collodion that I have thus treated upon this glass plate. I will next place it in this bath of nitrate of silver, when a change will take place, the iodine of the iodide of ammonia going to the silver, and producing a film of iodide of silver upon the plate. Now, after removing this from the bath, I am about to expose one part of this plate to the action of the electric light, and then I shall place in front of our lime-light a small quantity of a weak solution of sulphate of iron in a small trough. At the back of it, between the light and the developing solution, I place a large piece of red glass, which will stop out the actinic rays of our lime-light. I dare say you will be able to see at once where the light has acted and where it has not. Before I applied that solution of sulphate of iron, the image was latent, and would have been entirely removed by the action of hyposulphite of soda. This was a sad barrier to surmount, no previously-recorded facts of a like nature existing to suggest the employment of another compound to fix that action of light without affecting the unimpressed material. We owe, I think, a great debt to Fox Talbot, Read, and Daguerre, inasmuch as they bridged the gulf.

Now I am about to try another form of experiment, using in this case a very carefully-prepared collodion, and I want to follow out an experiment from beginning to end, by endeavouring, if possible, to take a photograph of the Queen. I have here a very beautiful print of the Queen, done for George Peabody, which has been kindly lent me by Mr. Dickenson. I first of all throw on the print a beam from our electric light. I then take a very well-prepared collodion plate, and having focussed her Majesty in the camera, we will endeavour to get a picture of her, and then we will see if we can develop it in our trough, and thus try if we can get an image upon the screen. I will then take it out of the trough, act upon it with hyposulphite of soda, and throw it on the screen with the lime-light lantern. In this way I think you will see the process as well as it possibly can be shown. Everything being prepared, and the picture being focussed, the plate is placed in the camera, and now we will allow the electric light to play upon the picture. Having exposed the plate for a few seconds, we will place it in our iron developer in the lantern. I place the non-actinic glass between the light and the solution. We must not allow this process to go on too far, although we use but a very weak developer. Now we will fix it and throw it again upon the screen. Of course, being done in this hurried manner, it is not very perfect, and being a negative, of course Her Majesty's face will be black. Still, I think you see pretty clearly the process of photography. I need not enter further upon the question of printing upon paper, having obtained a picture of that nature. It rather involves chemical than optical principles. Here, for instance, I have placed on a piece of ordinary albuminized paper a piece of lace. I submit that to the action of light; again the iodide of silver becomes altered in the places that are exposed to the light, and, as you can understand, we get a complete picture of the lace. Further than that I need not go, because entering on the question of the influence of gold and such like salts would be going more into chemical questions than optics, with which we are concerned. I should like, however, to draw your attention to some magnificent photographs which I have here. For instance, this magnificent landscape picture of Mr. Earl's is probably one of the finest ever done.

I have already alluded to the employment of bitumen by Niepce, and this leads me to speak of the action of light on other materials than the salts of silver for the production of photographs. The chromium salts, in combination with organic matter, are the most important of these. In 1838 Mungo Ponton showed that a solution of bichromate of potash and sulphate of indigo on paper was rendered insoluble by exposure to light, therefore an object having degrees of light and shadow, placed in contact with such a surface and exposed to light, rendered a negative transcript on washing away the unaltered salts. I had intended to have tried some experiments with bichromate, but time is going too rapidly. Here we have a piece of paper covered with bichromate and a little gelatine (organic matter of any kind will do), and a piece of lace has been placed over it. You see the alteration of these salts under the action of light. Following up this idea, Becquerel made numerous researches on the combinations of the bichromates with organic matter. Poitevin extended these researches, and succeeded in obtaining transfers for the lithographic press. If the piece of paper exposed just now were damped, the gelatine in admixture with the bichromate would imbibe water on those parts unacted upon by light. It is very curious that light has no action on this mixture of bichromate and gelatine when wet, hence it is necessary for the film to be dry, and, even stranger still, those parts of the film on which the light has impinged are no longer capable of taking up water, and inasmuch as lithographic ink will stick to a dry surface, or at any rate a surface nearly so, such parts would take up the transfer ink from an inked stone or roller. Here you see I am doing this. We are dabbing this with lithographic ink. This is a piece which was exposed this morning to the action of light, and here you see the parts that are acted upon by the light taking the ink most beautifully. Thus we get a picture in black or coloured ink on the gelatine, and if this were laid on a plain grained lithographic stone, a transfer might be obtained for printing.

Poitevin also mixed pigments with the bichromate and gelatine, and found that the light acted on these black and other coloured surfaces, rendering the gelatine insoluble where the light had been permitted to pass through the negative, or other object partly intercepting the light. When this already uniformly coloured surface was placed in water, the parts unacted upon were washed away, leaving the impressed parts as a coloured image. For simple line subjects Poitevin's process gave highly satisfactory results, but in the gradation of light and shade, as given by photographs from nature, the process failed owing to the half-tones being but very imperfectly rendered. The reason of this was that the gelatine mixture next the support was still in a soluble condition, not having received any light through the dark coloured pigment, and therefore the material would be fixed only in those parts in which the light had been able to penetrate the entire depth of the gelatine and bichromate layer. The Abbé de Laborde appears to have been the first to point out the cause of the loss of half-tones in Poitevin's process, but it remained for an Englishman to discover the true remedy. Blair, of Perth, proposed to allow the light to act from behind the support. This was the secret. The slightest action of light now became fixed, and as it penetrated, so in proportion did the bichromate fix more pigment, giving greater and increased depth and vigour to the picture. The theory was now plain, and practical improvement followed. Fargier acted upon bichromate, colouring matter and gelatine, in the original manner, but after doing this he coated the surface with a strong film of collodion. He then floated the whole in water until the film floated off the support. In this way he changed the support from glass to collodion, the advantage of which was that he avoided the blurring effect produced by the light passing through the support. The great objection, however, was that the film being so slender it was next to impossible to produce large pictures. Again an Englishman, Swan, came to the rescue. He formed a layer of gelatine and colouring matter only, applying the bichromates afterwards by floating it on a bichromate solution. After drying and exposing under the negative, it was cemented to a support of paper with indiarubber solution. In this way the picture was enclosed between two supports, through one of which water could permeate, and eventually be removed. Other improvements by J. R. Johnson have rendered the pigment process what you see in the beautiful specimens kindly lent me by the Autotype Company. I have prints on the table produced in the lithographic-press from films of gelatine containing resinous matters supported on very thick glass plates. These specimens show the great perfection to which this method has been brought by J. R. Sawyer, of the Autotype Company. Other pictures by the Heliotype process, printed from films of gelatine, by direct pressure in a common printer's letterpress, are before you, but, as the surface is similar to a lithographic one, you cannot use common type at the same time with these, which is a great disadvantage. I have also some examples of the Dallastype process. Here are some beautiful specimens of microscopic objects, some curious reproductions, tables of figures, a page of the *Times*, marvellously distinct, reduced to $3\frac{1}{2}$ and 5 inches. These are all printed from blocks, a specimen of which you see here. They can be printed at the same time as the ordinary standing type.

The uses of photography are numberless. A summary of them would be the work of an evening.

Medicine has profited by it. Now-a-days we photograph our cases of interest, and this brings them back to us, when similar cases occur, with a far greater accuracy than could be done by any painter's brush. We have, again, some astronomical photographs; those worlds that are far distant to us, even they yield to our sensitive film. Here, for instance, are the spots in the sun beautifully photographed, showing even the actual structure of the sun; and here are some of the moon. I would also direct your attention to Rutherford's large photographs of the moon on the wall, which are really most marvellous specimens of this kind of work.

Here, again, we have a microscopic photograph, which illustrates how rays from even the minutest objects can be reproduced with marvellous beauty. Here, for instance, is one showing numberless forms of infusorial insects. The lens collects all the rays, even from these minute objects, and presents them to us in the wonderful manner you see there. Thus you see our light rays—distance being no object at all—are our picture carriers. The lens collects and arranges the rays as they come under its refractive influence. Then chemistry steps in, and, "like a giant refreshed with wine," we obtain at its bidding fairy-like scenes with a more permanent existence than even nature gives them.

Works of art, curiosities of nature, fossils telling of ages long gone by, monuments of art raised by human industry, the industry of men decayed and forgotten, the living forms of existing races, from the aborigines whom no mission voice has reached, to the great and mighty crowd of the civilised world, monarchs on their thrones, the poor in their cottages, old and young—all these forms the lens has gathered up with mathematical accuracy, dividing off the rays it required from those surrounding them which it did not, that the picture may be handed over to the chemist, for him to render that permanent which as yet one ray of light would dissipate.

It would be curious to know how many in this room have dabbled in photography; some, I know (for probably most of us have made attempts), have done far more than dabble. I beg to appeal to them to bear me out in what I say, that photography has proved a great educator of the people; the world has grown wiser under its influence; and let me say, if it is still further to be developed (and who could suppose otherwise), that development can only result from pursuing it in a strictly scientific spirit, and with strictly scientific accuracy.

Lastly, it is only right that I should acknowledge how much I am indebted from first to last in this lecture to the kind and courteous assistance of my able friend Mr. Hart.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

The following special note on the Fine Arts Division has been issued:—

1. The attention of artists and manufacturers is especially called to Division I. of the subjects chosen for the series of Annual International Exhibitions. Hitherto the exhibition of works of fine art has been too much limited to the display of pictures and sculpture, dissociated from purposes of utility; and it may be doubted whether a picture on enamel or on pottery, destined to be applied to a piece of furniture, or a sculpture in wood intended for a picture-frame, however great its merits, would find any place in the exhibitions of the Royal Academy of London, or in any of the numerous other exhibitions of the works of artists. Still less would a Cashmere shawl or a Persian carpet, the chief excellence of which depended upon its combination of colours, find in any of these exhibitions its proper place.

2. Such a complete separation of artistic work from objects of utility may indeed be said to be only the characteristic of modern times; for in the ancient and mediæval periods the highest art is to be found in alliance with the meanest materials of manufacture. The Etruscans painted on vases of clay subjects which still charm us by their beauty of composition and skilful drawing; and the finest works of Raffaelle were designed as decorations for hangings to be made of wool.

3. It is intended that these exhibitions shall furnish the opportunity of stimulating the revival of the application of the artist's talents to give beauty and refinement to every description of object of utility, whether domestic or monumental.

4. In the annual exhibitions every work in which fine art is a dominant feature will find proper provision made for its display. Painting, on whatever surface, or in any method—sculpture in every description of material—engravings of all kinds—architectural design as a fine art—every description of textile fabric of which fine art is a characteristic feature—in short, every work, whether of utility or pleasure, which is entitled to be considered a work of excellence from the artistic point of view, may be displayed in the exhibitions under the division of fine art. Whilst the manufactures which fall within Division II. will have been brought under review in a series of ten years, the fine art division will recur annually, so that the greatest possible encouragement may be given to progress in the application of art to objects of utility.

5. Every artist workman, moreover, will be able to exhibit a work of merit as his own production, and every manufacturer may distinguish himself as a patron of art by his alliance with the artistic talent of the country. In the fine art section the artist may exhibit a vase for its beauty of painting, or form, or artistic invention; whilst a similar vase may appear in its appropriate place among the manufactures of the appointed year, on account of its cheapness or the novelty of its material.

A memorandum has been sent round to members of the committee for Cooking, with a request for suggestions on the treatment of the following articles:—1. Toast making. 2. Muffins. 3. Chesnut roasting and preparation. 4. Potatoes — Boiling, mashing, chips, puddings, steaming. 5. Eggs — Omelettes, etc. 6. Sauces (?)—Melted butter, bread, oyster, apple, currant, onion, egg, etc. 7. Soups (?)—Beef tea, broths of mutton, chicken, barley, etc. 8. Fish. 9. Meat—Baking and roasting before fires and by gas, etc.; hashes of cold mutton, beef, rabbit, and chicken. 10. Preserved meat—Australian meats. 11. Salads. 12. Kitchen confectionery—Fried puddings, pancakes, fritters, college dumplings; baked puddings of bread, plum, bread and butter, sago, rice, tapioca, millet, batter; boiled puddings of bread, and custard. 13. Pastry—Pie crust, puff paste, short crust, common pie crust for meat. 14. Rice, how to use it—Boiled as in dumplings, pudding; loose, for curry. 11. Baking—of bread, cakes, etc. 16. Vegetables. 17. Uses of dripping—For puddings (baked or boiled), pie crusts, cakes, apple dumplings (baked or boiled); how to clarify dripping or waste fat for frying. 18. Uses of suet in puddings—Boiled suet, suet crusted apple pudding, jam pudding, treacle pudding, lemon pudding, sultana raisin pudding, plain raisin pudding, currant dumplings.

It has been suggested to Her Majesty's Commissioners that in the class of Surgical Instruments and Appliances of this year's exhibition at South Kensington, there might be included representative collections of ancient instruments, or of those used by celebrated surgeons in different ages. For example, steps have already been taken to obtain, through A. Castellani, of Rome, reproductions of the well-known surgical instruments discovered at Pompeii, and now exhibited in the Museum of Naples. It is hoped that the implements used by the old English surgeons will also be well represented. Mr. Charles Hawkins has promised to send those used for lithotrity by Sir Benjamin Brodie. Mr. T. Wormald has offered those which belonged to Mr. Abernethy. Mr. Liston's will also be shown, and it is believed that there exist, in many museums and private collections, curious and ancient surgical instruments which would show the progress of the art of surgery, and form a most interesting and instructive series, if collected together next April for public exhibition and professional study. The possessors of any such specimens can obtain all necessary particulars as to the cases, &c., provided to exhibitors, on application to the Secretary of the Royal Commission, Gore-lodge, S.W.

The 2nd meeting of the Committee on Steel as applied to railway purposes took place January 7th, at the offices, Gore-lodge, South Kensington. Mr. John Ramsbottom was voted into the chair, and among those present were Mr. W. Adams, of the North London Railway, Mr. W. G. Beattie, of the South Western Railway, Lieutenant-Colonel Hutchinson, of the Railway Department, Board of Trade, Lieutenant-Colonel Rich, of the Railway Department, Board of Trade, and Mr. F. W. Webb, of the London and North Western Railway. Major-General Scott, C.B., secretary to the Royal Commmissioners, attended the meeting. Among the applications reported to the meeting was one to exhibit a complete series of steel goods for railway purposes, as made by Mr. Webb, in the London and North Western Railway locomotive works at Crewe, consisting of locomotive boiler complete, with fire-box, and tubes and samples of the ores, fluxes, and fuels employed in their manufacture. The Directors of the Great Southern and Western Railway, Ireland, will also exhibit cast steel crank-axles, springs, &c., as used by their engineer, Mr. McDonnell, and a very complete illustration of this important application of steel will be represented by the chief railway companies in the kingdom.

EXHIBITIONS.

VIENNA UNIVERSAL EXHIBITION OF 1873.

Notices to British Exhibitors.

Protection of Industrial Designs and Inventions.

A special law for the protection of objects exhibited at the Universal Exhibition in Vienna, in 1873, sanctioned by his Imperial and Royal Apostolic Majesty, and dated 13th November, 1872, has been promulgated and published in the official *Wiener Zeitung* of the 28th November, 1872, No. 273, and in the *Imperial Law Gazette* of the same date, LVIII., No. 159. Her Majesty's Commissioners have caused the following translation of the law to be prepared for the information of exhibitors in the British section.

By order,
P. Cunliffe Owen, Secretary.
41, Parliament-street, London, December, 1872.

With the concurrence of the two houses of the Reichsrath I hereby decree as follows:—

Art. 1. Every Austrian and every foreigner who exhibits any object or objects in the Universal Exhibition of 1873 at Vienna, which may be suitable, according to the provisions of the law of August 15, 1852 (*Imperial Law Gazette*, No. 184), and the two laws of December 7, 1858 (*Imperial Law Gazette*, Nos. 230 and 237), to be granted a patent or protection as to security of trademark or design, can obtain for the same from the Director General of the Universal Exhibition a "certificate of protection" (*schutz-certificat*). An application to that effect must be addressed to the Director-General at a date previous to the opening of the Exhibition, or before the installation in the Exhibition of the object or objects after that date, and be accompanied by an exact description of the same, and (so far as is required for explanation) by double copies of plans or drawings, or two specimens of the trade-mark, design, or model, as the case may be, enclosed in two separate cases or envelopes. If the application be made through an agent or other authorised person, the letter of authorisation must be added likewise.

Art. 2. The "certificate of protection" will be issued free of expense, by the Director-General of the Universal Exhibition, and be countersigned by an official appointed for that purpose by the Hungarian ministry, and will secure to the applicant, from the date stated therein, of the admission of the respective objects into the Exhibition —or if the application should have been made after that date, from the day of making the application—until the 31st December inclusive, the same rights and privileges which a patent obtained in the regular course, or a duly obtained registration for the protection of a trade mark, design, or model would grant him. The exhibitor is reserved the right to apply to the appointed authorities, before the day of expiration of the "certificate of protection" for a patent, or the protection of a trade mark or design, for the same object or objects, according to the provisions of the laws mentioned in Article 1.

Art. 3. No appeal or complaint will be admitted against the decision of the Director-General respecting the granting or refusal of such "certificate of protection." In case the validity of any of the "certificates of protection" should be disputed, the competent authorities will have to decide the question according to the existing laws of protection.

Art. 4. A double register will be kept by the Director-General of the Universal Exhibition of the applications for "certificates of protection" and of the certificates issued, of which, after the close of the Exhibition, one with the aforesaid applications and a copy of the descriptions attached to them, as also of the trade marks, designs, and models, will be lodged with the Imperial and Royal Ministry of Commerce; and the other, with copies of the application and other appendices, with the Royal Hungarian Ministry for Agriculture, Industry, and Commerce.

Art. 5. The "certificates of protection" issued will be published in the Austrian and Hungarian *Official Gazettes*. The inspection of the register of "certificates of protection" is open to every one, but the descriptions, plans, models, &c., will be kept secret, if it be so desired in the application.

Art. 6. The Minister of Commerce is charged with the execution of this law. (Signed),

Franz Joseph, M.P.
(Countersigned) Auersperg, M.P.
Banhans, M.P.
Gödölö, 13th November, 1872.

Custom-house Regulations.

The following rescript of the Imperial and Royal Austrian Ministry of Finance, with regard to the Custom-house regulations to be observed in respect of goods sent from foreign countries to the Vienna Universal Exhibition, 1873, dated August 9, 1872, and published in the *Imperial Law Gazette*, XLV., No. 127, has been communicated by his Excellency Baron Von Schwarz-Senborn. Her Majesty's Commissioners have caused the following translation of the rescript to be prepared for the information of exhibitors in the British section.

By order, P. Cunliffe Owen.

1. The frontier Custom-house offices are instructed to direct (without opening the packing-cases and parcels) all Exhibition goods which arrive, accompanied by due certificates of admission from the respective foreign exhibitions commissions, to the chief custom-house office stationed in the Exhibition grounds. A list, with details of contents of packing-cases and parcels, must accompany every consignment forwarded by each exhibitor, which list will be attached to the permit for the goods.

2. The chief Exhibition Custom-house office examines and removes the seals of each consignment, and books all the lists specifying the goods arriving with the permits, and delivers the goods to the respective foreign commissions, whose duty it is to keep an exact account of the goods handed over to them, and to submit the same when required to the Custom-house authorities for inspection.

3. The list of details of contents which is to accompany each packing case and parcel need not contain a description of the goods such as is required by the customs tariff; it will be sufficient that the goods are specified according to their commercial denomination, as to kind and quantity. It will be the duty of the chief Custom-house office to amend the lists of details by the addition of the exact tariff classification to which the goods belong, and to complete the entries in the register in accordance therewith.

4. No goods are allowed to leave the Exhibition and its precincts without a proper permit. Such permits will be issued by the commission of the country whence the goods have been sent, and must have attached to them, in order to be valid, the seal of the chief Custom-house office in proof of having been officially dealt with; the permits for foreign goods will be distinguished by their different colour from those for inland goods.

5. Goods which are being sent back to the foreign countries must be directed by the chief Custom-house office to the respective frontier custom houses, and accompanied by a permit.

6. For goods which remain in Austria or Hungary, and within the excise district of Vienna, import duty and consumption excise duty must be paid respectively, according to the charges made by the chief Custom-house authorities after examination of the goods.

7. The Exhibition goods and owners of the same are held answerable, in the first instance, for the custom and excise duties; and, next, this responsibility devolves upon the respective foreign commissions. This responsibility is transferred to the forwarding agents when they take charge of the goods.

8. Unexplained discrepancies between the actual contents of the packages and parcels as to the quantity and kind of the goods and the list of details; as well as the unauthorised removal of goods from the Exhibition buildings and grounds, and also the unauthorised sale or disposal of goods in the Exhibition buildings and grounds, will be dealt with according to law.

9. Tobacco and goods manufactured of tobacco are not permitted to be sold in the Exhibition buildings, nor are they allowed to be brought away for such a purpose from the Exhibition.

10. Foreign Exhibition objects which have not been presented to the chief Custom-house office for the purpose of obtaining the necessary permit for their exportation within three months after the close of the Exhibition, will be liable to the payment of import duty, and, if they are subject to the consumption excise duty, to the payment of that also.

(Signed) LASSER, M.P.

THE DUBLIN EXHIBITION AND IRISH INDUSTRIES AND MANUFACTURES.

The reports and lists of awards of the juries of the Dublin Exhibition of 1872 enables a comparative estimate to be formed of the statistics and progress in some of the leading industries since the last International Exhibition held in 1865. The recent exhibition did not assume to be international, and, with the exception of some few British exhibits, was almost purely national. Indeed, the endeavour was made to give preference to the admission of such objects as were especially identified with Ireland, and calculated, by their being placed in comparison with other productions, to stimulate and develope those branches of manufacturing industry in the country which are most capable of advancement. The National Portrait Gallery contained upwards of 400 portraits of the most celebrated and distinguished individuals connected with the public transactions of Ireland during a period extending over three centuries.

Although barely five months were occupied in the preparation for this exhibition—which originated in individual enterprise—in spite of its opening very late in the season, and having also to contend against an epidemic in Dublin, unprecedently wet weather and other disadvantages, yet it must be considered on the whole as a great success. The juries awarded 206 medals, and 93 certificates of merit. From the reports of the juries some striking facts are brought out on the condition and progress of some of the leading Irish manufactures.

Some of the natural products shown were of the highest order of merit, comparing most favourably with samples of like articles contributed to former exhibitions. The preserved meats, essences, soups, and extracts shown were remarkably good. The jurors found the meats tender, well flavoured, and from their mode of preparation their nutritious properties were perfectly retained. Now that home resources prove insufficient to meet the great and rapidly increasing demand for animal food, colonial and foreign preserved meats happily present themselves from many quarters. What is called advanced civilisation in our country tends to diminish the agricultural population, who have long subsisted chiefly on vegetable food, whilst cities and towns, whose people love and desire animal food, rapidly increase in number and size. Such preserved meats may not be so palatable to most people as freshly-dressed home productions; but if sufficient quantities can be suppled at prices reasonably below those of home produce, they will probably meet with a large consumption, especially amongst the middle and artisan classes.

Amongst the most important of the national productions was the magnificent collection of raw and manufactured minerals of the Mining Company of Ireland, embracing coal, culm, lead ores, pig, short and pipe lead (lead alloys which resist the action of soft water), silver cake, patent shot and oxides of lead used as paints and for other purposes. This company not only raise large quantities of coal and ores in various parts of Ireland, but they also import argentiferous lead ores for the purpose of smelting both Irish and foreign ores at their great works, Ballycorus, county of Dublin. An important industry has lately acquired large proportions in Ireland, namely, the manufacture of the cheaper acids, bleaching powder, salt cake, and artificial manures. A very large capital is embarked in this manufacture, which affords employment to several thousand persons. From Dublin large quantities of bleaching powder and salt cake are monthly exported to England, Scotland, and the Continent. The value of the artificial manures made in Ireland last year could not be less than £500,000.

A very fine collection of products from sea-weeds was shown by the Manure Salts Company of Ireland, and several interesting products of sewage, &c., with sea-weed charcoal by Mr. Stanford, of Glasgow. The latter collection was of especial interest now that the solution of the question of sewage utilisation is engaging the attention of many corporations, companies, and private individuals.

The slates shown by the Killaloe Slate Company were of excellent quality, and equal, if they do not excel, the best Welsh slates. The Ventnor Slate Company also showed slates of good quality, and with a very pretty greenish and bluish shade, which would produce a good effect in roofing churches, &c. The specimens of Donegal stone shown attracted much attention. The granite blocks were exhibited just as they were found in the quarries, in slabs, with even, natural surfaces, and almost, if not quite, ready for the builder. The polished red granite is quite equal to that from Aberdeen. The Belfast Portland Cement Company contributed a large number of samples of their production; the articles shown were in every respect excellent. A group of marble pillars or clustered columns of various Irish marbles, with Caen stone basement and cap, carved in natural foliage, and a font in the same style, with various Irish marble shafts, admirably displayed the wealth of the native quarries, and showed the ease with which such materials can be adapted to useful and decorative purposes. The great beauty of the marbles and the high polish and finish they had received, displayed to great advantage the green and black marbles from the quarry near Middleton, in the county of Cork, which is worked by Messrs. Sibthorpe and Son. The latter is little inferior in brilliancy, variety of shade, and contrast of colour and tone to jasper. For this reason it has been technically named Irish jasper. The practical value of Irish marbles, and the high polish they are capable of taking, were further successfully illustrated by specimens of marble pavement and by a portion of the altar railings lately erected in the chapel of Trinity College; this last showed the rare qualities of solidity joined to grace and the appearance of lightness.

It is a curious fact, that although no pottery works of any importance are known to have existed in Ireland prior to the establishment of the works of Messrs. D. McBirney and Co., at Belleek, Dublin was, in the early portion of this century, famous for the admirable decorations, china, and porcelain obtained at a manufactory then established in that city by Donovan. Excellent specimens of porcelain, from different manufactories, decorated in Donovan's establishment, and generally bearing his name and trade-marks, were shown in the loan museum of the exhibition, and such articles obtain a high price in the market. This establishment was closed and its contents dispersed on the death of Mr. Donovan, who, however, realised a large fortune in his life-time. This art (which had apparently ceased to exist in Ireland) has been again introduced into the country, and mainly through the exertions of Mr. Herbert Cooper, it is rapidly improving in excellence and regaining its former local fame. Some of the decorations of the Belleek ware, by the pupils of the Queen's Institute, are admirable works of art, the subjects selected with judgment and executed with taste.

Messrs. Early and Powell, of Dublin, exhibited works of great merit in stained glass windows, equalling mosaic in their effect. The composition is clear and well-calculated for distinctness of effect at a distance—an object of great importance in large cathedrals, where graduated shadows and finely pencilled tinting are somewhat less effective.

In the class of textile fabrics, &c., Irish productions, considering the limited nature of her manufactures, were effectively represented. The number of textile factories in Ireland exceeds 240, of which 154 are employed on flax, 64 on woollen and worsted, and 14 on cotton. Although the number of factories is only about half those in Scotland, yet the spindles employed are about the same, somewhat over 1,000,000, the power-looms employed 19,000, against 33,000 in Scotland, and the operatives 62,000, against 89,000 in North Britain.

Reviewing the comparative merit of Irish skill in the last exhibition and that of 1865, the jury report considerable improvement in the leading branches of manufacture for which the country is remarkable, viz., linens, poplins, and lace goods. In the great staple trade of the north the exhibition was comparatively limited, but the quality and finish of the goods shown were excellent, and fully maintained their established reputation. Of the productions of the Dublin looms, poplins, terrys, and brocatelles, the jury speak most highly, and without attempting to draw any distinction of merit between the several exhibitors. They specially notice the curtain brocatelles of W. Fry and Co., and the terrys of Fry and Fielding, which they consider equal if not superior to anything of the class manufactured in Lyons, the principal centre for that branch of the trade. The various descriptions of laces and other fancy work contributed by convent and other industrial schools compare favourably with the highest class of skilled work of France, Belgium, and Nottingham. In noticing the several descriptions of fine lace sent from the industrial schools of Ireland, attention is drawn by the jurors to Mrs. Palliser's pamphlet, "Notes on the History of Lace." While giving credit to the industry and great research of the talented authoress, they complain of the complete ignorance of facts as manifested in her reference to Ireland. Mrs. Palliser states "That a normal school was opened in Dublin in 1856, and that it contained 24 pupils." Further on she says, "Brussels flowers, Valenciennes, crochet, tatting, Irish point, were all made with great aptitude and precision, but the fabric was not remunerative, and consequently languished." Again she remarks, "With great facility for making it, lace working has little chance of success in Ireland." The jury admit that from about 1848 to 1858 an immense amount of French labour found employment throughout several counties in Ireland in working what are called "served muslins," and that this class of work has languished not only in Ireland, but also in Scotland, where it originated; but this has arisen solely from change of fashion, and not from the effect of high wages or its unsuitability to Irish labour. Had the authoress visited this exhibition, and inspected the numerous contributions of fine laces, she would have found her notes on Ireland to be erroneous and inappropriate. Finally the jurors report that at no time within the period stated by Mrs. Palliser has the Irish lace trade been so remunerative or in so flourishing a condition as at present.

Irish woollens were respectably represented in friezes and tweeds.

The collection of philosophical instruments and inventions of a scientific nature shown, was not extensive or varied. It, however, presented some objects of interest and specimens of excellent workmanship. One of these was the Rev. Mr. Jillit's optical saccharometer, beautifully constructed by Messrs. Spencer and Son, of Dublin. This instrument was not shown for the first time, but experience having proved its practical value, it is deserving of special notice. By passing a beam of polarised light alternately through a saccharine solution of a standard strength, and through the solution to be tested, the strength of the latter can be found with a facility and accuracy not hitherto attainable, the error even of a single observation being less than the 200th of a grain for a cubic inch. The same principle and mechanism are applicable to a wide range, and the instrument may be described as one by which the ratio of the rotatory power of any transparent fluid to that of a standard fluid may be accurately defined.

A model of the highest interest was shown by Mr. Howard Grubb, of Dublin, illustrating the manner in which he and his father, Mr. Thomas Grubb, made their great Melbourne telescope, showing how it is mounted, and displaying its many novel and most valuable adjustments. The Melbourne Newtonian reflector is the largest and most powerful instrument which is at present placed on equatorial mounting. The system of equipoises, so difficult in a machine of such weight and size, the manner in which the huge speculum is relieved from strain in its varying positions, and the ingenious bearings of the axis, which give steadiness to the ponderous fabric without unnecessary friction, and enable the clockwork to move it with smoothness and facility, are all very high examples of mechanical ingenuity.

The manufacture of carriages is a most important branch of industry, and one in which the Irish department has specially excelled. The competition, though limited in numbers from want of space, was of a high character, and the jurors notice with pleasure an improvement in the general style of the Dublin builders.

The collection of jewellery and bog-oak ornaments indicated improved taste and increasing manufacture in Dublin, especially the former. There were also more exhibitors than at the Exhibition of 1865, whose designs and workmanship were wholly Irish. In musical instruments a noticeable feature was the exhibition of two cottage pianos, made in Dublin, by Messrs. Gunn and Sons. It is so many years since any such had been manufactured in the city that the fact is now almost forgotten, and few are aware that this effort is only a revival of what once succeeded, and ought to succeed again. The jurors state these specimens are most encouraging, and taking the combination of tone, appearance, and very moderate price, they seem well fitted to meet a growing demand.

In the class of photography the collection, though not affecting to be completely representative, was full of interest, beauty, and instruction. The frames of Irish views, by Mr. Payne Jennings, might challenge competition with those of any other photographer for beauty, softness, and artistic feeling Good manipulation is now taken for granted. The extension of photography has made it as easily attainable as any mechanical calling. Taste and art must be added if it is now sought to deserve special commendation. Vulgarity is the natural danger of photography—to rise above it is the desideratum by which alone it can become, if not art itself, at least art's useful and fitting assistant and reflection.

Berlin Fishery Exhibition.—Mr. Wilke, Consul-General for Germany, writes to the *Times* to say that the German Fishery Society of Berlin proposes, with the sanction and support of the government and under the immediate patronage of his Imperial Highness the Crown Prince, to hold an exhibition in that city during the ensuing month of March and April, to which the manufacturers and others of all countries who are in any way connected with fishing and fisheries are invited to send specimens of their manufactures, inventions, and improvements. Further particulars may be obtained upon application at the Consulate-General of the German Empire, 5, Blomfield-street, London-wall, E.C.

Melbourne Exhibition.—This exhibition was opened on November 6. It was held in connexion with the London International Exhibition of 1873. New South Wales was represented at the first of the series of Exhibitions in 1871, and Queensland contributed to the second in 1872; but it was considered that the arrangements for the London International Exhibition of 1873 gave Victoria, and the Australian colonies generally, a better opportunity for the display of their wares than either of the two preceding ones. Accordingly the Victorian Government, on the 30th May last, appointed a Commission to carry out the Exhibition. The Commissioners, having obtained a vote of £3,000 from Parliament, at once set to work to make the necessary provision for the exhibition of articles in Melbourne, which should be ready for shipment to London early in December. They were met at the outset with the difficulty of confining the exhibits within the narrow limits prescribed by the London International Commissioners, but as they were desirous of organising an exhibition which should effectively represent the industries, products, and resources of Victoria, they determined that the display should be upon a somewhat larger scale, and it was arranged that other articles should be admitted, some for exhibition in Melbourne only. In the silk and velvet section not very much was shown, as sericulture is yet in a very undeveloped state in the colony. The steel manufactures and cutlery were good, but did not show many specialities. Some of the carriages shown were excellent specimens of workmanship, rivalling in this respect anything likely to appear at South Kensington next spring, and there were many local articles which we may perhaps see in London. The number of the exhibits was not great. The show of agricultural products was good, and evidenced considerable increase in the production of artificial manures. Amongst the articles of food, of course the preserved meats were specially noticeable. The importance to the colony of this branch of industry was acknowledged by the commissioners of the Exhibition, and they relaxed their rules in its favour as to the quantity to be forwarded by any one exhibitor. The result of this concession was that the display of preserved meats was very large, and formed one of the most noticeable features of the exhibition. Nearly all the meat-preserving companies in Victoria were represented, the Melbourne Company, as the oldest and most prosperous, taking the lead. The wines showed great improvement upon former years, and will probably attract notice at the International Exhibition. Many admirable ranges for cooking were shown, but perhaps none likely to attract attention in Europe.

The first Japanese line of railway was inaugurated on Nov. 15th. It connects Yeddo, the capital, with the port of Yokohama; and within a brief period will, it is expected, be supplemented by a complete system of telegraphic communication.

MINISTERIAL INQUIRY INTO THE CONDITION OF MANUFACTURES IN ITALY.

Districts of the Alessandria, Turin, and Cuneo Chambers of Commerce; Provinces of Turin, Novaro, Alessandria, and Cuneo.

At the close of the year 1871, the Commendatore Castagnola, Minister of Agriculture, Industry, and Commerce, instituted a commission to inquire into the condition of the manufactures in the kingdom of Italy, and study the best means for improving and developing them, in accordance with the wants of the times. These requirements are now radically changed by the issues of the late disastrous war between France and Germany, and especially from the fact of the former country having entered into a policy regarding the importation of goods from other States, which renders it essential to modify the customs dues. This may be considered as one of the most important steps taken by the government of late years, and it has been welcomed throughout the kingdom, and facilitated in a wonderful manner by the parties interested, so that there can be only one opinion as to the opportuneness of the happy idea so ably carried out by the gentleman to whom it has been confided.

The Commission of Inquiry, nominated by the Ministry, and presided over by the Commendatore Luzzatti, Secretary-General (Under-Secretary of State) of the Ministry of Agriculture, Industry, and Commerce, with Senator Rossi, well known as manufacturer of cloth at Schio (Vicenza), has already held its meetings in succession in many of the principal cities of Italy, among which are Genoa, Venice, and Milan, and now at Turin, which served for the several provinces of ancient Piedmont.

Seven days were occupied by the meetings of the Commission at Turin, which were held from the 20th to the 27th October last, in the magnificent hall of the Carignan Palace, the President of the Turin Chamber of Commerce taking his seat as one of the members of the Commission.

The readers of the *Journal* will remember that no sooner was the union of the various provinces of Italy effected, than the chambers for the Parliament, which assembled in the ancient Carignan Palace, became too small for the purpose, so that the building had to be enlarged by the addition of another wing, which, in point of architectural beauty, is unrivalled among all the modern edifices in the country. It was not completed when Rome, which Cavour declared to be the only rightful capital of Italy, had already become the seat of government; and it is worthy of remark that the first debates which were held in the hall were those on the promotion of the manufacturing interests of Italy. On the platform were the members of the Commission, while the manufacturers were successively called upon to reply to the questions put to them, for the purpose of enlightening the government upon the subject of modifying and improving the laws regulating their mutual relationship. It was, to a great extent, a technological Parliament; and the information elicited will certainly be fruitful of great results, so that the noble city of Turin may boast of once more having taken part in the deliberations of the central government.

It may be asked how it is that public opinion had been so long dormant, and it is surprising that so many competent men have now come forward for the first time to give their substantial advice upon a thousand details regarding manufacturing interests, which are of inestimable value to direct the government in legislating; and it is to be regretted that the public do not seem to have made that legitimate use of the periodical press, by means of correspondence, which would have unquestionably caused the country to develop far more rapidly and surely, and have aided the Parliament in framing the laws, one by one, as they were made. We earnestly hope that the citizens will learn the important lesson of making use more largely of the power they hold in their hands for doing good, by making use of the newspapers to make known their ideas.

The inquiries of the Commission referred principally to the influence of taxation generally on manufactures, and more especially the import and export dues of the Custom-house, and those levied by the towns, known as municipal or *octroi* rates, received at the gates of all towns having a population above 20,000 inhabitants, and employed for local expenses. Then came the economical condition of workmen; the cost of carriage by railway, and the inconveniences experienced from the way in which goods are carried by railways, and the tariffs they employ. Much other valuable information was also elicited, showing how some branches of manufacture were susceptible of great improvement, while others had small chance of success, notwithstanding all the efforts made in their favour. For several years paper currency has existed, and every ministry, in arriving at power, has promised to return to gold coinage, from which, in point of fact, Italy is further off every year, on account of the yearly deficits; but it has been abundantly proved by the late meeting, that the exchange on gold, which is no less than two shillings in the pound, is in reality the greatest boon to the greater part of the manufacturers in Italy, whatever it may be to the consuming portion of the population, and is equivalent to a protective tax of ten per cent. In this manner it is probable that paper money will be continued for many a long year, or until some quite unforeseen change takes place in the condition of Europe. We may now turn to the results of the investigations into special industries.

Silk.—In the course of the last two years, the wages of workpeople in the ribbon trade have risen about 20 per cent. There are about 300 ribbon looms in Piedmont; but before the treaty of commerce with France, concluded some years ago in order to keep in good favour with the Napoleonic government, that number was double what it is now, so that it would appear that without protection this branch of manufacture cannot compete with St. Etienne, in France, and it was suggested as essential that the present import duty should be increased from 1½ to 5 per cent., and that the duty should be paid according to weight, instead of *ad valorem* as at present. In the united silk-ribbon mills in Turin, the silk is dyed in the building. There are 190 power looms, half of these being looms for common ribbons, and half Jacquard looms, for figured and fancy ribbons: they have also 180 machines for silk and woollen fabrics. Most of the power is furnished by the mill-stream passing through the premises, but an auxiliary engine is erected, which is required in seasons of drought. About 350 women and girls, and 50 men are employed, at wages varying from 1½ to 2½ francs per diem.

The velvet looms in Turin were 50 in number before the treaty of commerce with France, and are now reduced to 25; the workmen have consequently emigrated largely to France, and wages have increased by nearly one-half.

A great deal of discussion took place upon the necessity of a greater subdivision of labour in the manufacture of silk stuffs. Workmen are obliged to be able to make all kinds of goods, according to the demand, as is indeed too frequently the case in Italy with most branches of manufacture. At Como, however, only one class of silk goods is made, viz., plain silk, and this is decidedly preferable, and has been found to work well. A great difficulty is experienced in obtaining good designers and good dyers; so that up to this time a considerable quantity of raw silk is sent to France to be dyed, and then returns to be spun and woven. Solei's celebrated silk manufactory, which was founded in Turin a century ago, has 100 looms, of which two-thirds are for rich damasked stuffs, unrivalled in point of beauty and taste, and too little known out of Italy, where they are much esteemed. This manufacturer has a retail shop in the town for the sale of his products.

Raw silk is now subjected to such a heavy import duty in France that it is next to impossible to compete in that market, but it is sent to England and Germany.

Wool.—The spinning of woollen yarns is carried on in various towns of Piedmont. The late war in France has proved very beneficial to its development, but there are many obstacles to be contended with.

In the manufacture of woollen goods, the treaty of commerce with France was pronounced to be injurious, and the price of carriage in Italy by railway far too high; on the other hand, the paper currency has proved very advantageous, the more so on account of the fluctuations in the price of the gold necessary for payment of purchases abroad on the part of tradesmen. It was also suggested that it was a matter of great moment that mill-streams should be more carefully attended to, so as to give a more constant supply of water, which often fails during the seasons when the Alps do not furnish water. The large woollen mills erected in Turin a year or two ago by Galloppo, of Biella, dispose of 200 horse-power furnished by the mill-stream, and possess 450 looms, of which 300 are still idle from want of proper hands, the population of the city being new to that class of work.

Silk Spinning and Silkworm-rearing.—The price of skilled labour in the spinning mills of Piedmont is 30 per cent. less than in France, and this is highly advantageous to this trade. Some towns levy a hurtful tax on the entrance of fuel; for instance, in Asti, it is 7 francs per ton; this tax it would be desirable to remove, as the price of fuel is high in itself at all times. It was considered advisable to increase the production of Asiatic silkworms, as these furnish the best silk for twists; and since so heavy an import duty has been established in France, it might be attempted with advantage to make a market for this article at Genoa, instead of sending it, as hitherto, to Marseilles, often to be exported again.

It was suggested that scientific research into the silkworm disease was too exclusively directed towards the worms themselves, whereas probably the cause of the disease might be attributed to the leaves of the mulberry tree. Silk weavers will not suffer materially by the French tariffs just introduced under the republic, it is rather the silk manufacturers who have to submit to the disastrous consequences of the treaty of commerce; and many of them have been compelled to close their business.

Tanning Leather.—Owing to the improvements introduced in the manufactories in Piedmont, the importation of morocco leather has become very insignificant; but it was considered advisable for the progress of this business to increase the duties on leather, and diminish those on hides, although it may be remarked that skins with the wool on are exempt from all import duty. Bullock hides are largely imported from India and South America into Genoa, while Italian hides may be considered as supplying about half the demand. Since the late war, a considerable exportation of cattle has begun; these are sent to France by the Mont Cenis tunnel, and the price of meat in northern Italy has consequently increased by nearly one-half; but, however heavy, as heightening the price of food, it was not considered as very injurious to the leather manufacturer. It was stated that the railway tariff for leather was far too high, and needed reduction; and with respect to tanning materials it was found impossible to procure them from places beyond Rome. Fifteen hundred workmen are engaged in the manufacture of leather in the neighbourhood of Turin; the price of wages has increased 20 per cent. of late.

Kid and Lamb-skin Gloves.—This manufacture flourishes and a considerable exportation takes place to France and South America; but the constant exportation of animals to the former country is very much felt, and increases the price of the article. Gloves made in Turin and Milan, though more expensive than those made at Naples, are incomparably better.

The Manufacture of Account Books is carried on with success at Turin, and the work turned out is in no respect inferior to that which comes from France; but the slow delivery of the goods by railway proves a great drawback to the extension of this trade.

Printing.—It was objected that the Government had established schools for printing in the military penitentiaries of Savona and Gaeta, and that these interfered very much with private enterprise. Large government contracts were likewise stated to be very objectionable, preventing, as they necessarily do, all competition, the more so as a new stipulation had been made that all the work should be executed in the city of Rome itself, which is by no means necessary or advisable. Railway tariffs by quick trains for printed matter are very high, and the time employed both too great and too irregular.

The well-known and venerable editor Pomba stood up for the rights of his profession, asserting that printing was a liberal art, although it was the custom of the government to look upon it as a mere mechanical one, so that permission to open a printing office was now obtained by application to the police-office, instead of subjecting the candidates, as was once the case, to a vigorous examination of capacity. To the same cause he attributed the introduction of many establishments unworthy of the art they exercise, in which the most demoralizing and pernicious kind of literature is prepared for sale. He also alluded to the fact of his having promoted the formation of a vast central depot for all books printed in Italy, to be erected, provided he succeeded in obtaining sufficient support in Florence, and where booksellers could apply when they want any book whatever, sure to find a few copies at once, without the great trouble and expense of corresponding with each separate publisher, a facilitation peculiarly necessary in a country where there are so many centres for literary and scientific publications, and where books printed in one city are almost unknown in many others, from the want of such a depot.

Lithography.—The lithographic stones come from Bavaria; the stones found at Bassano and near Pavia and other places in Italy are not at all suitable for the purpose. Ink and colours are also procured from Germany. Division of labour is one of the most essential requisites in this art, for the draughtsman who has to do everything is materially injured. Hitherto it has been found necessary to keep fixed hours, whereas in Paris the artistic work is done at the houses of the draughtsmen, each of whom is known for his expertness in certain branches. Lithography was considered as an excellent employment for females, and is likely to be lucrative to them. The artists employed are Swiss, French, and German. Italians are not yet procurable for this work, as they do not think it sufficiently sure of giving them employment. A good school of design for learning the art of lithography was considered as highly essential, and the president took up the idea very favorably, promising to consider it. The lithographic printers are Turinese. Doyen's lithographic establishment, in Turin city, probably the largest in the country, employs 100 workmen, and has 30 hand presses and 5 printing machines, with a steam engine. He turns out all kinds of work except maps, which it appears no private printing office in the country is able to execute decently.

Paper Manufacture.—The price of labour has increased of late about 25 per cent, but the paper currency has proved highly favourable, by permitting makers to compete with other countries. Two requisites were much insisted on, the regulation of the mill streams, and the lowering of railway tariffs on paper.

Furniture.—In this trade is felt greatly the want of artistic instruction among the workmen, which, with the import duty in France, renders the exportation of furniture almost impossible for the present. Unfortunately, the school of design founded by Professor Giusti fell to the ground, but it was proposed to re-establish it, in order that art should be instilled into all objects of common use, down to a simple lock and key or a stirrup. In such a manner alone could Italy hope to maintain her reputation for art, which is now much neglected. The town dues on the introduction of new furniture at the gates varies considerably according to the place; thus in Turin it is 24s. shillings per ton, in Florence 12s., in Rome 40s., in Naples £20! This absolutely prevents manufacturers in other parts of Italy from introducing their goods for sale in so large a city. Martinotti, of Turin, employs 140 workmen, half of whom by piece-work and the rest by time; the men get as much as three francs per diem, and the value of the furniture made is about £6,000. A still larger manufactory, furnished with the most improved machines, exists in Turin, and belongs to Levera, Brothers.

Umbrella Manufacture.—These are now made exclusively of Italian materials; thus, the silk comes from Como, the sticks and iron work from other towns of Italy. The high price of gold has greatly favoured the manufacture in the country.

Pianofortes.—Upwards of 800 pianofortes are yearly manufactured in the city of Turin, which supplies almost the entire Italian markets, besides their being largely exported to South America. These instruments are sold at prices varying between £12 and £60, but not higher; they are generally sold with the names of foreign makers, for which they frequently pass current with the public. The import duties on the materials employed was considered as prejudicial, on account of its high rate, and as thus demanding reduction. Wages have increased 20 per cent. within the last year.

Agricultural Implements and Machinery.—This manufacture is thriving, though exercised but on a small scale, and for certain articles, so that it is quite of second-rate importance. Mechanics accustomed to this particular branch of work are difficult to procure, so that each manufacturer has to train them himself. When division of labour will have become practicable, the makers will profit largely. Great difficulty is experienced in the high price of coals, but this might to some extent be overcome if they were sent by railway from France, the more so as iron ore is abundant throughout Northern Italy. The municipal dues on coke and numerous other materials employed in the manufacture vary so considerably in the different towns, that the heads of factories stand on very unequal footings; and it was considered that a remedy could be easily applied by introducing a law applicable to the entire kingdom, that all towns should levy a fixed duty on certain raw materials employed in manufacture, but especially on fuel, for these are worked up in the towns, but immediately afterwards sent off to all parts of the country, including districts outside the octroi limits.

Philosophical and Scientific Instruments.—A large quantity of nautical instruments, such as quadrants, sextants, ship's compasses, &c., made in Turin, have frequently been sold in Genoa by tradesmen with the name of English manufactures, even to the government, for the use of the royal navy, for that service will only purchase such articles as are made in England. Theodolites with English names on them are likewise manufactured here, such is the value of a name. The forced paper currency has greatly favoured this manufacture. Telegraphic apparatus employed on the Italian railways is entirely purchased abroad, whether at Vienna or in Switzerland, but Allemanno, of Turin, asserted that he was perfectly in a condition to supply this branch of the public service with instruments as good as those obtained from other countries.

Weights and Measures.—The principal manufactory of these articles in Turin, belonging to Decker, employs 100 workmen; but weights and measures are also imported, and these are sometimes employed in the railway stations.

Printing and Lithographic Presses.—The only manufactory of these in the kingdom is in Turin, and the business prospers; for whereas only 50 presses were made annually previous to the war in France, 150 are now turned out, not to mention accessories for printing offices.

Railway-plant, Iron Bridges, Boilers, &c.—It was stated that if the import duties on rolled iron of various forms, such as are employed for these purposes, were reduced, the whole of the plant for railways could easily be made in Italy. The differential tariffs for the carriage of goods for distances exceeding 500 kilometres, or 336 English miles, has proved very beneficial in enabling manufacturers to supply plant for Southern Italy.

Cards for Woollen and Cotton Manufacture.—It appeared that the duties on the raw materials employed, such as leather and iron wire, was double that for cards ready made and imported from abroad, and it was suggested that this anomaly should cease—the more so as iron wire made at Lecco (Como) was not sufficiently good for the purpose, and it was necessary to employ English wire. Leather and its substitutes are also imported into Italy, the peculiar kind used being far better made in other countries.

Earthenware Stoves.—It is customary to use stoves for burning wood made of refractory clay, and these are manufactured on a very extensive scale for Northern Italy, at Castellammonte (Turin), but the patterns are all ancient, and absolutely devoid of taste, so that it was stated to be extremely necessary to establish a school of design for the instruction of the workmen of the little town of Castellammonte, which lives entirely by this art, and where excellent refractory clay is procured. Young men should also be instructed in chemistry, to enable them thoroughly to understand the processes of firing and glazing—this last having been hitherto beyond the reach of the makers—and the proper manipulation of the materials employed.

Brick-making. — Chinaglia's continuous brick-kiln, patented and worked in Turin, combines the various operations of drying and baking, and can be worked with the inferior kinds of fuel to be obtained in the country, lignite, turf, and even artificial fuel, an economy resulting of about 40 per cent. over the common kilns. By extending the use of ornamental bricks for the fronts of houses, instead of the plaster generally employed, this art would be greatly benefited, but hitherto the price of carriage by railway is too high to permit of bricks being conveyed long distances—for instance, beyond Bologna—in spite of the differential tariffs for goods sent upwards of 500 kilometers.

Beet-root Sugar.—Prof. Peyrone, who has lately analysed many samples of beet-roots, spoke rather discouragingly of the prospects of introducing the manufacture of beet-root sugar into Italy, mentioning that an establishment of this kind, commenced many years ago near Naples, and another in the Tuscan provinces, had completely failed, on account of the poor results of the sugar. He was convinced that there was no deficiency of saccharine principles, but he urged that, on account of the abundance of chlorides and nitrates in the soil, a considerable proportion of the sugar was uncrystallisable, and would be only fit for making alcohol.[*] The commission invited Prof. Peyrone to mature well his studies on the subject, the more so as a word from such an authority would go far to shake public opinion, now turned so energetically to the manufacture of sugar in this country, and as numerous companies are starting up on all sides, both for making beet-root and sorgho sugar.

Bones for Manure.—These are exported at present, but when they are more appreciated for the preparation of artificial manures by the extraction of the phosphates, the exportation will be replaced by importation, as has taken place in Germany, owing to the labours of Liebig.

The Government Mechanical Works for the Supply of the Army, in Turin, turns out some £180,000 worth of work yearly, the city having subscribed £8,000 towards the erection of the building, in order to obtain it within its jurisdiction. The director, Colonel Della Cà, considered that it would be highly advantageous to organise similar establishments in each military district, by which about 60 centres of manufacture would be at once created in the kingdom. Regarding the materials employed, the needles for sewing machines are purchased abroad; the varnished leather and sheet iron, the iron wire and varnished pieces of steel for harness all come from other countries.

Trade in Cloth, Woollen, and other Goods.—It was stated that the manufacture of these goods had been greatly facilitated by the extension of mill-streams, and the employment of hydraulic power, and by the forced paper currency. Carriage by railway was declared to be far too expensive, so that a case sent to Salerno, not far beyond Naples, costs more than a similar one sent from Leeds to Turin. The division of labour, and the specialisations of manufactories, were again much insisted on, as essential to the prosperity of this business.

Glass Manufacture.—In the little town of Intra, on the Lago Maggiore (Novara), glass is still made, while most of the other manufactories have been closed, owing to the scarcity of fuel, rather than to the want of skill of the workmen. Common glass vessels are imported from France at very low prices. Window glass of small size is made at Intra; large sheets are imported.

Paper Manufacture.—English, French, Swiss, and German workmen are employed in this manufacture, which would succeed far better were it not for the immense exportation of rags to America, to avoid which it was stated as important to increase the export duty. Great complaints were made against the railways for the way in which they deliver goods. Every kind of paper is made, including that with 25 per cent. of wood. During the last ten years the importation of paper has diminished about one-third.

Iron Manufacture.—It was stated to be advisable to take off the import duty on Swedish iron in the raw state, to enable it to be worked up in Italy. It was also said that steel paid too heavy an import duty, and steel implements too little.

File Making.—The cemented steel employed cannot be obtained sufficiently good in the country, but the import tax weighs too heavily on the makers. Laurenti, of Turin, employs 140 workmen in his file works, and mentioned that, since the late war, this business had greatly increased.

The director of the municipal taxes levied at the gates of Turin alluded to the facilities afforded in this city by the drawback on certain articles sent out of the town again; thus on many food and chemical products the sum allowed as drawback, during something more than two years, amounted to half a million pounds sterling. No tax is levied, as is the case in other towns, on many raw products used in the manufactures, and seconds flour for the labouring classes is now exempt from dues.

Gold Lace and Trimmings.—The gold and silver is made up in France; the yarns are spun in Italy. Trimmings are also largely imported.

Cotton Manufacture.—Some cotton comes from America to Piedmont. Indian raw cotton has found a ready sale, and comes from Bombay to Genoa, *viâ* the Suez Canal, in Italian steamers. Southern Italy also furnishes cotton to the sub-alpine provinces. Half the yarns employed are introduced from England, especially the finer kinds. It is difficult to compete beyond number 40, although the numbers range as high as 80 in some rare cases. It was asserted that 1,100 tons of yarn were spun in the kingdom, valued at £1,500,000. Water is the motive power generally employed, fuel being too expensive for use in most seasons of the year. The spinning machinery is English, and it was universally pronounced to be a folly to manufacture it in Italy, and therefore the import duty demands reduction, to permit spinners to compete with so formidable a rival as Manchester. By paying duty on yarns *ad valorem*, increasing in proportion to the numbers, the manufacturers could compete more easily than now. The paper currency has permitted spinners who had closed their mills, to open them again. A school is much wanted for instruction in weaving. A Manchester workman will do far more work in a cotton mill than a Piedmontese, although he certainly has higher wages. On the other hand, wages have increased 10 per cent. of late. About three-fourths of the cotton goods sold in Italy are of English make. Now that Alsace forms part of the German empire, the manufactory of Anneci and Pont propose to print cotton goods, which was impossible as long as Mulhausen belonged to France, on account of the treaty of commerce with that country.

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[*] This is the opinion of a good chemist, and deserves mature consideration in the choice of the soil; but probably it is too absolute, as many soils are extremely saline, others again are very deficient in nitrates and chlorides. Numerous manufactories of beet-root sugar are springing up. One near Arezzo, beyond Florence, and another near Anagni (Rome), give promising results. The Commendatore Devincenzi has likewise introduced the cultivation, near Teramo, on the Adriatic coast, in his estate, and experimented on the manufacture. Beet-root is being grown in many places as an experiment, and not a few competent persons are very sanguine of success.

Carpets.—Rey's carpet manufactory at Vinovo (Turin), has 40 weaving machines; he makes carpets with foreign patterns modified, but has not succeeded in getting original ones. English carpets compete very seriously with those made in the country. The *ad valorem* duty was advocated, in contradiction to opinions expressed on other occasions, but with heavy penalties in cases of fraud.

Linen and Hemp Goods.—Flax yarns from numbers 0 to 20 are spun in the town of Poirius (Turin); higher numbers are obtained from Belgium, England, and Switzerland. The hempen yarns are exclusively national. The weaving is given out to the workmen at their own houses; they number about 1,200, and employ exclusively hand-looms of antiquated construction.

Carriages.—The springs and axles of the wheels of carriages are procured from England. Carriages are imported from abroad on a very small scale. In the case of carts and common vehicles, everything is made in Turin and in the other manufactories of the country.

Stearine Candles and Soap.—These are made with palm oil in preference to tallow, as it furnishes glycerine and stearine. Half the tallow used in the large manufactory of Langa Brothers, in Turin, is furnished by the country itself; the rest is imported from Russia and America. As there is a great expense to incur for carriage by railway, these goods cannot be sent to Southern Italy, but in the northern provinces they sustain the competition of Belgian and Dutch stearine candles. The glycerine is exported to America. One hundred tons of caustic soda are employed in the same manufactory in the making of soap, of which 300 tons are sold in Piedmont. The number of workmen is 200, and the increase of wages of late 20 per cent.

Woollen Manufacture.—With the establishment of a school for learning the art of dyeing, it was considered possible to compete with other countries in such a town as Biella (Novara), where the manufacture of woollen goods is very extensively carried on, and has increased greatly within the last ten years. It appears, from the observations made, that it was considered impossible to make shoddy goods, which require great skill in working them, whereas a better class of cloth is made with success.

Oils.—In the manufactory of Rossi, in Turin, the machinery employed was purchased in France. It was asserted that Italy could produce oil from seeds, not only for home consumption, but also for exportation, and that it would be very desirable to have a market for oil-seeds at Genoa. Colza oil-cake is now much employed in the neighbourhood of Bologna, where it is sent, but that of sesamum is absolutely unsaleable. If the cost of carriage was less heavy, oil seeds could be brought by the Suez Canal from India.

Lucifer Matches.—The French government having commenced a monopoly of matches, numerous French manufacturers will probably emigrate, and, the supply they formerly sent to America ceasing, Italy will be able to compete in that distant market, so that it may be said that this manufacture is now in the most favourable condition. It would be requisite to put an export duty on bones, on account of the phosphorus they contain. Eight hundred workmen are employed in the manufactory of De Medici, in Turin, and a branch at Piolesi. Matches are now exported by him to Austria, while the movement used formerly to be in the contrary direction.

Dye Extracts.—A manufactory of this new branch of industry has just been opened at Susa (Turin). Hitherto France furnished this article to the spinner.

Carriage by Railway.—After having heard so many complaints and observations against the system of working the railways and the tariffs by goods trains as now in use, the commission invited Commander Amilhau, director of the North Italy Railway Company, to explain his views regarding the anomalies asserted to exist, hoping that if they were well founded it might lead to the removal of the inconveniences, and facilitate the introduction of modifications advantageous to the country at large. It may be mentioned that the North Italy Railway posseses all the lines from the Mont Cenis Tunnel to Florence and Pisa, with the railway from Turin to Venice and the Austrian frontier beyond Udine, also the line from Alexandria to Genoa and the French frontier near Nice, and the innumerable branches in all this populous part of Italy.

Commander Amilhau said that the price of coals had increased formidably, so that whereas they cost 34 francs per ton (£1 7s. 2d.), they must be now procured at nearly double that amount, whence, he asserted, that it was impossible to diminish the tariff without compromising the existence of the company. In carriage of goods, the fixed expenses were a large item, so that the company gained far less on the carriage for short distances than for long ones. The mean distance run by the trains is 64 miles, against 87 on the lines of the South Italy Railway. The rolling-stock consists of 800 locomotive engines, 11,000 waggons, and 2,500 carriages. The line from Turin to the Mont Cenis Tunnel has proved very productive, giving just £1,000 per mile, or 40,000 francs per kilometre; but the reason why goods from Geneva and the rest of Switzerland sent to the Mediterranean coast are shipped at Marseilles instead of at Genoa, is that the French lines (Paris to Lyons and the Mediterranean) charge only 42 francs per ton from Geneva to Marseilles, and for the short distance from Geneva to the Mont Cenis Tunnel, 29 francs, leaving only 13 francs for the carriage thence to Genoa, which is absurd. Thus, the noble tunnel of the Alps is well-nigh cut out of the main line of traffic with Central Europe, and Italy loses all the Swiss transit trade, which will be only secured definitively by the St. Gothard line, now being made.

The North Italy Company purchases the engines, rails, and metals abroad. Of the £400,000 it lays out in other materials, £340,000 is spent abroad, and £60,000 in Italy.

Wine.—The province of Alessandria, where wines are grown on a larger scale than in any other, produces 1,000,000 hectolitres, or 22,000,000 imperial gallons, of which 25,000 are made by the Italian Vinicole Company, at Asti, founded, with a capital of £120,000, within the last year. Italy furnished 1,146,000 bottles of wine exported to South America during the year 1871, and of this quantity it was stated that two-thirds were sent from the province of Alessandria. The Cavaliere Manfredo Bertone di Sambuy, who has a great reputation as being one of the first wine growers in Italy, considered that it was necessary to extend the knowledge of the grapes themselves, as when the innumerable varieties of grapes are mixed together, instead of carefully keeping them apart, an inevitable consequence is that the wine made is of inferior quality. The manipulation of the grapes requires much greater care than is bestowed on it by the peasants. He assured the Commission that scientific laboratories might be very good in their way, but that the essential point was to teach in practical schools, to be established rather in the rural districts than in the towns. Wine should be made on the spot by the several growers, and not by persons occupying themselves exclusively with this business, who purchase grapes on all sides, as a mixture of the various qualities is too apt to take place in the latter case. Once made, wine could be sold to those whose occupation is to manufacture and prepare it for the several markets, each country having a different taste, wines exported to England being unsaleable if shipped to South America. The export duty levied on wines is one franc for every hectolitre, or 10d. for every 22 imperial gallons, when in barrels, and 66 centimes on every case of 12 bottles, equal to one halfpenny per bottle, so that bottled wine can with difficulty be exported. It is not, however, the sum paid on wine exported in barrels which is to be complained of, so much as the fact of the opening of these barrels at the Custom-house, where a certain quantity is sure to run out, letting in a corresponding amount of air, which spoils the whole of the wine left behind. When properly made alcohol should never be mixed with the wine, which has sufficient spirit in itself.

Vermouth.—The export duty on vermouth is very injurious to this manufacture, nor is it possible to decide how much spirit it generally requires to be added to the wine. This article is a speciality of Piedmont and France. The exportation is chiefly to South America, the Levant, and India. One house exports 500,000 litres, or 11,000,000 gallons. The trade with foreign countries appears to be not much less than twenty-fold what it was a few years ago.

Copper Mining in the Valley of Aosta.—Fuel is not scarce for the moment, but in the course of a few years the trees will be all felled if metallurgy is extended there. Though there is a mining school at Aosta, there are no students in it, for those who are employed in these mines have not sufficient general instruction to avail themselves of it.

Artificial Flowers.—From £80,000 to £100,000 worth of artificial flowers, and elements composing them, such as pistils, stamens, leaves, &c., are imported into Italy. The duty was declared to be too low on the made flowers, being only eight francs per kilogram. Hitherto the elements employed are exclusively of foreign make. Zeano, of Turin, makes about £4,000 worth of artificial flowers, which are sold in Italy; the artistic beauty of the work he turns out is such that they are in no way inferior to the best made in France, and they are highly esteemed in this country.

Earthenware—Basio, of Mondovi, Cuneo, employs 120 workmen, many of whom frequent evening schools, and are docile and disciplined. Owing to the low import duty, French pottery competes greatly with that made in the country.

Sorgho Sugar.—The sorgho plant is now cultivated at Chivasso, Turin, where 1,300 tons of sorgho canes will be treated this season. Last year already eight tons of sugar were manufactured by this company, and 30 tons of treacle. The mean price of the sorgho canes is thirteen shillings per ton. A hectare of ground yields 500 francs' worth of sorgho in mean, which is equal to £8 per acre.

Such were the chief results of the inquiry at Turin. The readers of the *Journal* will bear in mind that these notes are placed in the same order in which the inquiries were made, whence there is no classification, and it would have been a gratuitous labour to attempt to alter the arrangement. Although referring exclusively to a part of Italy, containing about 4,000,000 inhabitants, this part is unquestionably one of the most interesting, advanced, and prosperous in an industrial point of view, and the information is equalled in importance only by what was elicited at the Milan meeting of the commission. Hence it will not fail to be read carefully in England. It is to be hoped likewise that it may lead to increased business relations between the two countries, by showing what a vast field is opened for the employment of capital, and what rapid strides in industrial progress are being made.

EDUCATIONAL CONFERENCE.

A conference, called by the Social Science Association and the Scholastic Registration Association, and consisting of teachers and others interested in education, was held on Tuesday and Wednesday in the rooms of the Society, which were lent for the purpose. Lord Napier and Ettrick presided. The object of the conference was to consider questions affecting mainly the education of the middle classes.

Mr. Barrow Rule said private schools were in danger of being, to a large extent, superseded, and it was the duty of all friends of education to do what they could to utilise all efficient existing teachers. He advocated the passing of a Registration Act, and proposed a Bill which would provide the advantages of centralisation, while it would in no way tend to create a monopoly; and would not interfere with the liberty of individual masters, or the stimulus of private and public enterprise. He proposed that the measure should include a general scholastic council, to consist of six persons of experience, nominated by the Privy Council—one representative each from the principal universities, a representative each from the College of Preceptors and the Educational Institute of Scotland, and seven representatives of registered persons chosen from their own body, viz., three for England, two for Scotland, and two for Ireland.

In the discussion which followed, the following gentlemen took part:—Mr. Fitch, Mr. G. Hastings, Dr. Oppler, Mr. Payne, the Rev. A. Rigg, Mr. Waymouth, the Rev. Brooke Lambert, Mr. Wyles, F.G.S., and Mr. Mast. The last two gentlemen proposed, and the meeting carried, the following resolution:—"That the Committee of the Scholastic Registration Association be requested to sketch a Bill which, when accepted by the Association, shall be placed in the hands of a member of Parliament for introduction in the House of Commons, with the view of being enacted into law; and that the Council of the Social Science Association be requested to afford their co-operation, and use their influence for the same object."

The discussion in the afternoon was "On the desirability of the Inspection and Systematic Examination of Endowed Schools. The conference was presided over by the Rev. A. Rigg. The subject was then introduced by Mr. Waymouth, who quoted from the Endowed Schools Commissioners' Report to show the inefficient state of many of the endowed schools in the country. Inspection and examination in endowed schools was also advocated by Mr. Pears, on the ground that it was an excellent machinery for keeping schools up to the mark. Miss Porter, Mr. Hastings, and others, took part in the discussion. On the motion of the Rev. Brooke Lambert, seconded by Mr. Waymouth, it was resolved, "that this meeting calls the attention of the two societies represented here to the importance of elaborating some plan for the examination of endowed schools."

On Wednesday the first proposition discussed was—"That the local examinations conducted by the Universities of Oxford and Cambridge should extend to all the pupils, and to all the subjects taught in each school examined." The Rev. Dr. Abbott, head-master of the City of London School, introduced the question. He advocated an extension of the Oxford and Cambridge examination, so as to constitute a leaving examination as in Germany, conducted by the class-masters of first grade and second grade schools, under the supervision of an examining branch, and open to all candidates. The Rev. A. Rigg spoke on the same question.

Mr. C. H. Lake, B.A., read a second paper on the question—"In order to bring these examinations within reach of the whole school, is it not absolutely necessary that the examination fees should be very largely reduced, and some change made in the nature of the examinations?"

The discussion was carried on by Dr. Oppler, the Rev. A. Rigg, Mr. Hastings, Dr. Aldom, Mr. Mast, Mr. Pears, Mr. S. Waymouth, Dr. Hirom, and others. Eventually the following resolutions were carried:—"That a system of leaving examinations and general examinations, with inspection, should be instituted, applicable to all first grade and second grade schools, including all the subjects studied in those schools, and also open to candidates not trained in them; and such examinations should, as far as possible, utilise the regular school examinations conducted by the school authorities themselves. Also, it is desirable that the examinations and inspections should, as far as possible, apply to the school rather than to select candidates; and, in the opinion of this meeting, the reduction of fees and costs of examinations would largely increase the number of those examined. Also, any legally-constituted examining Board should contain an adequate proportion of persons practically experienced in teaching."

At the afternoon sitting, the Rev. Brooke Lambert, M.A., opened a discussion on "What ought to be the relations between the Government and the middle classes in regard to education?" A long discussion ensued, in which Mr. Pears, Mr. Fitch, and others took part, and at the end the following resolutions were accepted:—"That, in the remodelling of ancient endowments, provision should be made for the encouragement of talented scholars educated either in public or private schools of the localities to which the endowments belong, so that all such scholars, male or female, should be able to prosecute their studies at any institution they choose, on condition of submitting themselves to annual examination." "That whilst it is most important to throw no obstacles in the way of the development of educational energy in private schools, yet the State has a right to demand that all schools should, as a condition of recognition, pass a certain proportion of their scholars at a public examination." The Conference closed with a vote of thanks to the noble chairman.

AMERICAN PATENT OFFICE.

The American Patent-office has recently begun to publish its specifications in a serial form. A book is to appear monthly containing the entire specifications and reduced fac-similes of the drawings of all patents. No specimen of this publication has yet been received by our own Patent-office, but from the account given it should be a very useful series. The technical journals of the States are accordingly indulging in a little jubilation, on their own account, and depreciating the work of our own office.

The *Scientific American* says that:—"The specifications of the English patents are issued in volumes measuring $7\frac{1}{2}\times10\times2\frac{1}{2}$ inches, each weighing some $4\frac{1}{2}$ pounds. Each year's publication occupies about fifty books of specifications alone, the drawings being bound separately in fifty additional volumes—$16\times22\times3$ inches in dimensions, and weighing about fifteen pounds each. The aggregate dead weight of a year's issue reaches 975 pounds, or nearly half-a-ton of printed matter, all of which, it seems, is required for the description of 3,000 patents in a manner not a whit clearer or fuller than our compact yet elaborate volumes. On the above English plan of publication it would require about five hundred volumes a year, weighing in the aggregate over two hundred tons, to produce the same number of patents as are yearly issued by this country, and which Commissioner Leggett expects to print in thirteen comparatively small volumes. As to the comparative expense of the two systems, no comment is necessary. As a matter of course the English publications might as well remain unprinted, for they are virtually out of almost every one's reach."

Now we may suggest that besides the published specification itself, we have a weekly—not a monthly—publication, which gives us an abridgment of the specification a few days after the specification is made public. True, we admit that these abridgments are not in all cases very well drawn, as they are made by the inventors, who have no special object in rendering them clear and good; but, at all events, they serve as excellent guides to the contents of the specifications. Then we have the excellent classified series of abridgments, which, not being made by the inventor but by qualified persons employed by the office, are in most instances extremely valuable records of each special class of inventions. Not only has the American Patent-office nothing like these, but it has not even yet published all its specifications of former years.

As to our publications being "out of almost every one's reach," there are thirteen complete sets of them distributed amongst the principal cities of America; and any American inventor has only to go to one of the thirteen public libraries where these are preserved to obtain the fullest possible information about every English patent that has ever been taken out on any subject whatever. The American Commissioners of Patents have over and over again acknowledged the value of our publications, especially of the classified abridgments. In comparing the American and English patent offices, one thing is always forgotten, that in America many inventions are made the subject of a patent which with us are merely registered. Hence the average length of an American patent is much shorter, and a greater number can consequently be contained in a smaller space. In spite of this, however, the weekly volume, as hitherto published by the States Patent-office, giving the entire specifications and drawings, is quite as bulky as a volume would be composed of a week's English specifications similarly bound up.

The arrangements of our own Patent-office are far from perfect, but we are decidedly very considerably ahead of any other nation in this respect. We have published, and accessible, a specification of every patent that has been granted since specifications were first filed to the present time; we have indexes that certainly, in some cases, require revision and amalgamation, but are, for the most part, as elaborate and exhaustive as they can be made; and we have small and cheap books giving a clear and brief account of all inventions relating to special subjects. To none of these can our friendly rivals across the Atlantic lay claim at present. Perhaps their known energy may enable them to overtake us, but they may wait awhile before they begin to boast. We are ahead of them still.

Ons Streven reports that the King of Bavaria has accorded his sanction to the plan of establishing a school of art and industry for female students. In this institution no other students are to be admitted but those who have completed their fifteenth year and succeeded in passing their examination in elementary drawing. A monthly fee of 5s. will be charged.

The Americans have adopted a novel method of showing their appreciation of Mr. Bessemer's services to science. In the midst of one of the richest iron and coal districts in Cincinnati they have begun to build a new city, which, from its geographical position and local advantages, will probably become one of the largest centres of trade in America. To this city they have given the name of Bessemer.

The French government is about to despatch a scientific mission to explore Central China. The mission is to be under the direction of M. Darby de Siersaint, French Consul at Canton.

An exceedingly rich vein of copper, penetrating to a depth of 40 feet below the surface, has been discovered at Hope, Pennsylvania.

CAVALLA TOBACCO.

The port of Cavalla, which, twenty-five years ago was hardly, if at all, known to the commercial world, has of late years been gradually gaining in importance, and is at the present time one of the chief outlets of the products of Macedonia. According to the account given by Vice-Consul Cortazzi this place has considerably gained since the tobacco grown in the district—the staple commodity of the country—has been introduced into Germany, Russia, Italy, Austria, the Danubian Principalities, and England, all of these countries consuming considerable quantities of the article, which, though all produced from the same seed, is of different qualities. The qualities preferred by Germany, Austria, and Italy are grown in the districts of Drama and Sarishaban; that of Drama is known by the name of "Bashi-baghli," owing to the leaves, some fifteen or twenty, being tied together by the stalks when being made ready for shipment; and "Bassama," in which the plant is pressed together when undergoing a similar process. It is, however, only an inferior sort of these descriptions, costing from 5½d. to 9d. per pound, that finds its way into the above countries. The best quality, of a dark red colour, is more or less exclusively sent to Constantinople, to Russia, and to the Danubian Principalities, this latter quality realising on the spot from 1s. 6d. to 2s. 4d. per pound. The annual produce of Drama, including Bashi-baghli, and Bassama is estimated at from 2,100,000 lbs. to 2,450,000 lbs., that of Sarishaban to 1,400,000 lbs. The crop of 1871, an exceptional year, was, however, calculated to yield over 2,800,000 lbs., being more than 140,000 in excess of the crop of 1870; and that of Sarishaban 1,900,000 lbs., is about 70,000 more than the preceding year. Other description of tobacco is also exported to these countries, such as the "Mountain Bashi-baghli" and "Demirli," (ferruginous), from the nature of the soil in which it grows. This latter quality is also called "Pravista," Pravista, three hours' distance from Cavalla, being the name of the district where this tobacco is grown. It is considered much inferior to that of Drama, fetching on the spot from 1½d. to 4d. the pound. It is, however, this quality of tobacco, owing to its yellow colour, and, perhaps, its price, that is sought for in the English market. Nearly 1,600,000 lbs. were shipped to England in the course of the year 1871, being 685,000 lbs. more than in 1870. The annual crop of Demirli is reckoned at 2,000,000 lbs., though the yield of 1870 did not nearly reach that figure, while the crop of 1871 greatly exceeded it, being likewise of superior quality. The district of Sarishaban also furnishes nearly 500,000 lbs. of hill and plain tobacco, called "Ghubek." It is highly prized at Constantinople, Smyrna, and in Turkey generally. It is of a gold colour, and varies in price from 3s. to 7s. a pound on the spot. Some 50,000 lbs. weight of this quality goes to Austria, 60,000 lbs. to Russia, and 11,000 lbs. to the Danubian Principalities. Yenidjeh district gives about 3,500,000 lbs. of the same class tobacco as Sarishaban, the pick of which is sent to Constantinople and Russia, *vià* Odessa. Some 900,000 lbs. of the inferior sort goes to Austria, and the remainder to the Danubian Principalities, and to the various parts of the Empire. The district of Cavalla, owing to its gravelly soil, and hill range, it is presumed, gives but an inferior sort of Bashi-baghli tobacco, of which the last crop consisted of about 280,000 lbs., selling at from 2d. to 3d. per lb., with a few exceptional qualities at 6½d. per lb. The charges on tobacco for transport from the villages, brokerage, lighterage, store-rent, weighing, and commission, amount, on the average, to about 4d. per lb. The sweepings of the warehouses, together with rejected leaves, called "refuse," amounting to about 900,000 lbs. every year, is sold at 2d. to 3d. per lb., and is chiefly shipped to Austria, Malta, Egypt, and Germany.

The weight of the whole tobacco crop grown in 1871 amounted to 11,200,000 lbs., and the quantity shipped was 7,600,000 lbs., valued at £37,825 sterling. Austria was the largest purchaser, 3,800,000 lbs.; England next, 1,598,000 lbs.; and then Turkey, 1,155,000 lbs. Throughout the province of Drama there are 326,000 acres of land cultivated, of which 75,000 acres are under tobacco, and an estimated population of 156,000 persons. With the exception of a road to the town of Drama—a distance of twenty miles from Cavalla—of which sixteen miles has been made only at intervals along the line, and, consequently, of no practical use, there are no public works in progress to improve the communications. The establishment of a bank or a branch bank would be a great boon to the country. As matters at present stand the farmers are at the mercy of unscrupulous usurers, who advance money to them on their crops at the rate of from 25 to 35 per cent., and as the security is valid, they seldom, if ever, incur losses. These people also advance sums of money to the peasants, charging them 8 to 12 per cent. per month, taking a lien on a man's house, his cow, his ass, his rude implements of husbandry; in short, on any conceivable article that can be converted into money.

EDUCATION OF THE WORKING CLASSES AT BORDEAUX.

Bordeaux has for more than a century been remarkable for its efforts to secure sound instruction for the working classes, and recent events have given the city deserved prominence in this important work.

In 1783 a private association was formed at Bordeaux under the name of the Société du Musée d'Instruction Publique. The Revolution dispersed its members and broke up the society, which, however, was replaced a few years later by the Société Philomathique. This was in the year 1808.

This society was established by sixty-nine private persons, many of them members of the bar, and was a kind of miniature Institut de France, being divided into four sections, for letters, sciences, music, and archæology. This society not only established numerous classes of public lectures, when there were no such in the whole province, but it awarded prizes for works produced in art, science, and literature. This society soon acquired considerable reputation, and the government frequently had recourse to its advice on commercial and other subjects, such as the reclamation of the waste lands of the Gironde, the cultivation of substitutes for indigo, hospitals, experimental farms, steamboats, the breeding of silkworms, &c. Its importance had grown to such a degree in 1821 that the then newly-established Linnæan Society solicited and obtained its patronage. Under the restoration it greatly extended its plan, commenced a course of commercial law, and instituted eight public courses of instruction on general physics, mechanics applied to the arts, the history and literature of France, botany, astronomy, geography, geology, and mineralogy. These courses then formed the only public superior education in Bordeaux, and the general government contributed nothing towards them.

In 1827, the society took another important step; it organised an exhibition of works of art and industry for the whole region, still known as the Bordelaise, and including six departments of France, an undertaking then surrounded with immense difficulties. Since that time it has organised eleven, if not more, exhibitions, gradually extending them to all the departments of France and to Algeria and the colonies; and finally, in 1865, including Spain and Portugal in the programme. Moreover, from 1850 it awarded prizes to workmen as well as to manufacturers. These exhibitions were on an important scale; the last counted three thousand exhibitors, and three hundred thousand visitors passed the doors in four months. The cost of this exhibition to the society amounted to £8,000, which was not quite met by the money received.

The essential work of the society has been popular education, especially since the year 1838, when Bordeaux was endowed with three faculties by the government.

For some years its efforts to give practical instruction to the working classes met with all kinds of difficulties, but in 1839 it had four hundred pupils of all ages, and in 1845 it had succeeded in establishing classes for professional as well as primary instruction, drawing schools, and a popular library, only open, however, on Sundays and *fête* days. Its progress grew faster than its means, but in 1849 the municipal authorities placed at its service a part of the old Palace de Justice. In 1851 it had made great progress in its professional instruction, having instituted courses of geometry, mechanics, masonry, carpentering, cabinet-making, &c., all combining practice with theory; and two years later it was enabled to add chemical and physical courses, and to divide its drawing schools into three sections, for mechanical, architectural, and freehand drawing. These courses were, however, only for young men of fifteen or more years of age, but in 1863 the society organised other classes for youths of twelve to fifteen years of age.

Between the years 1864 and 1867, the adult classes were augmented by five new courses of instruction, namely, hydraulics, naval construction, commercial geography, and the English language. Next some elementary courses were established for females, and a course of political economy for the working classes.

At the commencement of the present year the society had grown to such an extent that it had twenty-two professors, and twenty-four courses of instruction, attended by more than two thousand pupils and students, the whole cost being about £600 per annum. It must be explained, however, that the honoraria paid to the professors are extremely modest.

The society is now enabled to extend its operations materially; one of its members, M. Fieffe, bequeathed it a sum of £24,000, to be spent principally on the erection of a large school, which is now completed, and supplies all the accommodation required. The programme of the institution has therefore been materially extended, and is now divided into three distinct sections; 1, elementary and general; 2, commercial; and 3, professional instruction. The first of these sections comprises seventeen courses, five for women, four for apprentices, and eight for adult males; the commercial courses are eight in number, and include geography and the English, German, and Spanish languages. Lastly, the professional sections, which are being greatly developed, comprise twelve courses, namely, physics, chemistry, mechanics, machine drawing, civil construction, architecture, ornamental drawing, the cutting of wood and stone, plan drawing, and industrial art. The society has no workshops for the apprenticeship of youths, but it possesses experimental shops, well provided with tools and other means of instruction and practice.

This extended programme has increased the expenditure of the Society to about £1,200 per annum, thus divided:—

	Francs.
Professors	13,950
Contingent expenses of courses	3,000
Library and conferences	1,000
Permanent exhibition	500
General expenses	9,200
Sundries, say	2,350
(£1,200). Francs	30,000

From step to step the society has created, at last, a complete system of gratuitous professional education, for even the most neglected of the working classes, which enables them gradually to elevate themselves, and furnish recruits to industry; and this is about to be completed by the grant of special diplomas awarded after serious examination.

Such a complete industrial and social institution exists nowhere out of Bordeaux, and the society enjoys a well-earned reputation. It is composed of six hundred members, united less by a scientific than a social object—the hope of resolving the important problem of the reconciliation of the working classes, and thereby ensuring the peace and prosperity of society.

Whatever may be the amount of success achieved in a social view, there can be no question of the great debt which the working classes of Bordeaux owe to the Société Philomathique.

PAPIN'S DIGESTER.

The constantly-increasing prices of food and fuel have recently caused public attention to be directed in a very decided manner to the question of economy in cooking. Attempts are being made to combine with economy in fuel such methods of cooking as shall prepare the food in a palatable and easily assimilable form. In view of the prizes recently offered through the Society of Arts by an anonymous donor, it will perhaps be of interest to refer briefly to that long-neglected piece of apparatus known as Papin's digester. The principle upon which it is based is exceedingly simple. The temperature of boiling water is not constant, but depends upon the atmospheric pressure. Thus, at the summit of a high mountain, where the pressure is low, ebullition takes place at a much lower temperature than it does at the sea-level. As a matter of experiment, it is found to be quite impossible to perform certain culinary operations in very elevated regions, because the heat of boiling water is not sufficiently great. These remarks only apply to the boiling of water in open vessels, but by using a tightly-fitting lid we have the power of causing water to boil at any temperature we choose, the confined steam creating an artificial pressure within the closed vessel. The digester, then, is nothing more than a steam-tight saucepan or boiler, furnished with a safety-valve to prevent explosions, and some means of varying the pressure (and with it the temperature) at which it is considered desirable to work.

The description of this apparatus was first given to the world by the illustrious inventor, in 1681, in a work entitled "A New Digester or Engine for softening Bones, containing the Description of its Make and Use in these Particulars: viz., Cookery, Voyages at Sea, Confectionary, Making of Drinks, Chymistry, and Dying. By Denys Papin, M.D., Fellow of the Royal Society. London: Printed by J. M. for Henry Bonwicke, at the Red Lyon in St. Paul's-churchyard, 1681." The work appears to have created some sensation, as a French translation was published in Paris in the following year, and in 1687 the author issued "A Continuation of the new Digester of Bones, &c." Papin, like most inventors, appears to have had a very exalted opinion of his contrivance, by the help of which, he says, "the oldest and hardest cow-beef may be made as tender and as savoury as young and choice meat." His public spirit would not allow him to seek the protection of letters patent, for he says, "I have not therefore thought it right, in a thing of so general use, that a man by virtue of a patent should hinder other people from working, that may perhaps have more skill in doing things good and cheap; and I have instructed Mr. Mayor, a founder, in Old Bedlam, how to make these engines of cast brass, so that any body may see them and buy them of him.' That the apparatus was used was quite certain, for we find that Evelyn in his "Diary," under date April 12, 1682, describes a supper at the Royal Society, all the viands being cooked in Papin's digester. He says:—

"I went this afternoone with several of the Royall Society to a supper which was all dress'd, both fish and flesh, in Monsieur Papin's digesters, by which the hardest bones of beefe itselfe and mutton were made as soft as cheese, without water or other liquor and with lesse than 8 ounces of coales, producing an incredible quantity of gravy; and for close of all a jelly made of the bones of beefe, the best for clearness and good relish and the most delicious that I had ever seene or tasted. We eat pike and other fish bones, and all without impediment; but nothing exceeded the pigeons, which tasted just as if baked in a pie, all these being stew'd in their own juice without any addition of water save what swam about the digester, as *in balneo;* the natural juice of all these provisions, acting on the grosser substances, reduced the hardest bones to tendernesse; but it is best descanted, with more particulars for extracting tinctures, preserving and stewing fruite, and saving fuel, in Dr. Papin's booke, publish'd and dedicated to our society, of which he is a member. . . . This philosophical supper caused much mirth amongst us, and exceedingly pleas'd all the company. I sent a glass of the jelly to my wife, to the reproach of all that the ladies ever made of the best hartshorn."

Papin appears to have made innumerable trials with his apparatus, and his two books, which together make up a quarto volume of about 180 pages, consist mainly of a record of his various experiments. So anxious was he to give the public all possible information as to his engines, that he arranged for a series of public demonstrations which he announces in these words:—"I undertake to let people see them try'd once a week in Black Fryars, in Water-lane, at Mr. Boissonet's, over against the Blew Boot, every Moonday, at three of the clock in the afternoone." He has certainly succeeded in handing down his name to posterity in connection with the digester, and he is, we think, much better known as the inventor of that apparatus than as a profound natural philosopher who was in intimate scientific relations with most of the eminent *savants* of his day. As a proof of the estimation in which he himself held his invention, we may remark that in his portrait in the Aula at Marburg (where he was professor for some years) he is represented with a copy of his "New Digester" in his hand, the plate of the apparatus being conspicuously displayed.

With regard to the economy of the digester as compared with the ordinary modes of cooking, we are not aware that any trustworthy experiments have ever been made. The only comparative trials which we remember to have met with are those published by Professor Junichen in the September number of Dingler's *Polytechnisches Journal* (Vol. 205, p. 412). His results are given in the following table:—

	Ordinary saucepan.		Papin's Digester.		Per-centage of saving.	
	Time in minutes.	Gas in cubic feet.	Time in minutes.	Gas in cubic feet.	Time.	Gas.
Beef	159	2·49	43	0·55	72·95	77·91
Pork	117	2·82	38	1·08	67·52	61·70
Potatoes	53	1·43	20	0·5	62·26	65·03
Split peas	92	1·7	34	0·68	63·04	62·94
Haricot beans	113	1·7	48	0·77	57·52	54·70
Damsons	27	0·59	9	0·22	62·50	62·71
Pears (whole)	167	3·15	52	1·22	68·86	61·27
,, (in slices)	162	2·5	46	0·78	71·60	68·80
Apples (in slices) ...	134	2·52	43	0·58	67·91	76·98
Chestnuts	147	3·12	57	0·97	61·22	68·91

The experiments appear to have been performed with care, and Professor Junichen gives full details of the circumstances under which they were carried out. Gas was used as the heating medium, from the great facility which it offered for comparing the quantity of heat consumed in the various experiments. For all practical purposes, however, we have not the slightest hesitation in pronouncing the results as utterly illusory and worthless. The same vessel appears to have been employed throughout, but when used as a saucepan it was simply closed by an ordinary loosely-fitting lid. It was of copper, but only held seven decilitres, or about a pint and a-quarter. It is obvious then that Professor Junichen's results are those of a mere laboratory experiment, and it needs very little knowledge of the culinary art to perceive that potatoes boiled for an hour all but seven minutes, would be reduced to a perfect pulp. Again, all cooks know that pork requires to be boiled for a longer time than beef, but Professor Junichen finds otherwise. Further, we should very much like to know what sort of beef it is that requires two hours and forty minutes to boil, when cut into pieces which would go comfortably into a pint pot. We have also to remark that two hours seems an unconscionable time for boiling a piece of pork which could not well weigh more than a pound and a-half. The pressure at which the digester experiments were made was five atmospheres—the temperature corresponding to such a pressure being 152 C., or 306 F. Here, again, we are constrained to point out that Professor Junichen is by no means acting fairly by reckoning the time—not from the commencement of ebullition at the ordinary pressure with the safety valve open, but from the period at which the steam just lifts the valve when screwed down to the pressure of five atmospheres, that 306° Fahr. It is obvious that the results with the digester are far too favourable, as no account has been taken of the time expended or gas consumed while the temperature was being raised from 212° to 306°. It would be perfectly easy to calculate what this would be, but Professor Junichen's experiments are not of sufficient value to merit further criticism. He appears to have commenced with a foregone conclusion, and to have done his best to make out a good case.

In spite, however, of the known advantages of the digester it has never found much favour, at least in this country. Several patents have been taken out in France for improvements in its construction, and judging from the fact of the *pot-au-feu* being in constant use among the poorer classes of Frenchmen, the digester ought to be more commonly used there. We may remark that the apparatus usually sold in the shops in this country are perfectly inefficient, and are no more capable of "softening bones" than they are of softening cannon-balls. In the first place they are not strong enough to withstand the necessary pressure, and, secondly, there is happily no means of loading the valve to attain such a pressure. In one which we examined the other day, we found that the valve was one inch in diameter, and taking its weight into account, steam would escape when the pressure was 6¾ ozs. on the square inch. This would make no appreciable difference in the temperature of ebullition, far less so indeed than would be brought about by the ordinary barometric oscillations. It would, of course, be perfectly easy to attach an ordinary spring pressure-gauge, but we warn those who may be inclined to make experiments with such an apparatus, that it must not be entrusted even to the very best "plain cook" who ever spoiled a dinner, unless, indeed, provision be made for limiting the pressure which may be applied. Even then there is the risk of the safety-valve sticking in its seat, which it is very liable to do, in consequence of the corrosive action of the acids, generated by the decomposition of fat, or by rusting. It is, moreover, a matter of difficulty to inspect the progress of the operation of cooking in a digester, as the sudden releasing of the lid would result in a great gush of steam, and the certain projection of the contents of the vessel up the chimney. Many cooks have a great fancy for frequently taking off the lid of the saucepan, just to see how the contents are "getting on." To such the digester would not be a welcome adjunct.

All these objections, however, vanish when it is a question of the introduction of high-pressure cooking apparatus into large public establishments such as gaols, lunatic asylums, workhouses, and so forth. There, of course, the apparatus would be under the control of a competent engineer, and need not be attended with any more danger than that due to an ordinary high-pressure boiler.

CORRESPONDENCE.

MELBOURNE COMMISSION FOR PROMOTING TECHNOLOGICAL AND INDUSTRIAL INSTRUCTION.

Sir,—The work of this Commission continues to be successful. There are seventeen schools of art established in various parts of the colony. These have all been founded by local effort, and have been aided by the Commission, distributing among them the annual grant of £500, passed for that purpose by the legislature.

The Commission also procure for distribution, as far as the limited funds at their disposal will allow, casts and examples for drawing from.

Some of the schools have properly-certificated masters; others are not so well off, but have to engage the best local talent that can be obtained.

The aid given to the schools is in accordance with the enclosed regulation of the Commission:—"That in order to promote the establishment of Schools of Art and Design throughout the colony, there shall be paid, from the funds placed at the disposal of the Commission by the Government, to every school which is conducted upon principles approved by the Commission and open to its inspection, an allowance of two shillings and sixpence per quarter for each pupil who shall have attended such school at least eight times during the quarter."

I am, &c.,
Samuel H. Roberts,
Hon. Corresponding Member Society of Arts.
Melbourne, November 7, 1872.

GENERAL NOTES.

Melbourne Education Bill.—The new Bill has passed the Lower House of Legislature, but as it has some most determined opponents in the Upper House, it will, no doubt, be much altered there.

University at Adelaide.—A university has been established at Adelaide. This has grown out of a movement set on foot by the dissenting bodies for the formation of a union college, wherein instruction in the higher branches of learning should be afforded. The basis of the new institution has already been determined upon. The machinery for raising money and building has not yet been set in motion, but Captain Hughes has intimated his willingness to give £20,000 to £30,000 for the object.

Archæological Discovery at Rome.—An important discovery has just been made in the Esquiline quarter of Rome. In clearing some ground the remains of a house were found, which evidently belonged to some rich citizen. The walls are decorated with beautiful frescoes; the pavement is in many-coloured marble, and a portion is in mosaic. Under the peristyle is a fountain in a niche decorated with shell work, and a basin in marble.

Royal Albert Hall Amateur Orchestral Society.—Four private evening concerts will be given by this society in the Royal Albert Hall, when instrumental and vocal performances by the full orchestra of the society, and other amateurs, will take place. These concerts will be held on Wednesday, 29th January, Wednesday, 5th March, Friday 4th April, and Friday, 2nd May, 1873, at 8.30 p.m. Honorary members have the privilege of attending the four concerts. Applications for honorary membership should be supported by the recommendation of a member of the Amateur Orchestral Society or of a proprietor of the Royal Albert Hall. Members of the Society of Arts who desire to become honorary members can obtain forms from the Secretary of the Society, John-street, Adelphi.

Bust of Mariani at the Theatre of Bologna.—A bust of the celebrated conductor Mariani has just been placed in the green-room of the Bologna Theatre. The work was executed by the sculptor Verna, of Faenza.

Experiments with Acids on Stone.—At a recent meeting of the Manchester Literary and Philosophical Society, Dr. R. Angus Smith, F.R.S., said that he, like others, had observed that the particles of stone most liable to be in long contact with rain from town atmospheres, in England at least, were most subject to decay. Believing the acid to be the cause, he supposed that the endurance of a silicious stone might be somewhat measured by measuring its resistance to acids. He proposed, therefore, to use stronger solutions, and thus to approach to the action of long periods of time. He tried a few experiments, and he says with promising results.—*Builder.*

A New System of "Fresco Painting."—Mr. Charles T. Kemmer, of Newark, New Jersey, has taken out a patent for a method of painting which consists in the application of "linseed-oil fresco paint" to a surface of muslin in the form of a thick film, which may be easily removed and then cemented to the ceiling or wall. The film is composed of six coatings of paint. The advantages claimed for the system are—that decorations may be worked out at a manufactory, without causing inconvenience in houses; that the film is elastic and does not crack; and, above all, that as the process can be conducted in cold weather, when in America good workmen are without employment, it becomes very economical.—*Architect.*

A Cheap Fuel.—The Iowa papers recommend people to use their corn for fuel. The *Council Bluffs Nonpareil* says:—"We are glad to see that many of our citizens are taking advantage of the low price of corn to lay in heavy supplies of it for fuel. We have experimented with it during last week, and find that it is an admirable substitute for both wood and coal, and that at present prices there is both economy and comfort in its use. A ton of corn, 33 bushels, at 17 cents per bushel, is 5 dols. 60c. We consider this equal to a cord of hard wood, as supplied and measured in our market, at 7 dols.; the cutting of this cord, 1 dol. 50c.; total 8 dols. 50c.; thus making a saving of nearly 3 dols. a cord. For kitchen fuel it is superior to wood, except hickory, and cheaper than that. It makes a very hot fire with a great deal of blaze. We judge that three tons of corn are equal to the heat of one ton of hard coal, while in economy of its use it is equal to one and a half tons of coal. In small families and small houses there is always a great waste of hard coal, while there is none in the use of corn."

Effect of Soap-water on Incandescent Metal.—Mr. W. F. Barrett stated before the British Association that having occasion to cool a red hot copper ball, it was plunged into a vessel of water in which he had just washed his hands. The ball entered the water without any hissing or perceptible evolution of steam; and on being removed seemed as brightly incandescent as before. Desiring to experiment further upon this phenomenon, other metal balls were tried with the same result. The soapy water was then replaced by fresh water; but upon plunging an incandescent ball into this, the hissing was loud and the evolution of steam copious. The author draws from these experiments the inference that the presence of the soap in the water contributed to the formation of the spheroidal state. Further observation showed also that albumen, glycerine, and organic matters generally facilitated its occurrence. He gives the following directions for reproducing the experiment:—Pour a little soap solution into a large beaker of water, and then by means of a hooked wire lower into the liquid a white hot metal ball, several pounds in weight, and best, of copper. The ball smoothly enters the water, and glows white hot at a depth of a foot or more beneath the surface. Notwithstanding the considerable hydrostatic pressure, it is seen to be surrounded by a shell of vapour, perhaps half an inch thick. The vapour shell is bounded by an envelope that resembles burnished silver, and has a most striking appearance. In fact, the hot ball blows a soap bubble of steam, from the limiting surface of which the light is totally reflected. As the ball cools the shell becomes thinner and thinner, and finally collapses, when immediately there follows a loud report, volumes of steam are given off, and often the vessel is broken by the violence of the action. Following out the same idea the author seeks to establish, the *Engineer* thinks incorrectly, a possible relationship between his phenomenon and certain boiler explosions, from the possible entrance into boilers on unfavourable occasions of oil or other organic matter.

Female Students at the University of Zurich.—It appears, from a report published by the University of Zurich, that the number of students at the present time is from 360 to 380, of whom 100 are females. Of this number 74 are engaged in the study of medicine, 25 in philosophy, and 1 in that of political science.

Education.—The *School Board Chronicle* extracts the following from a foreign paper:—"New York has 101,883 scholars to rather over a million of inhabitants. These children receive their instruction from 2,765 masters (*i.e.*, one teacher to every thirty-six pupils); the educational budget amounts to very nearly £700,000, or £7 for each child. In England, in one year, 35,999 men and 49,522 women were found unable to sign the marriage register."

Education of Girls.—The Netherlands Association for the Promotion of Labour and Industry has awarded a gold medal to Mdme. Elise van Calcar, a well-known Dutch authoress, for her solution of the following prize question:—"How should girls be taught and educated so as to enable unmarried woman to earn an independent livelihood, and the married to bring prosperity and happiness to their respective families?"

Spent Bark from Tanyards as Fuel.—Antonio Cantalupi in his "Tables and Formula for the use of Engineers and Architects," published at Milan, writes respecting the value of the spent bark of tanyards as fuel, that from 1,250 kilogs, of fresh oak bark, 1,000 kilogs of spent bark may be utilised, and this equals in heating power 800 kilogs of wood, or from 270 to 300 kilogs of coal. The heating power of spent bark in a perfectly dry state is equal to 3,400 heat-units, while that usually met with in commerce is only 2,400. A steam-engine of 12-horse power consumed 12 kilogs of bark per hour per horse-power.

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

THE LIBRARY.

The following works have been presented to the Library:—

Rondiconti del Reale Instituto, Lombardo. Second series. Vols. 1 and 2.

Memorie del Reale Instituto, Lombardo. Classe di Lettere e Scienze, morali e politiche. Parts 1 and 2 of vol. 11.

Memorie del Reale Instituto, Lombardo. Classe di Scienze, Matematiche, e Naturali. Parts 1 and 2. Vol. 11.

Solenni Adunanze del Reale Instituto, Lombardo. Part 5. Vol. 1.

Annuario del Reale Instituto, Lombardo, 1868.

Elementary Lessons on Applied Mechanics. (Cassell's Technical Manuals.) Presented by Messrs. Cassell, Petter, and Galpin.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. The following meetings have been arranged.

January 15.—"On the Sulphur Deposits of Krésuvik." By Charles W. Vincent, Esq., F.C.S. The Paper will be illustrated by Photographic Views of Iceland, exhibited by the Electric Light. On this evening Baron Grant, D.L., F.S.A., M.R.I., will preside.

January 22.—"On Rendering Wood Incombustible." By D. O. Macomber, C.E.

January 29.—"On Guilds and their Functions." By John Yeats, Esq., LL.D. On this evening Thomas Webster, Esq., Q.C., will preside.

CANTOR LECTURES.

The second course of these lectures, viz., seven, "On the Energies of the Imponderables, with especial reference to the Measurement and Utilisation of them," will be delivered by the Rev. Arthur Rigg, M.A., on the following evenings, at eight o'clock:—

Lecture I.—Monday, February 3rd, 1873.

On the Sources, Inter-relations, and Measurements of Energies—Units of Measurement.

Lecture II.—Monday, February 10th, 1873.

On the Energy of Gravity, with especial reference to the Measurement and Utilisation of it.

Lecture III.—Monday, February 17th, 1873.

On the Energy of Vitality, with especial reference to the Measurement and Utilisation of it.

Lecture IV.—Monday, February 24th, 1873.

On the Energy of Affinity, with especial reference to Suggestions for Estimating and Utilising it.

Lecture V.—Monday, March 3rd, 1873.

On the Energy of Electricity, with especial reference to the Measurement and Utilisation of it.

Lecture VI.—Monday, March 10th, 1873.

On the Energy of Light, with especial reference to the Measurement and Utilisation of it.

Lecture VII.—Monday, March 17th, 1873.

On the Energy of Heat, with especial reference to the Measurement and Utilisation of it.

Members are entitled to attend these lectures free, and to admit two friends to each of them.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Royal Geographical, 8½. 1. Mr. C. W. Lawrence, "Journey from Kidto to Yeddo." 2. Mr. J. H. Gubbins, "Ascent of Fujiyama" (Japan). 3. Mr. F. R. H. McClatchie, "Trip in Mushashi" (Japan).
Social Science Association, 8. Mr. E. O. Greening, "On Co-operation."
Medical, 8.
Institution of Surveyors, 8. 1. Discussion on Mr. Arundel Rogers' Paper, "Mines and Minerals." 2. Mr. E. J. Castle, "The Origin of Parochial Relief."

Tues....Medical and Chirurgical, 8½.
Civil Engineers, 8. Colonel W. H. Greathed, "On the Practice and Results of Irrigation in Northern India."
Royal Institution, 3. Prof. Rutherford, "On the Forces and Motions of the Body."
Photographic, 8.

Wed. ...**SOCIETY OF ARTS, 8.** Mr. C. W. Vincent, "On the Sulphur Deposits of Krésuvik, Iceland."
Meteorological, 7.
London Institution, 7. Mr. G. F. Rodwell, "On Ancient Science."

Thurs...Royal, 8½.
Antiquaries, 8½.
Linnæan, 8. Mr. J. G. Baker, "On the Recent Synonyms of Brazilian Ferns."
Chemical, 8. 1. Mr. Grimshaw, "On Ethylamyl." 2. Mr. C. Schorlemmer, "On the Heptanes from Petroleum." 3. Mr. T. Carnelley, "On the Vanadates of Thallium." 4. Mr. C. T. Krugzett, "On the Formation of Sulphate of Sodium by the Action of Sulphuretted Hydrogen upon Sodium Chloride."
Numismatic, 8.
Royal Society Club, 6.
Royal Institution, 3. Dr. Debus, "On Oxidation."

Fri ......Royal Institution, 8. Dr. William Spottiswoode, "On the Old and New Laboratories at the Royal Institution."

Sat ......Royal Institution, 3. Dr. Edward A. Freeman, "On Comparative Politics."

JOURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, JANUARY 17, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

PRIZE FOR STEEL.

1. The Council has resolved to award the Gold Medal of the Society to the manufacturer who shall produce and send to the London International Exhibition of 1873 the best collection of specimens of steel suitable for general engineering purposes.

2. The specimens exhibited must include a complete illustration of the applications of the varieties of steel submitted.

3. Each manufacturer should send with his specimens a statement of the nature of the tests he has applied to each kind of steel submitted, and give the results of such tests.

4. The samples tested are to be exhibited together with duplicate samples, or portions of the same samples; these will be submitted to tests should the Council consider it desirable.

5. The Council reserve to themselves the right of withholding the premium, in the event of the specimens exhibited not being sufficiently meritorious.

January, 1873.

PROCEEDINGS OF THE SOCIETY.

SIXTH ORDINARY MEETING.

Wednesday, January 15th, 1873, Baron GRANT, D.L., F.S.A., M.R.I., in the chair.

The following Candidates were proposed for election as Members of the Society:—

Baines, Harry Cuthbert, M.A., Slapton, near Dartmoor, Devon.
Blundell, George Thomas, 33, Burdett-road, E.
Blandford, Marquis of, Blenheim, Woodstock.
Browne, R. Mackley, F.G.S., Northside, St. John's, Sevenoaks.
Browne, William Morgan, F.R.G.S., Junior Athenæum Club, W.
Corscadden, John F., 24, Holland-park, W., and 33, Wellington-street, Strand, W.C.
Foster, William Robert, 87, Grange-road, Bermondsey, S.E.
Givry, Victor, 23, Old Bond-street, W.
Hill, Thomas G., 4, Kensington-park-gardens, W.
Inglis, Robert William, 26, Weighton-road, South Penge-park, S.E.
Knight, Charles Joseph, 7, York-terrace, N.W., and 14, Argyll-street, W.
Ladenil, Morel, 13, Camden-road, N.W.
Mannel, Robert, 19, St. Dunstan's-hill, E.C.
Mappin, Walter S., 19, Stanley-crescent, Kensington-park-gardens, W.
Palmer, Joseph, F.R.G.S., the Grammar School, Wells, Somerset.
Stewart, P., Middle Temple, E.C.
Stewart, Dr. William, 23, Sackville-street, W.; Cordon, Newburgh, N.B.; and Paraguay.
Tilley, Samuel, 10, Finsbury-place south, E.C.
Vallentin, James, 55, Cow Cross-street, E.C.
Wheeler, —, 4, City-terrace, Peterborough.

The following candidates were balloted for and duly elected members of this Society:—

Bell, George William, 114, Chancery-lane, W.C.
Carillon, John Wilson, Wormhill, Buxton, Derbyshire.
Corner, William Mead, F.R..G.S., 104, Leadenhall-street, E.C.
Dewes, William Petitt, Ashby-de-la-Zouch.
Eliot, Major-General John, Limpsfield, Surrey.
Goodenough, Capt. James, R.N., United Service Club, S.W.
Harper, William H., jun., Protestant Grammar School, New Shoreham, Sussex.
Kirton, John W. 73 Belgrave-road, Birmingham.
Muir, Edwin, C.E., Canal Wharf, Rochdale.
Neal, John, 44, 46, and 48, Edgware-road, W.
Raiser, L., 5, Hereford-square, South Kensington, W.
Russell, Thomas, Saracen Foundry, Glasgow.
Sanford, Percival, 8, College-gardens, Dulwich, S.E.
Yates, Richard, 80, Falmouth-road, New Kent-road S.E.

The Paper read was—

ON THE SULPHUR DEPOSITS OF KRISUVIK, ICELAND.

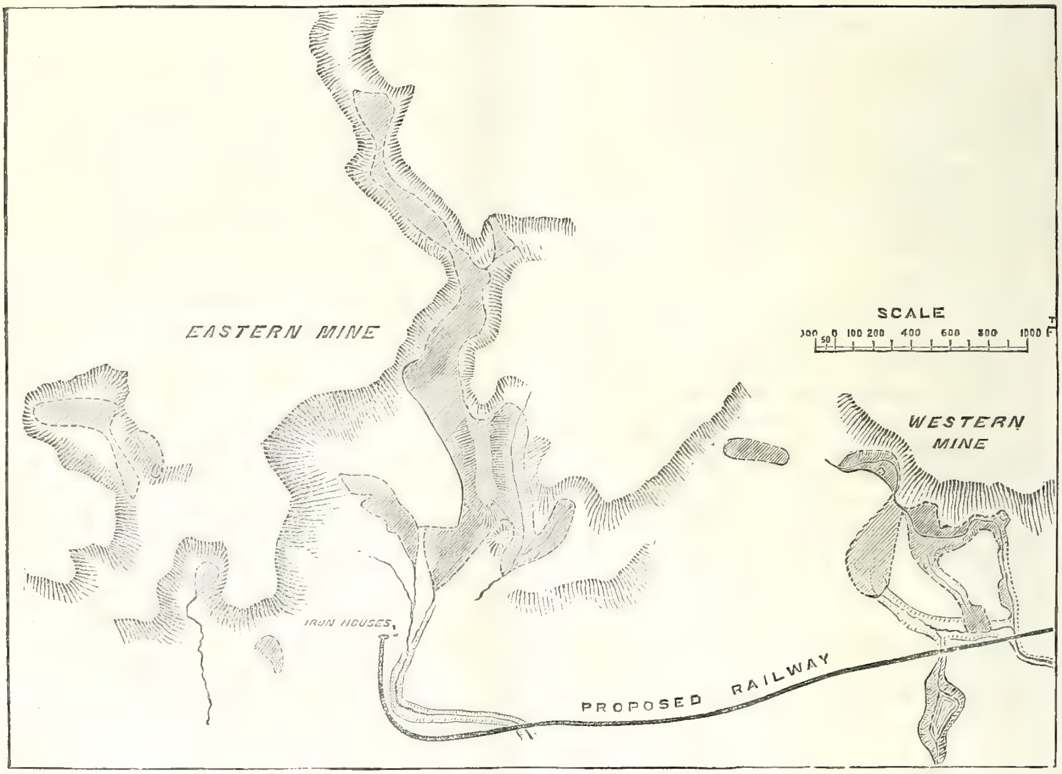
By Charles W. Vincent, F.C.S.,

The canton of Krisuvik, in the district of Gullbringu, in the south-west corner of Iceland, has long attracted great interest, on account of its boiling mud cauldrons, hot springs, and above all, its "living" sulphur mines; these are all arranged in lines, evidently corresponding to the great volcanic diagonal line stretching from Cape Reykjanes to the Lake of Myvatn. At the present time the greatest amount of volcanic activity is manifested at the southern end of this line, in the district some peculiarities of which I now propose to bring before you.

In the last century it was the northern end of the volcanic diagonal, near about Myvatn, where, according to the Icelandic records, the kind of pseudo-volcanic action was most vigorous, by which the boiling springs are set in operation and the sulphur deposits are formed; but a violent eruption of the mud volcano Krabla, to a great extent buried the then active strata beneath enormous masses of volcanic mud and ashes, so that the energy has been probably transferred along the line southwards.

The Krisuvik springs are in a valley beneath some high mountains (see plan; the shaded portion represents the sulphur beds surrounding the active springs). They are reached by a track, so narrow that there is no more than room to enable horses to pass along it—across the brink and along the side of a vast hollow, termed the "kettle." Following this rude track, the "Ketilstip," the summit of the range of hills, is reached which overlooks Krisuvik. In the midst of a green and extensive morass, interspersed with a few lakes, are cauldrons of boiling mud, some of them 15 feet in diameter, numberless jets of steam, and boiling mud issuing from the ground, in many instances to the height of six or eight feet. Sir George Mackenzie (who was accompanied by Sir Henry, then Doctor, Holland, now the President of the Royal Institution), in his justly-celebrated "Travels in Iceland, in 1810," gives a vivid word-picture of the scene. "It is impossible," he writes, "to convey adequate ideas of the wonders of its terrors. The sensation of a person, even of firm nerves, standing on a support which feebly sustains him, where literally fire and brimstone are in incessant action, having before his eyes tremendous proofs of what is going on beneath him, enveloped in thick vapours, his ears stunned with thundering noises. These can hardly be expressed in words, and can only be conceived by those who have experienced them."

The photographs which I have the honour to exhibit are many of them taken from paintings made on the spot by Mr. Waller, a nephew of Prof. Huxley, who certainly, by his faculty of close and accurate observation, does great credit to his distinguished relative. I have obtained from him corroboration of many facts which, though they might be expected to be noted by a chemist, or physicist, do not lie within the ordinary vocation of an artist.



On the other side of the mountains subterranean heat is also manifested, and hot springs, accompanied by sulphur-beds, are also found; but they have not been as thoroughly examined as those in the valley, and are represented as being less active.

Mr. Seymour, who has spent many months at Krisuvik, tells me that the sulphur beds on this side have been submerged by the clays washed down by the winter rains, and are, for the most part, now completely overgrown with grass. On digging beneath the surface, however, the sulphur earth is found to be only a short distance down, and on analysis the per-centage of sulphur in one bed, 116 yards long, running up the side of the mountain, was discovered to range between 64 and 65·5. Here the earth was completely cold, and all further deposition of sulphur appeared to have ceased.

In the valley itself the springs are not always visible at the surface, being so completely covered by the earth that it is only by piercing through the crust of indurated sulphur earth, that their presence is discovered. Sometimes the explorer is made unpleasantly aware of the insecure nature of his footing by falling through, and thus opening up a fresh thermal spring. The late Sir William Hooker, when visiting this place, in endeavouring to escape a sudden gust of strongly odorous vapour, jumped into a mass of semi-liquid hot earth and sulphur—and but for his presence of mind, in throwing himself flat upon the ground, would have sunk to a considerable depth; as it was, the difficulty of extricating himself was very considerable.

The surface of the ground is covered in many places with a crust of two to three feet in depth of almost pure sulphur; and in the valley, where the steam jets are protected from the extreme violence of the wind, the sulphur is deposited tolerably evenly over the whole surface. If it were not for the ever-varying direction of the wind, the sulphur would, Captain Forbes is of opinion, be precipitated in regular banks, but it hardly ever falls for twenty-four hours in one direction, the wind capriciously distributing the shower in every direction.

It has been suggested by those who wish to utilise the immense sulphur-producing power of this wonderful locality, that chambers should be erected (Sir George Mackenzie), or walls built up (Dr. Perkins), by which means the force of the wind being broken, the sulphur would be quietly floated to the ground, instead of being carried up the sides of the hills, and thus more widely distributed.

With little variation the general appearance of the "solfataras" over the space of twenty-five miles along the volcanic diagonal is much alike: an elevation about two feet high and three feet in diameter, which is composed of a dark-bluish black viscid clay, forms a complete circle round the mouth of a medium-sized spring. The water is sometimes quiescent, and sunk about two feet within the aperture; at other times it is ejected, with great hissing and roaring noise, to the height of from five to eight feet. At all times clouds of steam, strongly impregnated with sulphuretted hydrogen and sulphurous acid gas, issue from the orifice, both of which, during an eruption of the water, are greatly augmented in quantity. From the dark coloured and elevated margin of the fountain the yellow crust of crystallised sulphur extends a great distance in every direction. Columns of steam ascend from numberless points in the whole district, which are thus impregnated; and thus it is that, apparently for ages past, sulphur has been gradually heaped up in this locality till there are actually hills, which, as far as they have yet been pierced, show sulphur earth to be their main constituents. Hence they have acquired the name of the Sulphur Mountains.

The soil is of different colours, but most generally white. It is, in the vicinity of the springs, a viscid earth, less plastic than clay, and more readily broken.

When excavations are made into this earth, it is found to be composed of multitudinous layers, of different colours or shades of colour, each layer being quite distinctly divisible from those above and below it, though frequently no more than an inch or two in thickness.

It is much to be regretted that the good example set by Olafsen and Povelsen of investigating the nature of the earth's crust round about the solfataras, by piercing the soil, has not been more frequently carried out. In the summer of last year one of the suggestions which I made for the instruction of an expedition to this place, was that boring implements should be taken out and extensively used; but accident prevented the necessary appliances being forthcoming at the right time. I believe, however, that one of the chief features in the expedition which is to set out in March, will be the thorough examination, to as great a depth as practicable, of the strata in various parts of the Sulphur-valley.

The spring chosen by Olafsen and Povelsen as the subject of their first experiment, was one which had made its appearance since the preceding winter, and which was just beginning to be surrounded by other mud springs, and jets of steam. The ground was still covered with lovely verdure, and charming flowers were abundant, even at the very verge of the cauldron of hideous hue and odour. A short distance from this opening they established their boring apparatus. The sequence of the layers was as follows:—

1. Three feet of reddish-brown earth, of a fatty consistence—of the ordinary temperature; at the bottom heat was perceptible to the touch.
2. Two feet of a firmer kind of earth, nearly the same in colour as the first layer, unctuous to the touch.
3. One foot of a lighter kind of soil.
4. Five feet of a very fine earth of different colours, the first two feet being veined red and yellow, with streaks of blue, green, red, and white intermingled. The lower portion of this earth was somewhat firmer than that which covered it. The heat of this thick bed was so great that the soil extracted by the auger could not be handled until it had been for some time exposed to the air.
5. One foot of a compact greyish blue earth.
6. In tapping this bed, which was 4 ft. 9 in. in thickness, and consequently at a depth of about 12 feet, water was first met with. It was found by comparison that the level of the water in the boiling mud spring coincided at this time with that of the water thus discovered. The heat was now very great, and a constant hissing and bubbling could be heard as proceeding from the bottom of the hole which had been made.
7. Nine inches of greyish blue earth.
8. One foot six inches of a similar unctuous earth, containing many small white stones. This was the hottest layer of any yet pierced; the buzzing, humming noise was now much louder than before.
9. Three feet of the same kind of clay, but much harder and more compact; this layer was also full of small, round, white stones.
10. Six inches of a violet tinged earth, very greasy to the touch. In this bed the heat sensibly diminished.
11. One foot six inches of red and blue clay intermingled. The heat continued to diminish very fast.
12. One foot of reddish-looking clay, the temperature remaining about the same.
13. Six inches of yellow and red clay.
14. One foot of a greenish coloured earth, much less coherent than the previous layers. Here the heat again began to increase.

15. One foot six inches of blue clay, filled with small pieces of white tufa. This bed was much hotter than either that above or that below it.

16. One foot three inches of soft blue clay.

17. Nine inches of an earth, easily pulverised when dry, which, whilst moist, was of a violet colour; on exposure to the air, however, this rapidly changed to a chocolate brown. The heat was again augmented as the centre of the bed was approached.

At thirty-two feet the full length of the boring implements was used up; but from the set of the country in the vicinity, the experimenters believed they were close upon basaltic rock, when the heat probably ceased.

In digging for the peculiar kind of brown coal which they call "surturbrand" (a kind of fuel very much resembling Irish bog-oak, which can be used for like purposes), the inhabitants frequently go as deep as 28 feet. They report that before reaching this depth they frequently pass through three or four beds of blue, yellow, and brown clay, and almost invariably find that the layers of blue clay are much hotter than any of the other strata.

A second trial of the soil was made in the neighbourhood of some recent springs, further to the the east. The activity of the agencies at work here appeared to be greater than in the former case, and to have been longer in operation. The whole surface was thickly covered with sulphur, in a finely-divided state; there was much gypsum, and a large efflorescence of feathery alum. Thousands of very minute holes were discoverable on close examination, through which continuous jets of steam, sulphuretted hydrogen and sulphurous acid gases were emitted.

An attempt was made to dig with spades; but the soil was found to be so hot, whilst the footing was at the same time so insecure, that it could not be persisted in. A spot some distance further off was therefore pitched upon, where the earth was firmer and colder. The borer pierced through six feet of blue clay with great facility, the lowest portion being extremely hot. After this depth the earth became rapidly softer, at the depth of 7 feet the same peculiar bubbling noise before noticed was heard. Continuing to bore, the bottom of the hole appeared to be in a state of ebullition, a boiling liquid being ejected in the narrow space around the handle of the augur with extraordinary violence, and no sooner was the tool withdrawn than a thick black fluid was ejected from the orifice to the height of several feet. A short time afterwards the jet ceased, the subterranean fire appeared to have expended its fury, but it soon recommenced with redoubled activity to dart forth fresh jets of steam and black, muddy water, continuing to boil and dance with but slight intermission. It appeared, therefore, evident that the result of this experiment was the premature formation of a fresh hot spring, which would otherwise have been, perhaps, a considerable time in forcing its way to the surface.

It is somewhat to be regretted that no one amongst the numerous eminent men, men accustomed to experimental investigations and acute observers, who have since traversed this region, should have investigated the question of the origin of these hot springs and sulphur deposits from the point of view which was thus displayed by these careful and painstaking philosophers.

The phlogistic theory being generally accepted in their day, and the chemistry of the earths and metals being in a very undeveloped state, we cannot now accept to its full extent the explanation they put forth of these phenomena; but the facts they disclose appear to me to be of the highest value, and to afford a clue which, if carefully followed, may lead to discoveries of much importance in the domain of volcanic energy.

The conclusion they drew from their investigation is, that the hidden fires of Iceland dwell in the crust of the earth, and not in its interior; that the boiling springs and the mud cauldrons certainly do not derive their heat from the depths of our globe, but that the fire which nourishes them is to be found frequently at only a few feet below the surface, in fermenting matters, which are deposited in certain strata.

By their theory the gases from the more central parts of the earth penetrate these beds by subterranean channels, and so set up the chemical action, producing fermentation and heat, these channels also forming the means of inter-communication between the separate sites of activity, and equalising and transferring pressure.

To return to their facts. They further observed that the heat is invariably found to be greatest in the blue and blueish-grey earth; that these earths almost always contain sulphuric acid; that they contain also sulphur, iron, alum, and gypsum; and lastly, that finely-divided particles of brass-coloured pyrites are visible throughout the whole of the beds when heat exists.

Sulphuric acid is found in the hot beds above and below that which is the hottest, but this latter manifests no acidity that is sensible to the taste.

Sulphuretted hydrogen is continually evolved from the clays containing the brass-coloured pyrites. Silver coins dropped into a hole made in these strata become rapidly reddened, and brass becomes quite black if held over it for a short time.

Lastly, not only does the heat increase and diminish in various successive layers of the earth, in the neighbourhood of the active springs, but the locality of the heat, as might be expected from their previous observations, travels very considerably in different years.

The solfatara of Krisuvik, with the mountains about it, is shown in the accompanying sketch by M. Eugène Roberts. It appears from afar to occupy the place of an ancient crater, but, as we have already seen, it is not near the crater, about the centre of the drawing, but at a considerable distance from the old volcanic centre, that the thermal springs and sulphurous exhalations have their present origin.

Wherever they may have been previously, the springs are now situated between two mountains, the one Badstofer, on the right, originally composed of lava, the other, Vesturhals, on the left, of basaltic formation. Both, by the action of the thermal springs, are undergoing a process of disintegration and reconstruction.

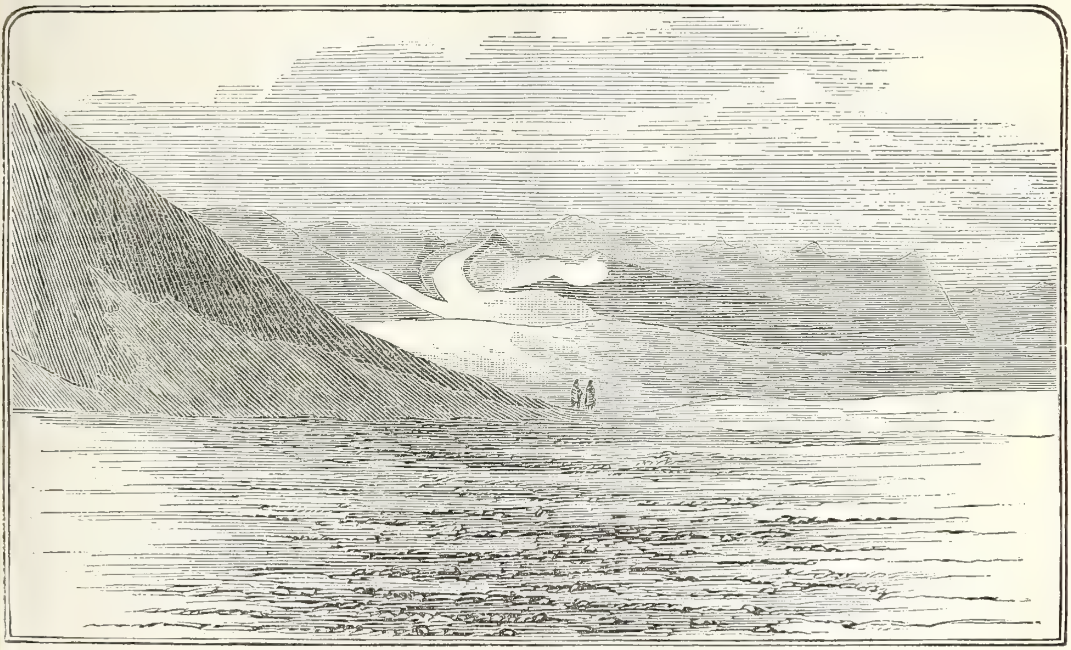
The kind of hills which form the solfataras, properly so called, increase in extent day by day; by the addition to the disintegrated rock of sulphur and of sulphurous and sulphuric acids.

The yellow sulphur earth contains about four per cent. of free sulphuric acids; sometimes a little free hydrochloric acid, and a variety of sulphates, as might be supposed. Treated with distilled water, the filtered solution reddens litmus strongly; on addition of acetate of lead a flocculent precipitate is produced, which, when heated with carbon, disengages sulphurous acid.

The sulphur is found in many different conditions, but for the most part in the same finely-divided, whitish-yellow form in which it is precipitated from sulphuretted hydrogen solutions. Where it assumes other states, crystallised in tears on the surface of the rocks, or coagulated in veins, it is on account of its having undergone subsequent heating. Of its primary origin by the decomposition of sulphuretted hydrogen, there is in my opinion no doubt.

Prof. Bunsen visited Krisuvik in 1845; his opinion is that sulphurous acid is evolved from the earth's interior, which, oxidised either at the surface by the atmosphere, or at subterranean depths by atmospheric oxygen dissolved in cold water, is converted into sulphuric acid. The sulphuric acid thus generated is diffused among the constituents of the decomposed beds. This process represents the first stage of the fumerole action, which is manifested in the namar or solfatara of Krisuvik.

Sulphur is now generally regarded as emanating from the stage of intermittent lethargy of a volcano, and the sulphides of iron, copper, arsenic, zinc, selenium, &c., fall in the same category as sulphur; they are secondary, not primary, formations. In the stage further off we have the host of sulphates produced by the oxidation of the sulphur into sulphuric acid, and its subsequent reaction on the metals and earths with which it becomes associated.



The description of the Sicilian sulphur beds coincides so very exactly with that of the Icelandic mines, that one might pass very well for the other. D'Aubigny pictures nearly the whole of the central portion of Sicily as being occupied by a vast bed of blue clay or marl, in which are numerous and thick beds of gypsum and sulphur, and a combination of this mineral with iron and copper. The natural process by which they have been formed must, I think, be the same in each case. At Krisuvik copper has been found only in small quantities, but that is probably because it has not been sought for below the surface. Carbonate of copper, associated with sulphate of lime, is of frequent occurrence, and native copper has to a limited extent been discovered.

A district in America, very similar in most of its characteristics, has recently been explored. The great hot-spring region of the sources of the Yellowstone and Missouri rivers, in the United States, has, on account of the wonderful natural phenomena there manifested, been set apart by the United States Congress as a great national park for all time.

The whole of this district is covered with rocks of volcanic origin of comparatively modern date. At present there are no signs of direct volcanic action going on, but the secondary kind of action, resulting probably as at Krisuvik, from the disintegration and decomposition of beds of volcanic origin, is in full progress. Boiling springs, mud-cauldrons and geysers are found in all parts of the region, and the description given by Mr. V. Hayden, of the Yellowstone-lake and its vicinity, in every respect coincides with those of the geysers, mud-cauldrons and hot-springs of Iceland.

In all cases there was found to be free access of water; free sulphur was widely dispersed, and the steam-jets were invariably accompanied by large quantities of sulphuretted hydrogen. The subterranean action in this country does not appear to have continued long enough to produce beds of sulphur and sulphur earths, but has, nevertheless, been of sufficiently long standing to build up geyser tubes of so great a length that the internal pressure has formed other vents, rather than lift the immense column of water above it.

The water of the springs contains sulphuretted hydrogen, lime, soda, alumina and a slight amount of magnesia; some of these are only occasionally at the boiling point, and these, when the temperature is reduced below 150° Fahr., deposit great quantities of the sesquioxide of iron, which lines the insides of the funnels, and covers the surface of the ground wherever the water flows. If the reaction consists in the decomposition of iron pyrites, and the sulphur is carried sufficiently far off to prevent its re-combination with the iron to form iron sulphate, the formation of the iron sesquioxide is fully accounted for.

As a rule, the groups of hot springs are, as in Iceland, in the lower valleys, and either along the margins of streams, or nearly on a level with them. The grand area where they occur is within the drainage of the Yellowstone, where a space of 40 miles in length with an average width of 15 miles, is either at the present time, or has been in the past, occupied by hot springs.

That the quantity of sulphuric acid here produced is very large, is proved by the immense quantity of alum which is found, for the streams, the mud, the earth are thoroughly impregnated with it. The funnel-shaped craters from which the boiling mud is ejected, are so similar to those of Krisuvik that the figure on page 139 will answer for both places. The circular rim varies from a few inches to several feet in diameter. Sometimes these are clustered close together, yet each one being separate and distinct from the others.

The foregoing are the most prominent facts connected with the development of sulphur from the earth in the elementary state. The full explanation of all the phenomena accompanying it appears to me to be the key by which the great secret of volcanic energy may be ultimately unlocked. At present it appears to be doubtful whether the sulphur results from the decomposition of metallic sulphides, by heat and water combined, or by sulphuric acid formed by the oxidation of sulphurous acid. In the one case, the whole action is so far within our reach, that it should not be an insurmountable difficulty to establish the point as to whether the whole action does not depend on the percolation of water into beds of pyrites surrounded by other beds which are non-conductors of heat.

The other view, viz., that the sulphur proceeds as sulphurous acid from a lower depth, is on account of the more complicated action required, far from being as satisfactory to my mind as the more simple supposition above.

Until boring experiments have been made, conducted with great care, and to considerable depths, no positive conclusion can be arrived at. It is also an element in the question of much importance, to discover whether the beds penetrated by the water are already heated, whether the water is heated before it reaches the sulphur-bearing strata (the clays containing pyrites), or whether both are not alike cold till they have been for some time in contact.

Less than a quarter of a mile from the hot springs is a lake, Geslravatn, formed by the filling up of an extinct crater. This the inhabitants describe as being fathomless (Mr. Seymour, last year, found no bottom at five and twenty fathoms). The depth is, at any rate, very considerable. Although so close to a spot where the ground is, even at the surface, scorching to the feet, the water in this lake is ice-cold. Sir George Mackenzie also remarked a somewhat similar fact. On the side of the sulphur mountain, amidst the seething, steaming hills of almost burning earth, a spring of clear cold water was met with. To my mind these facts are most in accordance with the view that the action is local and self-dependent.

The Krisuvik sulphur mines have been worked at various times, but want of proper roads, and ignorance of the proper method of extracting and refining the sulphur, have prevented their proper development. The Sicilian mines can be worked at a considerable profit, where, more than 390 feet below the surface, beds are met with containing only 15 per cent. of sulphur. At Krisuvik, absolutely on the surface, clays are met with which contain from 15 to 90 per cent. of sulphur. Under proper and careful supervision their future should be prosperous.

Two German gentlemen, under the auspices of the Danish government, worked these mines in the early part of the last century, and so much was exported to Copenhagen during the time the excavations were carried on, that a sufficiently large stock was laid up to serve the consumption of Denmark and Norway from 1729 to 1753.

Horrebow describes the sulphur mines as being actively worked from 1722 to 1728, to the great advantage of the inhabitants, who reaped much profit from its extraction.

By his account of their mode of prosecuting this enterprise, the sulphur does not appear to have been refined in the island, but exported in its crude state. The less active mines were chosen for cutting into. He says:—There is always a layer of barren earth upon the sulphur, which is of several colours, white, yellow, green, red and blue. When this is removed the sulphur earth is discovered, and may be taken up with shovels. By digging three feet down the sulphur is found in proper order. They seldom dig deeper, because the place is generally too hot, and requires too much labour, also because sulphur may be had at an easier rate, and in greater plenty, in the proper places. Fourscore horses may be loaded in an hour's time, each horse carrying 250 pounds weight. The best veins of sulphur are known by a kind of bank or rising in the ground, which is cracked in the middle. From hence a thick vapour issues, and a greater heat is felt than in any other part. These are the places they choose for digging, and after removing a layer or two of earth, they come to the sulphur, which they find best just under the rising of the ground, when it (the sulphur) looks just like sugar candy. The farther from the middle of the bank the more it crumbles, at last appearing as mere dust. But the middle of the bank is an entire hard lump, and is with difficulty broken through. The brimstone, when first taken out, is so hot that it can hardly be handled, but grows cooler by degrees.

In two or three years these veins are again filled with sulphur. The death of the person at Copenhagen who had the sole and exclusive privilege of exporting sulphur from Iceland put an end to what had promised to be a very thriving industry, The inhabitants continued to collect the sulphur earth for some time after its exportation had ceased; and many of them lost considerably by it, large quantities having been gathered which they were never able to dispose of.

According to Dr. Perkins, the sulphur mines were again worked by the Danish Government for fifteen years, but the method of purifying adopted was very imperfect. The sulphur earth was heated in iron boilers, and when the sulphur was melted fish oil was added, and the whole mass stirred up. On allowing the mixture to stand for a time, the earthy matter formed a soap on the top of the molten mass; this being removed, tolerably pure sulphur remained behind.

In 1832, these mines were visited by K. von Nidda, the celebrated geologist, by whose advice a Danish merchant, named Kruntynon, purchased them. He only worked them for a short period. The sulphur earth was collected without much regard being paid to the relative richness of the beds. It was taken on the backs of horses to Havnafiord, and thence shipped to Copenhagen. The cost of transport brought the sulphur to too high a price to render the undertaking successful.

In 1857, political matters caused the attention of her Majesty's government to be directed to finding a new source of sulphur supply. Commander J. E. Commerell, of her Majesty's ship *Snake*, was sent to Iceland by the Lords Commissioners of the Admiralty, to visit and report upon the capabilities of the mines of Krisuvik and Husavik. He found that the nearest safe port to the Krisuvik beds was Havnafiord; this port is 14 miles from the sulphur beds by the present roads, and nine miles from Reikjavik. The harbour is well sheltered, with good anchorage of seven or eight fathoms three cables length from the beach; it at present enjoys as much traffic as Reikjavik. The road from Krisuvik might be much shortened, and a tramway might also be laid down. During the past year a survey has been made and plans drawn for a railway or tramway to Havnafiord.

The actual extent of the sulphur beds it is quite impossible to calculate; 47 have been already discovered. The deposit of sulphur Commander Commerell personally saw he describes as amounting to many thousands of tons, and, all the mines being in what is called a "living" state, the sulphur taken away is reproduced in two or three years. He considers that sulphur in a pure state could be shipped at Havnafiord for £1 per ton.

The sulphur at Myvatn, though great in quantity, is, he considers, at too great a distance from a port of embarkation to permit its extraction being carried on with any chance of competing with that from the Krisuvik mines.

No further steps were taken in the matter by the British Government, the political complications which led to the expedition having been removed; but the attention of English merchants having been drawn to these rich deposits by the highly favourable character of Commander Commerell's remarks, renewed attempts are being made to render commercially available the immense sulphur-producing power which the Krisuvik solfatares undoubtedly possess. To some of these gentlemen I am greatly indebted for much valuable information, put at my disposal for the purposes of this paper, and amongst them I have specially to tender my thanks to Mr. Ramsdale and Messrs. Thorne, of Gracechurch-street, and particularly for the use of numerous and carefully-selected samples of the sulphur earths which were freely placed at my disposal. These samples I hope to make the subject of a future paper.

Since writing the foregoing paper, I mentioned, in the course of conversation with Sir Henry Holland, the conclusions which are derived from the examination of all the trustworthy facts relating to the sulphur deposits. This led him to examine entries in his unpublished diary, made at Krisuvik in 1810. The theory which he then conceived so thoroughly agrees with all that has been learnt respecting the phenomena in question, that I, with his kind permission, print an extract from his note book:—

"The theory of these sulphureous springs (if springs they may be termed) at Krisuvik is an interesting object of inquiry. They are situated in a country decidedly of volcanic origin. The high ground on which they appear is composed principally of the conglomerate or volcanic tufa, which has before been noticed. The source of the heat which can generate permanently so enormous a quantity of steam must, doubtless, reside below this rock; whether it be the same which produces the volcanic phenomena may be doubted, at least if the Wernerian theory of volcanoes be admitted. It certainly seems most probable that the appearances depend upon the action of water on vast beds of pyrites. The heat produced by this action is sufficient to raise an additional quantity of water in the form of steam, which makes its way to the surface, and is there emitted through the different clefts in the rocks. The sulphates of lime and alumina, appearing upon the surface, are doubtless produced, in process of time, by these operations. In corroboration of this view it may be observed, that the quantity of steam issuing from the springs at Krisuvik is always greater after a long continuance of wet weather, and that whenever earthquakes occur on this spot it is during the prevalence of weather of this kind."

The learned and now aged author expressed the highest gratification that the views which he formed at 22 years of age should possess so much value so many years after.

At the conclusion of the paper,

The Chairman called on any gentleman present who might have any remarks to make on the subject, but, as no one responded, he at once proceeded to propose a vote of thanks to Mr. Vincent for his able and instructive paper.

The vote having been unanimously passed, the meeting was dissolved.

During the reading of the paper Mr. Vincent illustrated his subject by several experiments showing how the deposition of sulphur might have been effected. He also showed a spectrum obtained by burning some of the sulphur earth, and it appeared that the thallium line became visible in the spectrum. Specimens of the various sulphur-yielding earths from Iceland were exhibited, and Dr. Clement Le Neve Foster showed samples from the Italian sulphur districts.

CANTOR LECTURES.

The fourth lecture of the first course of Cantor Lectures for the present Session, "On the Practical Applications of Optics to the Arts and Manufactures, and to Medicine," was delivered on Monday, Dec. 16th, by C. **Meymott Tidy**, Esq., M.B., Joint Lecturer on Chemistry, and Professor of Medical Jurisprudence at the London Hospital. The Lecturer said:—

The question must have occurred to many of us—What is light? We know its effects, but can we explain its origin? By Newton's powerful support, for a long time the creed of scientists was the theory of emission. This was their idea:—Light was the emanation of an imponderable substance, of extreme tenuity, shot out, as a cannon-ball from the cannon's mouth, from the source. To accept this theory, you must believe that light is material. It is strange to think how one who was so eminent an experimenter, so accurate a worker, so marvellous a thinker, could have been the disciple of an old theory, one utterly destitute of an experiment in its support, and so ardent a disciple, moreover, that at last we are tempted to regard him as its apostle. The theory of undulation has this great argument in its support, that the phenomena of light are explicable upon a mechanism similar to that by which the vibrations of elastic media are known to be propagated. It supposes the existence of an ether, filling all space and all material interstices. The vibration of this ether constitutes light. This theory is almost universally received at the present time. I cannot, of course, show you the vibrations of this ether, but in the case of sounding bodies—and there is a close analogy between light and sound—these peculiar motions are, in a way, traceable even by the eye.

I want, if I can, to make this idea of undulation—wave motion—clear to you. I have here a tuning-fork—a very ordinary one—upon a resonant case. If I strike it, you can all hear it sounding. I have placed upon it a little piece of zinc-foil, which is cut to a point. Then I have here a piece of glass, blackened by being held over a candle flame. Now, the mechanism of a sounding-fork is perfectly simple. When a tuning-fork sounds, in the first instant the prongs are within their natural limits, in the next instant they are outside their natural limits. If, then, whilst this tuning-fork is sounding, I draw the piece of zinc-foil attached to one of the prongs rapidly along this blackened glass, I shall produce a magnificently wavy line; In order to show the effect, I will, after doing so, put the glass into the lantern, and throw the picture of it on the screen by means of the lime light. You see the wavy line that I have thus produced I want you to imagine this to illustrate the light wave, although of course it represents a sound wave. Now, let me explain that when sound travels from the source of sound to the ear, the air particle does not travel; it is only the force that travels. If you are out in a boat you say, "here is a wave coming," but the particles of water do not move, it is the force that moves. One particle communicates its force to its counter particle, and so the force travels on and on. If we were to examine the water wave, we should find that the motion of the particles of water was up and down, whilst the passage of the force was in a wavy line, such as is represented on this diagram. What I want you to see is, that the motion of a wave is the motion of force, and not the motion of a particle.

Now, let us study those undulations a little further, for what I am drawing your attention to with respect to sound and water is equally true, I believe, of the waves of light. You throw a stone into water, and you know those magnificent series of rings that result—the little waves produced by the stone falling upon the surface. They are constituted by depressions and little ridges in the water. We call them crests and furrows, and a wave we may regard as constituted of a crest and a furrow. Let me put that to you clearly, because it is only in England that we regard a wave as made up of both crest and furrow. We speak of so many vibrations being necessary to produce a given note, but on the Continent they would speak of just double the number of vibrations, because there the crest is regarded as a wave and the furrow as a wave; therefore one of our waves would by them be regarded as two. Our stone, then, is the source of these little rings. Let us throw a second stone in, at a little distance from the first. That will produce a second series of rings, and rings will come across rings. But there is no real antagonism between these two sets of waves. Nature has quite settled what should happen with them beforehand. Let a crest of one series of waves come across the crest of another series of waves, and the crest is heightened. And the same is true of the furrows. If furrow comes across furrow, the furrow is deepened. But supposing a furrow comes across a crest, what then? Why this happens, that the surface is equalised. This is an unalterable law of wave motion. I have represented it in a diagram here, where you see crest coming across crest, and furrow across furrow.

This law is not confined to water waves; it also finds its counterpart in sound waves. In the case of sound waves, we have a series of condensations of air particles and a series of rarefactions of air particles. This diagram represents a sound wave. In some parts the air particles are pressed into closer contact, and, as a matter of necessity, there are some air particles that are spread out. If you could see the state of the particles of air between my mouth and your ear you would find there are a number of particles compressed, and, as a matter of necessity, there are a number of particles spread out. The condensation and the rarefaction together constitute a sound wave. On the Continent it is held that either a condensation or a rarefaction constitutes a sound wave.

Now let us suppose that we start two waves of sound, as represented in this diagram. We place a tuning-fork at exactly one wave's distance from another tuning-fork, and they are both giving the same note. The length of the wave in both cases is, therefore, the same. In this case condensation meets condensation, rarefaction meets rarefaction, and the sound is intensified. Just as in the case of the water waves, if furrow meets furrow, or crest meets crest, the wave is enlarged. But, again, let us arrange our tuning-forks, so that one shall start exactly half-a-wave behind the other. What happens? Condensation comes across rarefaction, and rarefaction across condensation; they destroy each other, and we have silence. Let us go a step further. Let us make one fork strike not at a half-wave, and not at a whole wave, behind the other, but let it strike at some other portion of a wave behind the other. We now get another effect produced. We find that there comes a time when condensation overtakes rarefaction, and then we get silence; and then sound begins again, and then we get silence again; and so we get a note interrupted by a period of silence. Let me show you what I mean. I have here two organ pipes. They both sound, but one note is a little higher than the other. What is the effect? They are just at that point where I know that the condensation of one will overtake the rarefaction of the other, and you notice what musicians call "beats," or intervals of silence, when they sound together. That is where condensation exactly overtakes rarefaction, and silence results.

Now it is time that I turned to light. Let us suppose two waves again, and let the waves correspond. Condensation of the ethereal particles coinciding with condensation, and rarefaction with rarefaction; what do we get? An intensification of the light. But let the two waves be in antagonism—let the condensation of the ethereal particles come across rarefaction of the ethereal particles, and darkness results. Darkness is therefore the exact counterpart of silence. But suppose these two waves interfere with one another by some fraction of a half-undulation, what do we get then? Colour. Thus I regard darkness as one end of the line and light as the other end, but the line between is colour.

But you may say it is all very well asserting the vibrations of this ether, and building up theories upon it, but what evidence have we of this ether at all? We are not wholly without evidence—evidence, I grant, as yet hung upon a slender thread, but still the slender thread exists upon which the evidence is hung. To suppose its existence is not to my mind a greater speculation than many other things in natural science. Heat can be propagated in a vacuum. Why? It is found that heavenly bodies meet with resistance. Why?

Let me suppose that I were to make a section of a ray of ordinary white light, say the light from our candle, I should find that the vibrations of the ether producing light are transversal to the direction of propagation. In sound the vibrations of the air are in the direction of the propagation. Let me draw your attention to this diagram, which represents the idea of a section of the ray of common light and the transversal vibrations of the ethereal particles. This assumption as regards light is justified by experiment, and this I hope to show you directly. I will just draw your attention to these card models, which were made by a very celebrated man, Mr. Woodward, for Dr. Pereira. That is his idea of a ray of common light, those black spots representing the ethereal molecules. Now, can we split this ray of common light up, so as to make all the vibration in one plane go one way, and all in another plane go the opposite, the planes still being kept at right angles? Here we have a magnificent substance, carbonate of lime, known as double refracting spar. For instance, if I put it over my writing, everything appears double. Here I have another and perhaps a better specimen. I generally see people single, but if I look through this, everybody appears double. I have split my ray of light up into two parts. What more have I done? All the particles vibrating in one direction go one way, and all the particles vibrating in the other, go in the opposite. Now I will endeavour to throw upon the screen a picture of a little diamond-shaped orifice. You see that that is single, but I will place this double refractor in front of my lime-light, when you will at once see that our diamond-shaped orifice is double. I will show you directly, that these two rays are perfectly distinct, perfectly disimilar, and that they are produced by the vibrations of something or other, whatever it may be, vibrating in exactly opposite directions. Both these are polarised beams, so that a polarised beam may be defined as one where all the vibrations of this ether are in one plane, not in all planes, as they are in ordinary light. This may be represented in a great many ways. Woodward represented it by these card models, and I do not know that there is a much better illustration of it than in the wrigglings of an ordinary toy snake. You know how a serpent moves about—he always moves in a wave, in one direction only.

There are other means of obtaining these polarised beams. There is a wonderful substance known as tourmaline. Here is a beautiful specimen, one that belonged to Dr. Pereira, and this has the remarkable power of quenching one set of rays, and allowing the other set to go through. Here is a model of our tourmaline, showing how only the rays in one direction can possibly get through, the rays in the other direction being cut off by these cross-bars. It is a model only, but still it represents very well what is the peculiar action of the tourmaline, that it only allows the rays in one plane to pass. And if we take a second model, and place it so that those two sets of slits correspond, it will let the light pass, but if I place them so that one set comes across the other, as I am doing now, as a matter of necessity it will cut off both sets of rays. I have here two pieces of tourmaline, both of which are movable, so that I can bring them so that their axis may correspond, or be at right angles to each other. You can understand that when they correspond the light can pass, but as soon as I turn them so that they come at right angles to each other, we get intense darkness. Here they are, and you see we have an intense blackness in the centre, where one comes across the other, but the light comes through at the two sides, where they do not cross. Now, if we go on turning till the axes correspond, we get the light coming right through.

The same effect is produced by allowing a ray of light to fall upon a blackened mirror (not a silvered mirror, mind, but a blackened mirror), at a given angle, that is, you produce a polarised beam of light. So, again, where a ray of light falls upon ordinary glass at a certain angle, one part of the light is transmitted, and one part is reflected. It is split up into two parts; and again both beams are polarised, both the part reflected and the part transmitted.

Now comes a more extraordinary part of our story. Having produced a polarised ray, we have the power of splitting it up into two parts. We can split it up by placing a double refractor in front of it; such a body, for instance, as selenite. Mind it does not then vibrate like common light, but one set of waves vibrates at right angles to the other set of waves, as you see represented in this model. One we know as the ordinary ray, and the other we know as the extraordinary ray, the ordinary ray forming an angle of 90° with the extraordinary. These traverse the crystal; they pass through our thin film of selenite, and they pass through it in different directions. But here is the point, they pass through it with different velocities. We get one wave lagging a little behind the other wave. We are doing with light what we did with sound—we have split the ray up, but the ordinary ray goes through much faster than the other ray, and that is the secret of the interference. You may say traversing a plate of selenite as thin as paper could not make any difference; but I beg you will remember that God hangs the greatest weights upon the smallest wires. Let us go on with our story. We have two rays; and we have one ray passing through at a little different pace to the other. Now what we want to do is this. We want to make the one which is a little behind come across the other—we want to make one interfere with the other. I now place in front of this selenite a double refractor, and what happens? I split up both rays, the one that lags behind and the one in front, and the half of the one that lags behind goes off to the half of the other, and the half of the other one goes off to the half of the lagging behind one, and they meet, and interfere one with the other, and as a result we get colour. For instance, I will throw first of all on the screen a picture of an individual some of you may recognise. I will place in front of it our double refractor, and two images become visible. Then I cause interference between the two rays, and colour results, producing as you see, at the same time, a double coloured image of the gentleman. But the colours are different. The colours that are coming through one part of my double refractor are very different to the colours that are coming out of the other part. Look at the two heads, one is green and the other is red; they are two different rays. Surely that is sufficient to show you that these two pictures are somehow or other different sets of rays. Let me turn my double refractor round, and then the two will change. I can bring it to a point where there is no colour, and on carrying it round again, the colours are reversed to what they were before.

Now, I want to go a step further, and show you that though these colours are different, they are, after all, but the breaking up, so to speak, of white light. I am now about to place my diamond-shaped orifice in the apparatus once more, and to place behind it a film of selenite. I will put my double refractor in front, and now I get two diamond orifices, without colour at present. By turning it round, I get the two diamond orifices coloured, one being green and the other red. Again, I can enlarge the size of my diamond spot so as to make one of those little coloured diamond spaces come across the other, and let us see the result. We shall produce white light where they meet. You see where the green overlaps the red; where one ray comes across another ray it is white. These are the complementary tints, and this illustrates, I think, most beautifully the overlapping of the two rays.

For our experiments to-night it is advisable that we should merely have one set of vibrations; we do not want a double refractor, and I shall, therefore, employ for the rest of the evening what is ordinarily known as a Nicol's prism—that is a double refractor cut diagonally across and then cemented together with Canada balsam, the substance having the property of diverting one set of rays and only allowing one set to pass. I want you to see, even with this Nicol's prism, the changes produced by the different sets of vibrations that pass through it. We shall find that we get the same effect as I have already produced with the double refractor, the red following the green, and then the green following the red in the interval, between which there is no colour at all. At one point you see there is a want of colour; then turning it we get green, and turning it a little further we get red; a little further again and no colour, all this owing to the different sets of vibrations, and whether the longitudinal or horizontal vibrations pass the prism. The varieties of colour depend upon the degree of retardation as the light passes through the selenite. You can understand this very well—that the changes of colour will be entirely due to the extent that one ray lags behind the other ray. For instance, I take a concave lens of selenite. It has been ground, so that the centre is very thin, whilst the sides are thick. You can understand, of course, that there is a greater amount of retardation at the edges than the centre, and we shall therefore get a different series of tints introduced. We will throw this on the screen. There you see the different tints produced by that concave lens, the result of these differences in thickness; or, again, I might take a wedge of selenite, such as I have here, instead of the lens, and there again we get different colours, due to the different thickness of the selenite; and by using two wedges, and turning them round, you see how beautifully the colours vary where the different rays interfere with each other. It is on this principle of different thicknesses of a film of selenite that we are enabled to produce all these beautiful results. Here are several designs, which I will show you, illustrating the beautiful colours which are thus produced, all of which are due to the different thicknesses of the selenite and the different degrees of retardation of the rays. Polarised light, I need not tell you, from these experiments becomes a delicate and most exquiste test of double refraction. This is a matter of considerable importance. For instance, glass, after it has been blown, has to be annealed, that is, to be slowly cooled. There is a marked difference between glass that is cooled rapidly and glass that is cooled slowly. When this cooling process is carried out with due care we find that the glass is much stronger than when it is cooled rapidly; there is a molecular difference, and I think that our polarised light will tell us what that difference is. For instance, I put a piece of common glass into our polarising apparatus. Here is a piece of ordinary well-annealed glass; we will allow our Nicol's prism to be on, and I do not suppose we shall get any effect at all. We will turn the Nicol's prism round and round, but I do not suppose we shall get any change. That glass is not a double refractor; therefore it does not produce two sets of rays. But if the cooling process had been hurried the glass would be liable to fly, as we call it, at the least touch. We have a remarkable illustration of this in the common toy known as Prince Rupert's drops. They are made of glass that has been cooled rapidly; when it was in a melted state it was allowed to drop into water. The external surface, of course, was cooled much more quickly than the interior; and you see how easily it will fly. I will break off the end of it, and the whole thing has gone to powder. That is badly-annealed glass. But here is the most extraordinary fact of all. When it is in this state it is a double refractor. Here is a piece of glass, which has been cooled rapidly. I will throw it on the screen again, using a Nicol's prism, and let us see what we get. Look at the colour, and see how magnificent it is. On turning the prism round you see the beautiful changes of colour which take place. All this is due to the rapid cooling of the glass. Polarised light in this way becomes a marvellous test by which we can prove whether glass be well or badly annealed, and I need not say that this is a matter of considerable importance to the optician, inasmuch as lens and prism glass should be particularly well annealed and possess very uniform density. Certainly, if it possesses the slightest effect of a double refractor, it is not fit for optical instruments.

Now, I think we can find out very easily what is the explanation of this effect, namely, that it is due to unequal tension. For instance, I will throw upon the screen a piece of ordinary glass, and I will place it in a screw frame, so that I can screw it up and produce unequal tension in the glass. First of all, in its ordinary state, you see we get no effect of colour, but if we screw it up tightly, at one point you see a little colour beginning to form; it has thus become a double refractor, inasmuch as there is more pressure upon one part than there is at another. On undoing the screw, away goes the colour at once, and this proves that the action on the place which produces the colour as a double refractor is due in some way to unequal tension in the glass. Dr. Brewster suggested polarisation as a test of temperature, for, he says, "Every tint in the scale of colours has a corresponding numerical value, which becomes a correct measure of the temperature of the fluid." Now, we find that a great many animal and vegetable substances are double refractors. For instance, in starches, in *Tous les mois*, arrowroot, and potato starch, we find a black cross when they are looked at by means of a polarised beam, this black cross being replaced by a white one in the other position of the prism. It is right to point out, however, that in Portland arrowroot and wheat starch no cross is visible. Of animal structures a slice of a nail of the finger or toe is a capital polarising object.

Now, what I have drawn your attention to, is what is known as plane polarised light. But we have other forms of polarised light. In plane polarised light we suppose that the particles, the atoms, the molecules of ether, are vibrating in parallel straight lines, but we have what is known as elliptical polarised light, where the particles of the ether describe ellipses, the planes of the ellipses being perpendicular to the direction of the ray. Again, we have what is known as circular polarisation, where the axes of the ellipses are equal. Circular polarised light is of two kinds—what we know ordinarily as right-handed or left-handed. We mean by right-handed, where you turn the analyser from left to right, and the colours descend in Newton's scale; whilst in the case of left-handed polarisation, when we turn the analyser from right to left, and in this case, again, the colours descend in the order of Newton's scale. There are two things necessary to convert plane polarised light into circular polarised light. First of all, it is necessary you should have two systems of luminous waves, of equal intensity, polarised perpendicularly to each other; and secondly, that the difference in the paths of these two systems should be of an odd number of greater undulations. These are the two essentials for the production of circular polarised light.

I should like to show you two or three illustrations of what I mean. I will show you a specimen of quartz, in illustration of circular polarisation. You see the beautiful changes of colour produced by the circular polarised light. There are some liquids possessing the same power as quartz, although in a smaller degree. As, for instance, a concentrated solution of cane sugar, possesses this property, probably in the highest degree, but still it has only 1-36th of the power that quartz possesses. This deviation of the plane of polarisation reveals differences in the composition of bodies, where chemical analysis entirely fails to do so. I cannot, unfortunately, enter into a description of the different forms of apparatus employed for this purpose, but I must tell you that polarised light becomes a most valuable means of determining the amount of sugar present in a given liquid, by the degree to which the polarised beam is turned. If, for instance, you were to fill a tube with ether water, or alcohol, you would find no effect produced by a polarised ray, but immediately you introduce a solution of sugar into the tube, you get a difference immediately. If you fill the tube with some active body, the extraordinary image at once reappears, and to extinguish it you must turn the analyser either to the right or to the left. Now comes the point. With cane sugar you must turn the analyser to the right, and the amount of rotation varies, either with the length of the tube or the strength of the solution. Thus polarised light is at the present time used as a test of the strength of sugar solution. But whilst cane sugar is left-handed, grape sugar is right-handed. They act in different directions. So, you see, if there is cane sugar and grape sugar in a solution, polarisation only shows the amount of cane sugar or grape sugar that is over and above what is necessary to neutralise the other. Hence, in our experiments, we are obliged to calculate the amount of grape sugar first, in order to know the amount of cane sugar that is necessary in order to neutralise it. Further, when we make a strong solution of cane sugar and subject it to heat, especially in the presence of an acid, it loses its crystallisability, and then acquires, curiously enough, a left-handed power; and, to destroy this crystallisability, manufacturers use a little cream of tartar in the preparation of their hard confectionery. In sugar refining, the object is never to let the syrup get beyond the first zero, or, in other words, care has to be taken never to convert crystallisable into uncrystallisable sugar. The raw sugar contains both kinds, the treacle being uncrystallisable. Sometimes, in order to make these experiments successfully, it is necessary to decolorise the sugar, by filtering it through a little animal charcoal. There is no difficulty in making the experiment. Again, directly cane sugar begins to ferment, it loses its right-hand polarisation, and becomes left-handed.

It has been suggested to employ this process in medicine. Diabetes is a disease, one of the peculiarities of which is a large quantity of sugar in the urine. Diabetic sugar turns the plane of polarisation to the right, and the extent depends upon the amount of sugar present. Of course the value of the degrees of polarisation must be ascertained by experiment. The urine must be clarified by heating with acetate of lead, and filtering. I do not think it is of very much use, because we have other, and, I think, better means of examining it. It is a difficult process and a tedious one, and, what is more, albuminous urine possesses the property of circular polarisation. Further, with respect to the volatile oils, nearly all are circular polarisers, except oil of mustard and oil of bitter almonds. Isomerism has no connection with polarisation. It is well known, for instance, that turpentine, lemon, and bergamot are isomeric bodies, but turpentine is left-handed, whilst lemon and bergamot are right-handed. Nor are oils from the same family identical. Aniseed is left-handed, fennel and caraway are right-handed—all from the Umbelliferæ. Mint is left-handed; lavender and rosemary are right-handed—all Labiatæ.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

The third meeting of the Committee for Carriages was held on the 9th of January, 1873, for the purpose of consulting with a special Council, appointed by the Worshipful Company of Coachmakers. There were present—The Duke of Beaufort in the chair, Lord Arthur Somerset, Mr. Holmes, Mr. G. N. Hooper, Mr. Peters, Mr. Starey, Mr. Thorn, Mr. Thrupp, and Mr. Woodall. Applications to exhibit more than 200 carriages were laid before the Council.

Her Majesty's Commissioners have decided to offer to art societies, which have no fixed places for the exhibition of their works, space where the works of each society may be exhibited together.

The Committee on Cooking has lately published a list of works on that subject, with the prices annexed. The list contains 121 entries.

The following are the rules for the admission of persons during the arrangement of the Exhibition:—

1. No person whatever will be admitted into the building unless he is the bearer of a pass or day ticket.
2. Passes, for the period specified thereon, will be issued as follows, at the discretion of the executive superintendent for general management, and under such orders as he may from tine to time issue:—
   (*a*) To exhibitors or their agents.
   (*b*) To workmen employed by exhibitors of machinery.
   (*c*) To workmen employed by foreign commissioners.
   (*d*) To workmen and others employed by Her Majesty's Commissioners.
3. A British exhibitor requiring a pass must apply to the superintendent of the galleries in which his exhibits will be placed.
4. Foreign commissioners must apply for passes for their exhibitors and workmen to the deputy-commissioner for foreign galleries.
5. Day-tickets will be issued by the superintendents of galleries as follows:—
   (*a*) To British exhibitors or their agents.
   (*b*) To workmen employed by exhibitors, when it is absolutely necessary that they should enter the building.
6. Passes and day-tickets must be shown on entering and leaving, and whenever demanded within the building. Expired passes and day-tickets will be taken by the doorkeepers.
7. Passes and day-tickets are not transferable.
8. Every person not properly authorised, found in the building, or conveying or removing any article from one part of the building to another, will be liable to be given into custody.
9. No bundles or parcels of any kind can be taken out of the building without previous examination.
10. All persons using tow or cotton waste are to provide a slate or metal box to contain the waste until removed from the building.
11. All smoking is strictly forbidden.
12. Every person is forbidden to introduce any lucifer matches or light of any kind into the building.

The following instructions regarding the reception of foreign goods have been published by H.M. Commissmissioners:—

1. Every foreign package, or unpacked object, on arrival, is to be assigned a rotation number, and entered in the foreign register.

2. The rotation number will be marked on each case, or the labels of unpacked objects, in red.

3. In registering cases, etc., particular care is to be taken that the marks on each case are entered, with the name and address of the delivering agent.

4. All foreign packages will be unpacked in the unpacking shed, between the hours of 8 and 4, and in the presence of the Customs House officials only, unless special permission is obtained to proceed without their presence.

5. The labels must not be removed from objects until they have been catalogued, and the catalogue numbers entered in the register.

6. All paper, matting, etc., used for packing, must be preserved in the place appointed for it, the property of each company being stored separately; but hay, straw, and sawdust must be burnt, or otherwise destroyed.

7. All cases placed in store must be perfectly empty, and must be distinctly labelled with the name of the country to which they belong.

8. When any breakage occurs, a written report should be at once drawn up, signed by two or three of those present, and forwarded to the Executive Superintendent for general management.

9. The delivery orders for foreign goods will be received from the executive superintendent for general management, and on the arrival of the goods they will be compared with the orders and initialed by the deputy commissioner for foreign countries, who will then return them to the executive superintendent for general management.

10. No foreign goods are to be allowed to leave the unpacking shed until a delivery order has been received or made out for them.

11. Objects of fine art will be taken from the unpacking shed to the fine art gallery; those belonging to classes of manufacture will be sent to those parts of the building which are allotted for the various classes.

12. When goods are sent by the deputy commissioner for foreign countries to the various superintendents of classes, a delivery note must accompany the goods, and the receipt on the counterfoil must be filled in by the class superintendent to whom the goods are sent, and returned to the deputy commissioner for foreign countries.

13. Foreign goods, sent in by foreign commissions, having been actually accepted for exhibition, no class superintendent is permitted to reject, or pass on to any other class superintendent, goods sent to him by the deputy commissioner for foreign countries, without reference to the executive superintendents.

The rules for the reception of foreign and colonial goods are as follows:—

1. All foreign goods (with the exception of those specified in rule 2) must be delivered at the east goods entrance, in Exhibition-road, on the appointed days, viz.:—

Saturday,	1st March	Paintings in oil and water colours
Monday,	3rd ,,	
Tuesday,	4th ,,	Sculpture
Wednesday,	5th ,,	
Thursday,	6th ,,	Reproductions and stained glass
,,	,, ,,	Fine art furniture and all decorative works
Friday,	7th ,,	Substances used as food
,,	,, ,,	Architectural designs
Saturday,	8th ,,	Engravings, &c. — Tapestries, &c.
,,	,, ,,	Cooking and its science
Monday,	10th ,,	
,,	,, ,,	Steel, cutlery, and edge tools
Tuesday,	11th ,,	Surgical instruments and appliances
,,	,, ,,	Machinery and raw materials
Wednesday,	12th ,,	Scientific inventions
,,	,, ,,	Designs for decorative manufactures
,,	19th ,,	Silk and velvet fabrics
Monday,	7th April	Carriages

If necessary, these days may be anticipated, but in no case may they be overstepped.

2. Foreign and colonial commissioners, having annexes, may deliver the goods of their respective countries at their own doors.

3. No packages can be opened except in the presence of the Customs' House officials, unless special permission is obtained.

4. Foreign and colonial commissioners or exhibitors who wish to have an agent of their own present during the unpacking of their goods must cause him to attend at such hours as may be appointed from time to time by the officers of the Exhibition.

5. To every object sent for exhibition a label, in proper form, must be securely attached. All particulars on the label must be in English, and the number on the label must correspond with the number in first column of delivery order (see rule 6); for pictures and works of art—label form No. 19*b*; for industrial objects and scientific inventions—label form No. 19.

6. Delivery orders, on form No. 31, must be sent by each commissioner or exhibitor. All particulars must be entered in English, and the numbers in the first column must correspond with the numbers on the labels (see rule 5). These delivery orders should be sent by post to the Secretary before the 1st March.

The *Food Journal*, commenting on the proceedings of the Committee on Cooking, remarks that "in them we find no notice of one of the most important questions of the present day, especially for families of small and moderate means, namely, how to prepare tinned meats and other preserved provisions in the most economical, agreeable, and wholesome forms. Considering the importance of this subject we have no doubt it will receive special attention.

"With respect to the mention of the cooking of the French poor, it may be remarked that French cookery is a system equally applicable to the poor and the rich. The best knowledge that the Commission could import from France under the head of cookery would be—not that which applies to the cooking for any one class or other, but the modes of carrying on the various operations, such as boiling, roasting, stewing, frying, and the preparation of gravies and sauces. The differences between dishes for the poor and dishes for the rich consist in little more than the greater or less cost of the ingredients and condiments, and the lavish or careful use of butter, &c. For instance, the cooking of vegetables is almost identical in all classes, and to teach English women how to make the most of garden stuff would, indeed, be a valuable lesson. The treatment of dairy produce in the various forms of *omeletes*, *œufs sur plat*, *fromage à la crême*, and the hundred other light dishes of the French *cuisine*, many of which have been given by competent hands in the columns of the *Food Journal*, would form an attractive as well as a useful exhibition."

The *Engineer* published, as a supplement to its last number, a brief "Dictionary of Engineering Terms, in Italian English, and English Italian." This dictionary is published in book form, as a sheet of sixteen pages, so that it can be folded into a pamphlet. The idea is a good one, and appears to have been carefully worked out.

EXHIBITIONS.

MOSCOW POLYTECHNIC EXHIBITION.

The following list of awards has been received from the Committee at Moscow, accompanied by a letter expressing regret that the former list should have been sent imperfect:—

Honorary Address of the First Class,*

With the signature of the Grand Duke Constantine.

Society for the Encouragement of Arts, Manufactures, and Commerce, London
India Museum, London
†Chadwick, Edwin, C.B.
†De-Winton, Major
†Foster, P. Le Neve, M.A.
†Murray, Andrew
†Owen, Philip Cunliffe
†Scott, Major-General H. Y. D., C.B.

Honorary Address of the Second Class.*

De Berg, Alexander, Imperial Russian Consul-General, London.

Diploma of Thanks.

Archer, Professor, Edinburgh
†Bartley, G. C. T.
†Buckland, Frank
†Cassels, Andrew
†Clarke, Hyde
†Cole, Henry, C.B.
Colman and Glendenning, Norwich
Dixon, Albert, London
Du Cane, Major ,,
Hooker, Dr., Kew-gardens
Inkens, —, (?)
†Kamensky, Gabriel
†Lawrence, Edwin
†Lennox, Lord Henry G., M.P.
†Lloyd, Sampson S.
†Marshall, W. P.
†Owen, Professor, F.R.S.
†Popove, Rev. Basil
†Redgrave, Samuel
Scrivenor, G. H., London
Stair, Earl of
†Teulon, Seymour
Watson, Dr. Forbes, Indian Museum, London

Honorary Prizes of the First Class,*

With the signature of the Grand Duke Constantine.

Colman, J., Norwich
Direction of Machinery, Ch. Cammell & Co.
Lawes, James Bennett, St. Alban's
Tankerville, Earl of

Honorary Prizes.*

Kew Gardens Museum
Macclesfield Chamber of Commerce
Platt, Brothers & Company, Oldham
Tapling, Thomas, & Company, London

The Grand Gold Medal.

Ashbury Carriage Company, Manchester
Blews, William, and Sons, Birmingham
Brocklehurst, J. and T., and Sons, Macclesfield
Cammell, Charles, and Co. (marine section), Sheffield
Cammell, Charles, and Co. (railway section), Sheffield
Christy, J. E. and W. and Co., London and Stockport
Clayton and Shuttleworth, Lincoln
Cohen, Barnet Solomon, London
Collyer, Dr. R. H., London
Colman, J. and J., Norwich (mustard)
Colman, J. and J., Norwich (rice starch)
Crighton and Co. (?)
Curtis, Parr, and Maddley, London
Dickins and Co., Manchester
Dougall, J. Dalziel, London
Elliott Bros. ,,
English Condensed Milk Company, London
Field, J. C. and J., Patent Candle Works, London
Garrett, Richard, and Son, Saxmundham
Greenwood & Batley, Leeds
Green and Sons, Wakefield
Hick, Hargraves, and Co., Bolton
Hornsby and Sons (?)
Keen, Robinson, Bellville, and Co., London
Kirkstall Forge Company,
Landscrona, Swenska Company (?)
Langton and Bicknells, London
Leonardt, D., Birmingham
Lloyd's Register of British and Foreign Shipping
Lossen and Sons (?)
Mather and Platt, Salford
Merryweather and Sons, London
Mitchell, C., and Co., Newcastle-on-Tyne
†Nicoll, Donald, London
Owen and Company, Patent Wheel Works
Piesse and Lubin, London
Platt Bros. and Co., Limited, Oldham
Pochin and Company, Manchester
Pooley, Henry, and Sons, Liverpool
Powell and Leland, London
Price's Patent Candle Co., London
Probyen and Son (?)
Ransomes, Sims, and Head, Ipswich (rural section)
Ransomes, Sims, and Head, Ipswich (technical sec.)
Reuss, Ernst, Manchester
Rimmel, Eugène, London
Robey and Co., Lincoln
Ruston Company (?)
Siemens, C. W., F.R.S., LL.D., London
Sommerville, — (?)
Tapling, Thomas, and Co., London
Thompson, Lincoln
Whitley Partners, Leeds
Willan and Mills, Blackburn
Woodbury, Walter B., London
Wouldham Cement Co., London and Wouldham
Young's Paraffin Light and Mineral Oil Co., Glasgow
Younger, W. and Co., Edinburgh

The Gold Medal.

Allen, M. J. Valente, London and Oporto
Broughton Copper Co., The, Manchester
Budde, C. and Co., Birmingham
Clarke & Dunham, London
Everitt, Allen, and Sons, Birmingham
Gausby, J., and Co., Birmingham
Howard, James & Frederick, Bedford
Illingworth, R., Bradford
Jenson, J., and Wilfred Nicholson, London
Leroy and Co., London
Naish, Osborne, and Eden, Birmingham
Ormerod, Miss Eleonore London
Shand, Mason, and Co., London
Smith, Frederick, and Co., Halifax
Soper, William, Reading
Storey, Isaac, and Sons, Manchester
Swainson, Birley, and Co., Manchester
Watts, Blake, Bearne, and Co., Newton Abbot
Windover, C. Sandford, London
Wood, and Ivery, West Bromwich

The Grand Silver Medal.

Baynes, — Glasgow
Bevington & Sons, London
Bryant and May ,,
Cassell, Petter, and Galpin, London
Clarke and Co., London
Clarke, Samuel ,,
Colman, J. and J., Norwich (rice flour)
Cornes, W., and Co., Macclesfield
Critchley, Brinsley, & Co., Macclesfield
Engert and Rolfe, London
Fortnum, Mason, and Co., London
Grant, Chambers, and Co., London
Hattersley, George, & Sons Keighley
Hewitson and Co., London
Kelsh, — (?)
Massey and Co., Manchester
Nicholson, J. O., Macclesfield
Ormerod, Miss, London
Potts, Wright, and Co., Macclesfield
Rabone, John, and Son, Birmingham
Reeves and Sons, London
Sandberg, C. P. ,,
Smale, J., & Son, Macclesfield

The Silver Medal.

Baxter Bros., Dundee
Bermingham, J. and H., Leek
Blythe, J. and A., London
Bullock, W., Macclesfield
Cochrane, Adam L., Galashiels
Cox Bros., Dundee

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* So termed in list sent.

† Members of Society of Arts Committee for the Exhibition.

Craig's Solid Pea Soup (Hewitson & Co.)
Fry, J. S. and Sons, Bristol
Gerrard, Edward, London
Howard, J. and F., Bedford
†Nicoll, Donald, London
Moir, Patrick, Crane, & Co., Manchester
Ormerod, Miss ,,
Sumner, John, and Co.
Thompson, W. J. and H., London

The Bronze Medal.

Burke, J. H., Dublin
Cropper, H. S. and Co., Nottingham
Davis, A. A. & Co., London
Kendless, R., Leeds
Nicholls and Son, Birmingham
Tangye Bros., Birmingham

(Signed) G. Stchurovsky,
Pres. Imp. Soc. of Friends of Nat. Science, Anthropology, and Ethnology.
N. Saenger, Secretary.

KIOTO EXHIBITION.

The following interesting account of a Japanese exhibition, recently held at Kiôto, has been forwarded to the Foreign-office by her Majesty's chargé-d'affaires in Japan. It was drawn up by Mr. Lawrence, of her Majesty's Legation, and was transmitted for the information of the Science and Art Department, by direction of Earl Granville:—

The idea of an exhibition at Kiôto originated with seven merchants, and the authorities eagerly took it up, in the hope of attracting people to Kiôto, the population of which has much decreased since the departure of the Court and the many people connected with it, for Yedo. A proclamation was published all over Yamashiro, the province of which Kiôto is the chief town, ordering people to send their goods to be exhibited; letters were addressed to the neighbouring states, requesting that the exhibition should be made known, and permission was solicited from the government at Yedo to open Kiôto to foreigners. Nine officials, four of whom had already been named commissioners to the Vienna Exhibition, were appointed directors, and interpreters were sent for from Kôbé for the benefit of foreign visitors, who, it was expected, would arrive in crowds, and spend a great deal of money. The authorities were the more induced to believe this because last winter an Italian gentleman got permission to visit Kiôto, and he and a French merchant who accompanied him spent large sums in bronzes, lacquers, &c.

Great preparations were made to receive visitors. The numerous houses destined for the priests, and the guests' apartments of the Temple of Chiônin, were made over to two enterprising Japanese, who set up an hotel. A Frenchman from Kôbé was also allowed to open an hotel. A large number of men, dressed in European style, with "guard" worked in the cuff of their coats, were stationed in the streets, to act as guides to Europeans, and protect them in case of need, for which, however, there was no occasion, as a population more peaceably inclined, or better disposed towards foreigners than the present population of Kiôto it would be impossible to find. Performances by dancing girls in the theatre were provided for the amusement of foreigners, and the pleasure grounds belonging to a large residence were converted into a sort of public garden. Foreigners were also permitted to visit the places of interest in the neighbourhood, such as the tea district of Uji, Nara, an ancient capital of Japan, and Otsu, on Lake Biwa, a town seven miles off, and the resort of pleasure parties from Kiôto. Before the exhibition was thought of, in order to accustom the people to foreign style of living, the Kiôto authorities had ordered a European restaurant to be built at Otsu, on the shore of the lake, and on the ground where the castle formerly stood. When the exhibition was resolved on, this restaurant was converted into an hotel, and, as a further attraction to visitors, on fine nights there was a display of fireworks. In fact, the Kiôto authorities did all they could to make the residence of their foreign visitors pleasant, and it is much to be regretted that the number of Europeans was so small.

The exhibition was opened on the 17th of April, with the intention of leaving it open for fifty days. The time was, however, extended for another thirty days, and it was not finally closed until the end of July. At the end of June only 200 foreigners had visited Kiôto, and 21 only had gone on to Otsu, so that as a financial speculation the exhibition was a failure. The price for the admission of foreigners was one riô (about four shillings), and for Japanese 1½ boo (about 1s. 6d.). The attendance of the latter was never very large, the price of admission being too high for the mass of the people. There is a project, notwithstanding, to have another exhibition at Kiôto, on a grander scale, next spring, and to build a place expressly for it, instead of having it, as the last one, in three separate buildings appertaining to the three great temples of Chiônin, Kenninji, and Nishi Honguanji, the last over two miles distant from the other two.

The objects exposed were arranged with very little order as to age or country. At the entrance to the exhibition at Chiônin was an ancient gilt shrine, intended to be carried in processions, in juxtaposition with a wooden horse, covered with European horse-clothing. A French schoolmaster, resident in Kiôto, who had been employed in the direction of the Exhibition in Paris in 1867, was anxious to assist the directors, but they were loath to consult him, as doing so would have betrayed ignorance. Very few European goods were exhibited. Some merchants of Kôbé wished to send some things, but very little encouragement was given to them. Most of the articles were from Kiôto or the neighbourhood, and, with the exception of those belonging to the Mikado and a few other people, were for sale, and could be taken away at the time of purchase.

At Chiônin the principal things exhibited were:—Ancient armour; weapons ancient and modern; sword fittings; raw silk from different provinces of Japan, the best being from Kiôto; hemp; paper of all the different kinds made in the country; silk and cotton goods; brocade and velvet of Kiôto, manufactured, some of the former 8s. per foot, the latter 4s. per foot; tapestry, ancient and modern, the former mostly Chinese (£200 was asked for one piece representing the death of Sherka); dresses of ceremony; ancient and modern head coverings—amongst these and the armour were many things of historical interest, such as swords, armour, yeboshi (cap worn by nobles) belonging to Taikô Sama and other Japanese heroes; trays, baskets, &c., made from the fibre of the *Westeria* from Minakuchiya, in Omi; ditto from the wood of the fern from Okabi, in Enshu.

At Kenninji:—Ancient and modern utensils in silver and gold, of Kiôto and Osaca workmanship; very fine specimens of the old and new gold lacquer, Kiôto; sword fittings and small ornaments in shakudo, a mixture of copper and gold; small vessels, such as drinking-cups and pots, in sahari, a mixture of silver, pewter, and copper. The difficulty and labour of mixing these metals being great, a small utensil, in sahari, which has the appearance of polished bronze with a tinge of silver, is worth from £8 to £40. Modern enamel, cloisonné, from the province of Owari. This is imitated from the old Chinese enamel, and is little esteemed; a plate or saucer is sold for 6s. Ancient bronzes, some of great age, from temples; modern bronzes of Kiôto, manufactured in imitation of the old; musical instruments; plaster work; sweetmeats; porcelain and pottery from Kujomidzu in Kiôto, and specimens from Satsuma, Banshu, Owari, Bizen, and Karadzu, which last is the most valued by Japanese; Japanese coins of all ages, from the old silver coins, said to be 1,000 years old, from which pieces were broken when small sums were required, to the modern coins of the Osaca mint.

At Nishi Honguanji, the portion of this temple given up to this exhibition was formerly the habitation of the

Daisôjô, or chief priest, in the Bhuddist priesthood. The rooms are beautifully decorated, the ceilings, sides, and partition walls being painted, gilt, and carved. Several rooms here were full of illustrated manuscripts, silk and paper scrolls, ancient and modern, with figures or poetry painted on them, and intended for hanging on walls of temples or houses. Some with Chinese characters were specimens of the handwriting of Mikados. There were also a great many scrolls with birds and animals, in the representation of which the Japanese artists excel. The modern manufactures were fans, lanterns, dolls of Fushimi and Kiôto manufacture. There was also a collection of minerals, fossils, coral, crystal, and jade ornaments, and flint and crystal arrow-heads from the province of Nambu.

(Signed) C. W. Lawrence.

Yedo, August 5th, 1872.

Vienna Exhibition.—In addition to the general contributions from France, the city of Paris will be a considerable exhibitor; the Municipal Council has voted a sum equal to £4,000 for expenses, and has appointed a special commission, consisting principally of architects, engineers, and school inspectors. The city will show, amongst other things, plans in relief, photographs, and engravings of its principal monuments, churches, theatres, markets, schools, &c., together with plans of intended buildings. The city exhibition will form an independent division of the French section. We know that the number of British exhibitors inscribed is large, and in some departments of manufacture—agricultural implements, for instance—they will make a fine show, but Great Britain, as a nation, will, we fear, look very small at Vienna next year. Is it too late to ask why the first universal exhibition to be held in Austria is regarded so coldly by our government and authorities? They made a notable show in many respects—not in all—at the Paris Exhibition in 1867; if less is done for Vienna in 1873, it will, in diplomatic slang, be "worse than a crime, it will be a blunder."—*Architect.*

THE TRADE OF FINLAND.

Of all European countries Finland appears to be of the most recent origin. Whilst on the borders of the Mediterranean there existed regulated societies, founded by the Phœnicians, Greeks, and Etruscans; and whilst commerce, industry, and civilization flourished there, Finland was, in all probability, under water, forming the rendezvous of the waves of the Polar Sea and the Baltic. This supposition is borne out and justified by geological observations. For centuries back certain upheavals and depressions of the surface of the shores have been observed, so much so as to render excellent ports inaccessible, and to convert gulfs and straits into dry land. Along the shores of the Gulf of Bothnia, that is to say, from Wasa to Tornea, the rising of the ground, according to observations, is 4·5 feet in a century, whilst in the southern part of the country, that is to say, on the shores of the Gulf of Finland, the rise does not attain two feet in the same period. A glance at the formation of the country immediately presents the aspect of the bottom of a sea partially drained, the recesses being still filled with water. The entire area of the country, including all the lakes (excepting the Lagoda), is upwards of 6,367 geographical square miles, that is to say, about two-thirds of the extent of France, and a little more than the late Prussian monarchy. It was annexed to the Russian Empire in the year 1809, and enjoys its own government, constitution, and lands under the title of the Grand Duchy. It is situated between 59° 48′ and 70° 6′ north latitude, and between 38° 35′ and 50° 2′ longitude of Ferro. From the River Tana, which constitutes the northern boundary, to Hangoudd, the southermost point of Finland, the distance is 1,230 kilos., and from east to west, on the other hand, the extreme width is only 650 kilos. A country so far north as 60° cannot be expected to be richly favoured by nature; at the same time, with the exception of Scandinavia, no other country, lying in the same latitude, enjoys so mild a climate. The isothermal line, indicating the mean annual temperature, traverses Finland at 66° north latitude, whilst eastward, through European Russia, it descends to 60°, and in Siberia to 54°, and to the westward, in Labrador, it does not attain even 50°. Nowhere, except in Norway, does agriculture extend so far to the north as in Finland. Cornfields are to be found on the borders of the Muonio, 68°, and on the southern shores of the Lake Enari, 69°. Naturally, in a country of such vast extent, the climate in the north varies greatly from that of the south. The forests consist of the red pine, fir, and birch, and in the southern parts the oak, lime, and ash may occasionally be seen. Finland is more populated and cultivated than any other country in the same latitude. The population in 1865 reached 1,843,253 persons, whereas Norway and Sweden, at an extension situated below 60°, and equal to one and a-half the area of Finland, had together 1,615,000 inhabitants, and the three Russian Governments of Archangel, Olonitz, and Wologda, covering an area of 23,842 geographical square miles, or more than three times the surface of Finland, have only 1,555,560 inhabitants. Out of this population of 1,843,253 persons, the Finnish language is spoken by 1,500,000, the Swedish by 250,000, and the Russian by 4,000. In the northern districts there are about 1,000 Laplanders, and here and there Bohemians.

According to regulations in existence, no statistical report of the articles imported from and exported to other countries, excepting Russia and Sweden, is published; it is, therefore, extremely difficult to obtain correct figures as to the value of the goods exchanged with the various foreign countries. Mr. Consul Campbell has been enabled to supply this deficiency of information from a reliable source, by which it appears that Finland draws her principal imports from Russia, and next thereto from Germany, Great Britain, Sweden, and America. In exchange for her imports Finland has little more to offer than the produce of her forests, of which Great Britain receives by far the greatest share, and it may be stated that the value of the timber exported from Finland equals nearly one-half of the total export of the country. In the year 1864 there were 13,558,954 cubic feet of deals and boards shipped, and in 1870 32,220,766 cubic feet. The forests, however, are becoming from year to year more and more exhausted. Prices in the interior have advanced at least 30 per cent. within the last seven years, with every probability that, seven years hence, they will be 30 per cent. higher than now. The most, as well as the best, of the red pine shipped at Helsingfors, Fredericksbavn, and Lovisa is cut in the forests of Wütosaari and Rautslompi, about 300 miles from the coast. The trees are floated in single blocks through rivers and lakes until they reach Kaapokoski, the northern end of the great Pajane Lake, where they are collected and formed into rafts containing from 1,500 to 2,000 each, which rafts are towed by steamships of a peculiar construction either to the railway station at Lahtis, for shipment at Helsingfors, or to the river Kymene, for shipment at Fredericksbavn. Almost all the timber exported is converted into deals and boards for shipment, through the agency of steam and water saw-mills situated near the coast. In the export of tar and pitch no important increase is observable. In the year 1850 151,936 barrels of tar and 4,636 barrels of pitch were exported, and in 1865 the quantity increased to 193,722 barrels of tar and 15,063 barrels of pitch, and in 1870 receded to 137,285 barrels of tar and 4,100 barrels of pitch.

The export of these articles is almost exclusively from the towns lying on the Gulf of Bothnia, and foremost of them stands Uleaborg, from which port alone one-third of the whole export of the Grand Duchy is effected

During the last three years a considerable increase has taken place in the export of butter, and in 1870 the quantity reached 3,895 tons, the whole of which found its way to the German markets, viâ Lubeck. Perhaps in no European country has the agriculturist a more uncertain or more unpropitious climate to contend with than in Finland, and Mr. Campbell remarks that during his six years' residence in the country he has had the misfortune to see on two occasions the most magnificent crops of grain which a country could produce totally ruined through a single night's frost occurring in the month of July. The last total failure of the crops occurred in 1867, when the country suffered from a dreadful famine, but since then it has been blessed with abundant harvests, and is now enjoying great prosperity.

The most important public improvement which has yet been carried out in Finland, and one which will confer an incalculable benefit on the country, was completed in the autumn of 1870, namely, the construction of the line of railway connecting the port of Helsingfors with the capital of Russia. The line was built by the Finnish Government under the superintendence of Finnish engineers, and is allowed to be the cheapest railway in Russia. A new line is projected from Ruhimaki, a station on the St. Petersburgh line, to Hango Udd, the south-western extremity of the Grand Duchy. In the average of winters the harbour of Hango Udd is only impeded by ice during two or three months, whereas the port of St. Petersburgh is usually closed for five out of the twelve. The promoters of the Hango line are of opinion that their railway, when completed, will, during the time the river Neva is closed, draw the exports and imports from and to St. Petersburgh by that route. The enterprise may prove successful, but experience of these regions shows that this part of the Baltic and Gulf of Finland are unnavigable either for steam or sailing vessels during the months of December, January, February and March.

LABOUR IN GREECE.

From the backward condition of the Hellenic Kingdom and the poverty of the population, the only localities in Greece where there would seem to be any likelihood of there being an opening for English skilled labour are—Athens, the capital, with its port, the Piræus, and its out-port of Ergasteria; the two sea-ports of Syra and Patras; and Corfu, or other towns in the Ionian Islands. Mr. Watson, our representative, residing at Athens, assumes that a skilled British artisan, who is not desirous of living in a southern climate, would not be disposed to emigrate from England to Greece, unless by so doing he should hope to secure one of two advantages—namely, that by coming to Greece he might see his way to bettering himself in the items of his food and drink, his clothing, lodging, and amusements; or that he might be justified in expecting to be in a position enabling him to lay by money. Native Greek skilled labour is greatly inferior, in almost every branch, to the average English, French, German, or Italian labour in the corresponding branches, the departments in which Greek workmen show most skill being stone-cutting and shoe-making. The Greek population are for the most part essentially a poor community, in addition to their not being accustomed to any higher degree of civilisation or any superior style of workmanship to what Athens presents. These considerations would induce the great majority of persons resident to prefer indifferent native workmanship to greatly superior foreign skilled labour, provided the former could be procured for less cost. It would, therefore, appear to be scarcely worth the while of such British artisans as may not be able altogether to distance native workmen in the quality of their workmanship, to endeavour to compete with them at Athens, unless, indeed, such British artisans are prepared to accept the same amount of remuneration as is given to Greek members of the same craft. It would not, for instance, be worth the while of an English shoemaker, or an English mason, to exercise his calling at Athens, unless he could see his way to benefiting himself by accepting when there the prices given to a Greek shoemaker or mason. The journeyman cabinet-maker receives per day from 3s. 4d. to 3s. 9d.; the mason, carpenter, and house-painter receives per day 3s. 9d., the latter during ten months in the year, and for the two months of August and September he receives, per day, about 5s. 6d. The average expenditure of a Greek mason would be 19s. 6d. per month, and of an artisan somewhat higher, estimated at about 38s. per month. There are, at Athens, or in the neighbourhood, a not very large number of French, English, German and Italian, or other foreign skilled workmen employed, either in connection with the Piræus Railway, with the Athens Gas-works, with road-making, or with one or two other undertakings. There are also some French hairdressers, tailors, &c. There is a German cabinet-maker, and there is also a French pipe-layer, both of which latter employ some journeymen. The English engaged are chiefly men skilled in making or working machinery. At the lead-smelting works of Laurium or Ergasteria there are employed about 2,000 workmen in all, of whom 78 are foreigners—30 being Frenchman, 30 Italians, and 18 Spaniards. The latter receive from 6s. to 6s. 8d. a day, the Frenchmen and the Italians rather less: whilst the living of all costs them about 2s. a day per person. The native workmen receive about 2s. daily, and can provide for themselves for 8d. a-day. It may seem somewhat singular that, whereas all the produce of Laurium, amounting in value to more than £180,000 annually, is exported in British vessels to England, there should be no British hands employed in these works.

The bulk of the population of Athens, as well as of other places in its neighbourhood, being, as has been said, poor and unaccustomed to better workmanship than their country produces, put up with Greek artisans, whose charges are lower than those of foreigners would be; but Athens contains a Court and a diplomatic and cousular body, the members of which daily feel the absence of the ordinary comforts to which they have been accustomed in other countries. There are resident at Athens, under ordinary circumstances, a French, an English, a Russian, an Austrian, a Prussian, a Turkish, and a United States' minister, all of whom on their arrival have in a great measure to furnish their houses from abroad, but who would, of course, prefer to employ upholsterers and cabinet-makers for the purpose if they could find men in the country capable of supplying their wants. Mr. Watson mentions the circumstance of a Greek gentleman, whose state of health makes it convenient for him to pass the winter at Athens, having brought, two years since, three house-painters from England, on contract (paying their passage money both outwards and homewards), to decorate his winter residence. It appears that these three men, who were highly skilled artisans, preferred to return to England rather than remain in Athens. But Mr. Watson has been informed by several persons resident, in whose judgment he places reliance, that there now exists an opening in Athens for a limited number of skilled British artisans. He has consulted on the subject with various persons established, and with several employers of workmen, and these have replied to his inquiries:—"Do not discourage English artisans from coming to Athens. Steady skilled men might make their way here very well." The demand, however, for English labour would seem to be only for men skilled in making, managing, or repairing machinery, and for locksmiths, bell-hangers, house-decorators, sign-painters, and cabinet-makers. As to the quality of workmanship in Athens, the inconvenience, expense, trouble and in fact the impossibility of getting any repairs done to houses at the worst season of the year are very harassing to the occupant—with respect to locks, door-handles, varnishing, &c.; and in Athenian rooms their condition is utterly disgraceful. As a means of obtaining furniture the possessor of empty rooms has to purchase at sales—when these occur—such articles as may be presented, without regard to his taste or to their corresponding with each other. The German cabinet-maker is often unable to execute an order under months. Such being the state of things it would be a boon to the more civilised portion of the community if some English artisans, of the crafts indicated, could be made to see their way to emigrate to Athens with profit to themselves, as in that case some of the blanks in the skilled labour market would probably be gradually filled up; besides, were a better quality of skilled labour introduced into Greece, it might be hoped that a taste for better workmanship would thus be, ere long, created amongst the Greeks.

The usual daily routine for a European artisan in Athens, if he be a bachelor, is to take a cup of coffee, with some bread, on rising in the morning; to breakfast a little before noon, when, at the same hotel where he may board, a meal is put before him consisting of soup, with bread, boiled beef, with one vegetable, and one other dish. The butchers' meat is not of a very nourishing or tempting quality, but a person boarding at any hotel for a fixed sum per day receives at a meal a sufficient quantity of food to satisfy his appetite. The market supplies vegetables, including spinach, cauliflowers, tomatoes, onions, potatoes, and French beans in abundance; fruit likewise in great plenty, including grapes, apples, pears, melons, oranges and figs; whilst wine is within the reach of all classes at a very cheap rate, a quantity less than a pint being, as a rule, supplied at each meal to each person. The European artisan, after an abundant mid-day meal such as indicated, resumes his work until nearly sunset, when he returns to his eating-house for another meal, of one hot dish with bread and wine. With regard to the facilities which an artisan would find in Athens for clothing himself, the climate, it can be said, excepting during the months of December and January, is a very mild one, his clothing, therefore, would have to be of a very much less heavy description than such as is worn in northern climates. Of the amount of comfort which an artisan would find in his lodgings, there is little to say, further than that in a southern climate this item is, perhaps, not so very important as in a northern climate. One can procure, as a general rule, a clean room, unfurnished, or a furnished room in a hotel, which, under ordinary circumstances, can be rendered more or less comfortable. English artisans would find a language strange to them spoken, and, with the exception of a few engineers connected with the railway, they would find scarcely any of their fellow countrymen. At Athens, however, there is a British Legation, at the Piræus a British Consulate, and there is an English as well as a Roman Catholic Church. At the University reading room, any respectable person may have a daily opportunity of perusing the *Edinburgh Review*, the *Spectator*, the *Saturday Review*, &c., free of charge. Under ordinary circumstances the expenditure would be about £5 per month, which estimate does not make allowance for much recreation, nor for the possible event of illness. As to what remains of his yearly earnings to an English artisan established in Greece, one can only say that this would depend on his skill, his health, his industry, and his carefulness. Several of the foreigners established there have been enabled to realise considerable property. Any British artisans, however, who may think of emigrating, should assure themselves that they are really skilled workmen, whose workmanship, by its superior quality, would commend itself to general appreciation. It would be as well moreover, to advise any artisan, before starting on his voyage, to be sure that he is provided with the means of paying his passage-money back to England, in case of his expectations of finding remunerative occupations not being realised, or in case of the climate not suiting him. He must be prepared to remain some little time before it becomes generally known to the community that there is such a workman, and during such time he must be prepared to provide for himself from his own resources. In conclusion, Mr. Watson strongly recommends that no English artisan should go to this country who is not of uniformly sober habits. Whilst several Englishmen and others have done as well as they could have reasonably expected, the majority of foreign artisans and workmen who have tried their fortunes in Greece, have succumbed to the temptation of intemperance, which the intense heat of summer, and the cheapness of the country wines and spirits, combine to present to men who are, by the nature of their occupations, forced to undergo severe physical exertion.

CHANGE OF MARINE MEASUREMENT IN FRANCE.

The dispute relative to the measurement of vessels passing through the Suez Canal, has given rise to the adoption by the French government of the English mode of calculating the tonnage of vessels.

In France at present the volume of a marine ton is fixed by an ordnance, which is nearly 200 years old, at 42 cubic feet. The method of gauging vessels was fixed by Legrange, at the end of the last century, but an ordnance of 1837, which is still in effect, reduced the official tonnage by about a sixth, or to little more than half the capacity of the vessel.

The English commercial ton, of 50 to 52 cubic feet, corresponds very nearly with the French ton of 42 cubic feet; and, as the official measurement is taken on the basis of 100 cubic feet, the result was much the same as that of the French method. The practical application of the rule, however, differs considerably in the two countries; the French authorities assume a theoretical form for all vessels, while the English take note of the effective form of the vessel.

"The English official tonnage," says the Minister of Agriculture and Commerce, in his report, "has this advantage over the French gauge, that it is always in proportion to the effective capacity of the vessel; and, with respect to deductions made for steam vessels, the advantage is also in favour of the English method, by which the deductions are based on the actual space occupied by the machinery, &c., while in France they are fixed uniformly at two-fifths of the whole tonnage."

Most maritime nations have adopted the English method of measurement, and the Minister recommended that France should do the same, and in accordance with that recommendation the president of the republic has issued the following decree:—

Art. 1.—Trading vessels are to be measured after the method applied in England, &c. The dimensions serving for the calculation of the tonnage are to be expressed in metres, &c., and their product divided by 2·83 cubic metres. The number of tons thus obtained to be cut with a chisel on both faces of the main beam of the vessel.

Art. 2.—The decree to come into force from the 1st June, 1873. All vessels built after that date to be measured before such divisions or partitions are set up within the ship, &c.

In our report last week of the Educational Conference, held by the Social Science Association and the Scholastic Registration Association, the name of the Rev. Arthur Rigg was inadvertently substituted for that of Rev. Dr. Rigg, Principal of the Wesleyan Training College.

A new metallic compound has recently been invented in America, which is called white brass. It is said that it is susceptible of high polish, and fuses easily, and that it has been found to surpass in durability all other anti-friction metals against which it has been tested.

IMPROVEMENTS IN THE MANUFACTURE OF SILK.

In a report to the Societé d'Encouragement, in Paris, M. Alcan lately gave an account of some recent improvements in the production and manufacture of silk. Among the various branches of this industry are the rearing of the silkworm, the collection of the cocoons, the filature or reeling of the raw silk, the spinning, the utilisation of various waste products, and the dyeing and weaving of the threads in their manifold stages, from the singles, trams, and organzines to the finished silk tissues. Moreover, there belongs to the silk industry the obtaining of the silk substance from the body of the worms, and its use for fish lines and violin strings. Recently the regaining of the silk fibre from the silken rags has been added to it; and in regard to this, we would say that it is more important than the shoddy industry, inasmuch as the silk threads regained possess a proportionally higher value than shoddy, because, when used again, they differ less from the new material which is mixed with them. Of these various branches, we will first allude to the killing of the worms. The most preferable method would undoubtedly be that in which hot air is the means, were it not for the fact that the contrivances used for the purpose are still very defective. Hence steam is mostly employed, and this process is easy and inexpensive. Yet there is one disadvantage connected with it, as the cocoons absorb moisture; and if not dried with the utmost care, they require afterwards to be turned over several times a day to prevent their loss by decay. In foreign silk-growing countries, much care is bestowed upon this branch of the art. In China, for instance, they use *calorifères*, specially built in Paris with great care. To facilitate transportation, the cocoons are treated in hydraulic presses, whereby spots will most assuredly show themselves if the dead worms have not been perfectly dry. In order to simplify this process, M. Alcan conceived the idea of employing a volatile substance (camphor), which he did in the following manner:—Thirty pounds of cocoons, which were to be sent from Southern France to Paris, were packed into a box with a small quantity of camphor, all the cracks having been carefully closed by pasting strips of paper over them. Although forwarded at a time most favourable to the metamorphosis, not a single butterfly was found on opening the box; all the cocoons were saved, and the worms had assumed a mummy-like appearance; they were black, hard, and caused no spots. From these facts, it may be inferred that this process may well be used in the killing of the silkworm. M. Alcan called attention to another operation, namely, the filature or reeling, an apparently simple but important part of the treatment, and one that must be very carefuly carried out. To fully appreciate the importance of the improvement to be described, it may suffice to point out the fact that formerly the silk from China and the Levant commanded a much higher price than the French production. This condition of things has been changed, for in Europe the silk is now treated differently from the process still followed in Asia. For the better understanding of this operation, let us mention the principal points required in reeling. The most common, as well as the finest, raw silk consists of at least three or four single threads, as many as there are cocoons thrown into hot water, which is used for the purpose of softening the threads, and to separate them from each other. These single threads have unequal cross sections, and they are unequally thick throughout their length; and, moreover, they are not round, but rather flat. Great care is necessary to produce a uniform thread; it should be smooth and brilliant, and when torn it should not divide itself; if it does, the union between the single threads has not been perfect. The unification is accomplished by twisting the fibres on their way from the hot water-basin to the reeling-machine, and it is consequently important that the length of the twisted part should remain unchanged during the reeling of one kind of silk. It is said that to this end Vaucanson has constructed a very simple but ingenious apparatus which seems to answer all purposes. Unfortunately M. Alcan has neither furnished an engraving nor a clear description of the invention. Another point that is very important is that the number and equal strength of the threads should be maintained. As the filature progresses, the diameter of the thread varies; and for this reason new cocoons must be used from time to time in order to equalise the variation in thickness. The successful performance of this operation requires an apprenticeship of from two to three years. The third point to be observed relates to the lustre of the product. If the threads have not been properly reeled, they exhibit, when magnified, arch-like twists, and appear downy. But if they have been stretched in a straight line, they reflect the light, and attain the lustre peculiar to properly treated silk. The improvement made in the art of reeling consists principally in the application of steam power. By this the velocity may be regulated at will, and if the cocoons are properly freed from the gummy substance, the operation may readily be carried out. The product obtained is in every respect superior to that obtained by hand; and the process was imperfect as long as hot water, which is not easy to retain at a uniform and sufficiently high temperature, was used. The stuff called *paquetaille*, a common product, was largely obtained as waste by the direct application of heat. So long ago as 1810, Gensoul introduced the heating by steam, and from this time dates a new epoch in the manufacture of silk. Two or three years since, a new method for applying heat came into use in the silk districts of France. The inventor is the manufacturer Limet, of Coisne, department Nièvre, and the principle consists in the alternate or combined action of water and steam, the operation being effected by the alternate opening and closing of stop-cocks. The first stop-cock furnishes steam with which the cocoons are to be softened; by opening a second cock, they are impregnated with water, which is heated by the steam. If allowed to remain in this position they would sink to the bottom of the basin, which would be a great disadvantage; a third stop-cock is therefore opened, by which the water is allowed to re-ascend, whereupon the cocoons swell, diminish in weight, and again ascend to the surface. This operation requires from two to six minutes, according to the hardness, species, or origin of the cocoon. After this preliminary treatment, the reeling is done with great ease, so that the operatives, although generally opposed to innovations, are not likely to return to the old method if they have once used this process. Not only is the silk improved in appearance and the production increased twenty per cent., but defective cocoons may also be reeled without much loss or trouble. Besides, one cocoon or one hundred may be treated with equal certainty. The invention is characterised by the following considerations:—1. The steam acts uniformly on all cocoons. 2. By the boiling in water mixed with steam, the friction of the cocoons among themselves, which causes loss, is entirely obviated. 3. By the subsequent application of steam, the water is driven out from the cocoons, so that they are caused to float. The advantages claimed are:—1. The more carefully-prepared cocoons can be better reeled; there are fewer ruptures and less loss, and the workmen are enabled to produce one-fifth more silk. 2. The silk is smoother and without down, to which all manufacturers of glossy goods object; it is cleaner from gum, and more uniform and strong. 3. The apparatus saves labour, fuel, and time.—*Journal of Applied Science.*

Some of the scientific societies of London are, it is said, endeavouring to form a joint stock company, with a capital of £40,000, for the purpose of erecting a building which would serve as offices, with a theatre for meetings, &c.

CORRESPONDENCE.

COLOUR AND VISION.

Sir,—Mr. Tidy, as reported in the *Society of Arts Journal* of January 3rd, says: "If Mulready saw a sunset as a deep blue, he mixes his colours a deep blue, but inasmuch as to my eye the sunset is not a deep blue, but a deep red, as a matter of necessity the colour which Mulready mixed would be to my eye a deep red too. The simple fact is that Mulready saw, and Mulready painted, with the same eye."

But, sir, one day I wished to call a rather short-sighted lady's attention to a somewhat distant object in the landscape before us; and, by way of bringing her eye into a line with it, asked her if she saw a red house at no great distance off. After looking about she said, "Is it that pinkish house you mean?" "Well," said I, "to me it appears bright red." So she took her eyeglass, and on looking at the house through it, said, "Oh, yes, now it does appear red." So here we had an instance of red appearing to be a colour verging in the direction of blue, merely because the coloured object was beyond the range of her focus. I feel sure that if she were painting that landscape without glasses she would have used for the house a more blueish shade of red than I would have done. Whereas, if she were painting with glasses on, which brough her focus to the same range as mine, she would have used the same colour that I would have used myself. It seems, therefore, possible to me, that Mulready might have viewed his palette with precisely the same eye, so to speak, as Mr. Tidy; and, nevertheless, might have viewed distant objects with a very different eye because the focal range of his colour-vision differed.

I am, &c., J. C.

THE PERILS OF OUR IRON AND COAL INDUSTRIES.

The great strike still impending in South Wales recalls one of several propositions designed to avert such calamities, published in the *Journal of the Society of Arts*, of the 27th of September last, under the title of "Heads and Hands," and copied into the *Mechanic's Magazine*, the *Builder*, &c.

In so far as both heads and hands in South Wales are content that workmen's wages shall depend upon masters' profits, the issue raised might be capable of solution by various methods.

One such method is obvious. Let the workmen who mistrust their own capacity to investigate the masters' accounts, invoke the assistance of experienced accountants, altogether independent of favours expected professionally. For such service the best qualified might be official examiners of disputed income-tax assessments, or accountants restricted to public service, or say some retired professional accountant of repute, zealous to "have done the State some service."

The process could be one of mediation—not of arbitration. Moreover, and for a few weeks, the reduced rate of wages might be accepted provisionally; and, meanwhile, the ten per cent. at issue might be put aside to abide the result of the investigation.

Jacob A. Franklin.

London Institute, Finsbury-circus.

P.S.—While the above has been in type, waiting opportunity for insertion, Mr. Crawshay pleads, and with reason, that iron sold for £9 2s. 5d. per ton, must not cost him £9 per ton.

We may be sure that no outsider, but only the ironmaster himself, can determine the rate of profit (average) which will maintain production. But why should common ruin be encountered without affording a chance of evolving, from trustworthy investigation, data fitted to adjust wages by profits by common consent, and possibly with reciprocal guarantees? J. A. F.

GENERAL NOTES.

Cape Diamonds.—It is stated that the largest diamond in the world was found on November 7th, at Waldeck's Plant, by a lucky Mr. Robert Spalding. The stone is lustrous, but off-coloured and has a spot in it. Its weight is 228 carats; from the same claim were also taken a 60-carat and a 30-carat diamond.

A Crystal Palace for New York.—The people of New York, encouraged by the example of the Crystal Palace in London, have determined to commence a similar undertaking in their own city. The "Industrial Exhibition Company" has been started, and a grand dinner was given at the St. James's-hall, in order to discuss the position and prospects of the company. The directors intend issuing 1,875,000 dollars stock, at 80 cents on the dollar, and to purchase a plot of ground outside the city, at a cost of about 252,000 dollars, for the erection of a permanent industrial exhibition. The matter is said to be in very good hands.—*Builder.*

Channel Passage.—The famous Bessemer ship (writes the St. Petersburg correspondent of the *Morning Post*) has just encountered an unexpected rival in the floating cabin devised by M. Alexandrovski, the inventor of the "under-water vessel." The construction is very much the same as that of the Bessemer, but the cabin, instead of being attached to a pivot, literally floats in a kind of tank placed amidships between the engines. The invention was tested not long since by the Grand Duke Constantine, in his capacity as heap of the naval department, with a perfectly satisfactory result; all efforts to shake the cabin proving utterly unsuccessful, the pitching as well as the rolling motion of the vessel being completely counteracted. M. Alexandrovski was expected shortly to leave for England, in order to patent his invention, intending to visit France a little later with the same object. We may remark that something of the same sort has already been patented, though we are not aware if any experiments have been made with such an apparatus.

The St. Gothard Railway.—The operations for the piercing of the St. Gothard tunnel are proceeding vigorously. The line is already staked out from Fluden to the entrance of the tunnel at Goschenen, as also from the opposite end at Airolo. Workshops and engine-houses are being constructed at the two points where the work of blasting will first commence, and it is expected that the actual work of piercing the tunnel will commence early next spring. The tunnel will be large enough for a double line, and will be perfectly straight, with the exception of 160 yards at the southern extremity, which will form a curve of 328 yards radius, for the purpose of uniting the centre line of the tunnel with that of the station Airolo. The length of the tunnel will be 16,300 yards, or 9 miles 46 yards, and the section, of about 200 yards, which will form the culminating point near the middle, will be 3,780 feet above the sea level, or about 40 feet less than the maximum height allowed. The gradient from the highest point within the tunnel, to the station of Goschenen, a distance of 8,155 yards, will be 5·82 per thousand, and from the same point to Airolo on the south, a distance of 8,145 yards, it will be 1 in 1,000. At the Goschenen end the curve of junction of the centre line of the tunnel with that of the railway will be outside. The transverse section will present the same dimensions as the Mont Cenis tunnel, that is 7ft. 9in. in height, and from 25ft. to 26ft. 3in. width. The two entrances, as well as the station at Goschenen, will be protected by strong retaining wal against the danger of avalanches, or the falling of detached masses of rock or earth from the mountain. The above mentioned figures will indicate something of the character of the work required for the tunnel proper, which however is nothing in comparison to that which will be needed for the approaches. The little mountain valley of Goschenen, situated at the junction of the Reuss and the Goschenen-Reuss, already begins to wear the appearance of a manufacturing town. New buildings are rising on every hand—inns, cafés, workmen's houses, workshops, &c. Proceeding along the St. Gothard road towards the Devil's bridge, one may perceive to the left of the roaring mountain stream at the foot of a perpendicular group of rock, a small black opening, like a rabbit-hole. This is the future northern entrance to the great Alpine tunnel.

Traction Engines in Germany.—A regular service of traction engines on the common roads has lately been organised by M. Stemmuller, of Gummersbach, for the carriage of goods between that place and Cologne, a distance of 12 German leagues, and also between Gummersbach and Lenness, a distance of six leagues, and according to all accounts these lines are giving great satisfaction.

Extract of Meat.—Professor Artus, of Jena, says the *Journal of Applied Science*, recommends a new method of making extract of meat, which possesses the advantage above that of Liebig of retaining the albumen, gelatine, and fat, which are all removed by Liebig's process, and which would seem, from recent experiments, to be the only really nutritious elements of the meat. For this purpose an extract of meat is first made with cold water by means of a very simple apparatus; this dissolves out the soluble salts, the albumen, and part of the gelatine and creatine. The meat, after having undergone this process, is then boiled for an hour in a Papin's digester, and the liquid pressed out. The fat is skimmed off its surface, and this extract is mixed with the cold extract, and the mixture is then evaporated at a proper consistence in a sand-bath, or better, in a vacuum apparatus. This certainly seems a much better way of preparing an extract of meat than any of the methods which necessitate the throwing away of the most valuable of its constituents.

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

REPORTS ON THE LONDON INTERNATIONAL EXHIBITION OF 1872.

The reports which appeared in the last volume of the *Journal* on the various sections of the above Exhibition, are now published complete in a pamphlet form (price 2s.), and can be obtained at the office of the Society.

THE LIBRARY.

The following works have been presented to the Library:—

Society of Engineers. Transactions for 1870. Presented by the Society.

The Philological Character and Genius of the Modern Greek Language. A Lecture by Professor J. Stuart Blackie.

The Parliamentary Buff Book for 1871 and 1872. By Thomas N. Roberts. Presented by the Author.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. The following meetings have been arranged.

January 22.—"On Rendering Wood Incombustible." By D. O. Macomber, C.E.

January 29.—"On Guilds and their Functions." By John Yeats, Esq., LL.D. On this evening Thomas Webster, Esq., Q.C., will preside.

February 5.—"On Ships for the Channel Passage." By Lieut.-Col. A. Strange, F.R.S.

CANTOR LECTURES.

The second course of these lectures, viz., seven, "On the Energies of the Imponderables, with especial reference to the Measurement and Utilisation of them," will be delivered by the Rev. Arthur Rigg, M.A., on the following evenings, at eight o'clock:—

Lecture I.—Monday, February 3rd, 1873.

On the Sources, Inter-relations, and Measurements of Energies—Units of Measurement.

Lecture II.—Monday, February 10th, 1873.

On the Energy of Gravity, with especial reference to the Measurement and Utilisation of it.

Lecture III.—Monday, February 17th, 1873.

On the Energy of Vitality, with especial reference to the Measurement and Utilisation of it.

Lecture IV.—Monday, February 24th, 1873.

On the Energy of Affinity, with especial reference to Suggestions for Estimating and Utilising it.

Lecture V.—Monday, March 3rd, 1873.

On the Energy of Electricity, with especial reference to the Measurement and Utilisation of it.

Lecture VI.—Monday, March 10th, 1873.

On the Energy of Light, with especial reference to the Measurement and Utilisation of it.

Lecture VII.—Monday, March 17th, 1873.

On the Energy of Heat, with especial reference to the Measurement and Utilisation of it.

Members are entitled to attend these lectures free, and to admit two friends to each of them.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...British Architects, 8.
Medical, 8.
Asiatic, 3.
Victoria Institute, 8.
Social Science Association, 4. Mr. John Liddle, "On the Defects of the Sanitary Provisions of the Building Act, 18 and 19 Vic., c 122, with Suggestions for their Amendment."

Tues....Royal Institution, 3. Prof. Rutherford, "Forces and Motions of the Body."
Civil Engineers, 8. Discussion on Colonel Greathed's Paper, "On Irrigation in Northern India."
Pathological, 8.
Anthropological, 8. Annual Meeting.
Zoological, 8½. 1. Rev. John T. Gulick, "On the Classification of the *Achatinellinæ.*" 2. Mr. Raphael Meldola, "On a certain class of cases of variable protective colouring in insects, &c." 3. Mr. A. H. Garrod, "On the visceral anatomy of the Sumatran Rhinoceros (*Ceratorhinus sumatrensis*)." 4. Mr. A. D. Bartlett, "Notes on the Birth of a Sumatran Rhinoceros."
Royal Colonial Institute, 8. (At the House of the Society of Arts.) Lord Bury, M.P., "On the Washington Treaty, a Balance of Advantages, &c.
Statistical Society, 7¾. 1. Dr. Guy, "On John Howard as Statist." 2. Mr. Francis Galton, "On the Relative Supplies from Town and Country Families to the Population of Future Generations."

Wed. ...**SOCIETY OF ARTS, 8.** Mr. Macomber, "On Rendering Wood Incombustible."
Royal Society of Literature, 8½.
Archæological Association, 8.
Geological, 8. 1. Mr. J. F. Campbell, "On the Glaciation of Ireland." 2. Mr. D. Mackintosh, "Observations on the more remarkable Boulders of the North-West of England and the Welsh Borders." 3. Mr. J. Lucas, "On the Origin of Clay Ironstone."

Thurs...Society for the Encouragement of Fine Arts, 8.
Royal, 8½.
Antiquaries, 8½.
Royal Society Club, 6.
Royal Institution, 3. Dr. Debus, "Oxidation."

Fri ......Royal Institution, 8. Prof. Birks, "Analogies of Physical and Moral Science."
Royal United Service Institution, 3. Commander W. Dawson, "On Powder-pressures in the 35-ton Gun."
Architectural Association, 7½. Mr. Sulman, "Teachings of some Old Churches in North Hants."
Philological, 8¼.
Quekett Club, 8.

Sat ......Royal Institution, 3. Dr. Freeman, "Comparative Politics."
Royal Botanic, 3¾.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,053. Vol. XXI.

FRIDAY, JANUARY 24, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

SCHOOL EFFICIENCY.

The Council have the pleasure of announcing that they have received a communication from Mr. John Buckle, placing at their disposal the sum of £100 to be offered as a prize to the Head-Master of any school conducted on the half-time principle, who shall, within a time to be fixed, produce the greatest number of well-trained pupils at the least cost per head for their tuition. The Council to fix the time to be allowed for the competition, the character of the examination, and the tests of successful training.

The offer has been referred to a Committee to settle the details.

PRIZE FOR STEEL.

1. The Council have resolved to award the Gold Medal of the Society to the manufacturer who shall produce and send to the London International Exhibition of 1873 the best collection of specimens of steel suitable for general engineering purposes.

2. The specimens exhibited must include a complete illustration of the applications of the varieties of steel submitted.

3. Each manufacturer should send with his specimens a statement of the nature of the tests he has applied to each kind of steel submitted, and give the results of such tests.

4. The samples tested are to be exhibited together with duplicate samples, or portions of the same samples; these will be submitted to tests should the Council consider it desirable.

5. The Council reserve to themselves the right of withholding the premium, in the event of the specimens exhibited not being sufficiently meritorious.

FOOD COMMITTEE.

The Committee met on Wednesday last, at 4 o'clock. Present:—Mr. Benjamin Shaw, in the chair. Mr. F. A. Abel, F.R.S., Mr. Hyde Clarke, Sir Antonio Brady, Rev. J. E. Hall, Mr. W. H. Michael, Dr. Pitman, Mr. Samuel Redgrave, Mr. E. C. Tufnell, and Mr. J. A. Youl.

The Committee had before them, sent by the Central Queensland Company, a specimen of meat from that colony, prepared under Fryer's Patent, which consists in placing the meat in tins hermetically soldered down and subjected to heat in an atmosphere of steam under pressure.

The Committee directed the following minute to be recorded.

Without expressing a final and decided opinion on the process (which from a single specimen they are scarcely warranted in doing), the Committee are of opinion that the specimen before them compares favourably with the meats that they have previously received from Australia prepared by other processes. They regard the products of this new method as in many points encouraging, and hope that they may have further opportunities of examining its results. The meat is perfectly fresh and sweet, but (as in other cases of Australian meats) somewhat insipid from over-cooking. In this instance the flavour and moisture have been transferred to the jelly to too great an extent. Like all other tinned meats, it seems likely that the flavour could be improved if the duration of exposure to heat could be shortened without endangering the preservation. The Committee would suggest that the Company should remit to them a duplicate series of five tins, prepared at various durations of heat exposure, in order that they may be better able to form some judgment as to the amount of time most conducive to the success of the process.

PROCEEDINGS OF THE SOCIETY.

SEVENTH ORDINARY MEETING.

Wednesday, January 22nd, 1873, T. R. Tufnell, Esq., Treasurer for the Society, in the chair.

The following Candidates were proposed for election as Members of the Society:—

Bannister, Robert Hope, 80, King William-street, E.C.
Walduck, Henry, 4, Warwick-court, Holborn, W.C.
Watt, Philip B., 3, Bilbie-street, Nottingham.

The following candidates were balloted for and duly elected members of the Society:—

Colebrook, John, 15, Hans-place, Chelsea, S.W.
Dean, James, Clapham-common, S.W.
Henry, Wm. G. P., 11, Grosvenor-crescent, Edinburgh.
Lawrence, Lieut.-General Sir Arthur Johnstone, K.C.B., Fox-hills, Chertsey.
Lawson, John, Halifax.
Maynard, Frederick, 55, Old Broad-street, E.C.
Muzio, Augustus, 33, Highbury-grove, Highbury, N.
Nicholson, Vice-Admiral Sir Frederick E., Bart., C.B., 15, William-street, Lowndes-square, S.W.
Sandeman, Richard, Lenzie by Glasgow.
Scott, John Chastleton, Bickley, Kent.
Smith, Arthur, 44, Chiswell-street, E.C.
Taylor, John Edward, 12, Queen's-gate-gardens, S.W.

The Paper read was—

ON RENDERING WOOD INCOMBUSTIBLE.

By D. O. Macomber, C.E.

Man is surrounded by what in former times have been called the four elements, viz., earth, air, water, and fire, but modern science has demonstrated that earth is composed of many earths—air, a compound of at least two gases; water, a compound of hydrogen and oxygen; and fire, only the production of light and heat during combustion. For our present purpose, however, it is most convenient to consider them as original elements, and as such they are all intimately connected with our subject of this evening, viz., rendering wood incombustible.

To the earth man is indebted for food, clothing, and the mineral and metallic substances, which, together with the rocks and carbons, form the bases of all the improvements and progress of the world.

Air, which forms the vital principle of life, and upon the purity and abundance of which depends our health, and the total loss of which is death, is not less important, inasmuch as modern science is rapidly converting it, by condensation, into a controllable motive-power.

Water, which forms the far larger portion of the surface of the globe we inhabit, as well as of our own bodies, and of all animal and vegetable life, seems to have been the parent of all the other elements, for it dates its existence in chaos, and claims priority by the creating hand of the great God of the universe. Of all the elements it seems the most wonderful in its functions and transformations. It descends in genial showers to water the thirsty earth, or it deluges a world and sweeps man and beast away in its course. It is invisibly absorbed in the atmosphere, and it is poured down in the destroying water-spout. It floats the navies of the world, and it swarms with curious animal and vegetable life. You may burn it, or extinguish a burning with it. It softens, permeates and cooks our food, quenches our thirst, and supplies the greatest modern power of the civilised world. You may burn, evaporate and scatter it abroad, but you cannot really waste a drop of it. You only change its condition. It is in the vapour, the atmosphere, and the world yet.

But fire is the friend, the slave, the master and the consumer and conqueror of man and his works. Although the true definition of fire may be merely "solid or gaseous matter at a high temperature," yet by fire we understand the activity of heat, when supported by an amount of atmospheric air sufficient to consume or disintegrate those bodies to which it is applied, or with which it comes in contact. If we look above by day (when fog and clouds permit) we see the great source of light and heat, 95 millions of miles distant, and modern research proves it to be a monstrous globe of active fire, flashing its flames out hundreds of miles from its body. If we search below the surface of our earth, we find the temperature rising (as we sink our shafts) one degree for every sixty feet, until at 2,500 feet deep (could we reach it) lead would melt, at 74 miles cast-iron, and at 190 miles rocks would be fused, and every known substance become liquid; the thin crust of the earth is passed, and heat reigns supreme.

But with all this a kind Providence has placed within the reach of man, guided by reason and science, the means of in a great measure controlling this destructive element, and rendering it obedient to our wills, a powerful auxiliary of progress in all the arts that minister to man's happiness, his warmth, comfort, and satisfaction, But it is not to be overlooked that the higher we advance in civilisation, the more boldly we stretch out into the fields of invention, progress, and improvement, the more intimate we become with the daily use and contact of this element.

Man in an uncivilised state requires heat for two purposes alone—warmth and cooking his food. In the countries under the tropics, where the sun furnishes heat in abundance, and ripens the abundant fruits of the earth, artificial fire is but little needed. In high northern latitudes, likewise, it is not a little singular that only a small portion of the fat of those animals which are used for food and for clothing, furnishes all that seems to be required for light and warmth; and the inhabitants of those apparently inhospitable regions enjoy all the comforts of home and kindred, with an increased attachment for their birthplace and climate, compared with the natives of more genial skies and brighter lands.

In the construction of the habitations of man, when the world was young, the materials nearest at hand were the trees, bushes, leaves and grasses which the temperate zone produced. These, as they became dry by exposure to the sun and air, became highly inflammable, and we may well suppose were often destroyed, even with the scanty use of fire of that period. But as man increased in numbers and began to build cities, he sought for more solid and durable materials. Stone, where it could be found in abundance, and unburned brick of clay or mould, as the best substitute for stone, was used, until wealth, taste, and love of the beautiful began to be developed in the use of marble and precious stones, as the interior of tombs, palaces, and pyramids testify. But ever and always the use of wood was predominant, as is proved by the fact that cities have been destroyed by fire from the earliest ages of antiquity. Indeed, it is scarcely possible to know how all the interior doors, casings, carvings and adornments of every kind could possibly have been wrought in any other material than wood. And so it has been in every age, and so it has come down to the 19th century. We do not mean to say that iron, stone, brick or plaster may not be used throughout a church, a palace, a house or a store, but the cold and rigid nature of either of these materials, to say nothing of the enormous cost, will probably always exclude them from universal use in interior ornamentation, and most certainly in furniture.

In the use of wood for any and all constructions for human habitations there are mainly but two objections, its liability to be destroyed by time and by fire. And it is not a little curious that attempts to preserve it from the slow destruction of the former of these have been the first to engage the attention of mankind, while to immunity from the rapid and fearful effects of the latter there has hardly been given a thought. Perhaps we may find a solution to this in the fact that from the earliest ages mankind seem to have been impressed with the idea that wood in buildings, when once ignited, must continue to burn until it is extinguished by the opposite element. Hence we find at an early day in the history of large towns and cities, that some rude methods were adopted for this purpose, and reservoirs for collecting and preserving water were contrived and used. But perhaps the universal impression that wood must be kept and continued combustible in order to be used as fuel, for warmth, for light, and for cooking, may have had something to do with this apathy in rendering it incombustible. The discovery of coal is quite modern, and that of mineral oil, and the illuminating and heating properties of other hydro-carbons, still more so. Therefore, let it be understood that in all our successful means of rendering wood incombustible, enough must be left in its natural state to kindle our coal-fires.

Nearly all fires originate in one or more of the following causes, electricity, spontaneous combustion, friction, carelessness in handling or controlling the element, and incendiarism.

No disastrous fire can be kindled where there is no wood that is combustible in the building in which it originates! To render any fire injurious to a great extent it must have a certain amount of atmospheric air, and this produces a flame. A fire may smoulder for an almost indefinite length of time, in certain combustible materials, engendering gases, but it assumes a dangerous condition only, when, by a supply of air, it bursts into a flame. If any method can be devised to prevent this flame, where there is no explosive material, not one building in five thousand could be destroyed. As stone, iron, brick and plaster will not of themselves ignite, there is only one building material to guard against, and that is wood. But unfortunately wood is the very material which is, and must be, used to a great extent in the construction of the interior of our buildings. The doors, window-frames and casings, the floors, base, ceilings, lath-work, and nearly all our furniture, are formed of some kind of wood.

The wood once kindled into a flame, and this flame allowed to get headway, our plaster partitions, our solid stone or brick walls, and iron, tile, or slate roofs rapidly melt, disintegrate, and give way under the intense heat. A common fire in a grate or fire-place gives but about 800 degrees of heat, but, increasing in intensity as it gains in volume, it soon rises to 1,070, which heats iron to redness, and this communicates instantaneous flame to wood or other combustible matter, and at 2,754 degrees iron melts, and granite disintegrates and crumbles to atoms.

Perhaps in the general use of stone, brick, iron and plaster, the City of London is as securely built as any city in the world, unless we may except Paris and Florence. But we have no better standard by which to judge of the security of our city and its presumed exemption from the destructive element, than the experienced judgment of its inhabitants, as proved by the amount of money they are willing to pay yearly for a partial exemption from this loss. The amount of property insured during the past year by 52 fire insurance companies in the City of London as we learn from the Law Fire Insurance Society's almanac for 1873, was £463,235,000 sterling. The amount paid on this, at the medium rate of premium of 28 shillings on a thousand pounds, was £16,544,000.

Now, what is the nature of an insurance against fire? It is merely a contract by an individual with a company to share with such company a portion of his loss by fire, for doing which the individual pays to the company a certain sum in cash in advance, which thus for a time, and to a specified amount, becomes a partner in any loss by fire which may occur on the premises during one year. If a fire does not occur during the year, the amount thus paid is a clear gain to the insurers and a dead loss to the insured, except in the feeling of safety and content which the consciousness of such bargain must give, a feeling which, perhaps, fully repays the insured, for no prudent man will allow valuable property to go uninsured. Insurance companies, then, are a necessity and a blessing; but can none of the calamities and losses by fire be mitigated or diminished? It may be possible to ascertain exactly what has been the real loss of property in the City of London, and even in the whole of Great Britain, during the past ten years by fire, but I have not been able to get figures sufficiently accurate to put before you. At all events the amount must be very large. I happen to know what it has been during the last two years in the United States of America, including the Chicago and Boston fires, and it amounts to something over £55,000,000 sterling, or more than 275,000,000 dollars. This is a low estimate of the money value, to which must be added the loss of human life and the human suffering.

There are many substances which may be used to render cotton or linen fabrics partially or wholly incombustible for a period of time, but recently the tungstate of soda has been most frequently applied in a liquid state for this purpose. An external wash of minerals mixed with clay, lime, and charcoal has been applied to rough wood-work, and this for a season will effect the object. But none of these, nor the manner of applying them, satisfactorily answers the great question—Can all kinds of timber for ship-building, beams for house-carpentry, and the finishing of dwellings, warehouses, and stores, and wood furniture, be rendered incombustible on a large scale, so cheaply as to render the use of such wood and lumber economical for the ten thousand purposes to which it is applied? No superficial application, no washing over after the work is finished, no painting, will answer this universal want. The nature of the wood must be changed at a period when it is capable of being permeated with a liquid, vapour or steam, that will effectually and for ever prevent such wood from becoming inflammable. It is not possible, nor is it necessary, to prevent wood from carbonising when exposed to a high degree of heat. But if it can be so prepared that it will not break out into a flame, the object will be obtained, for no fire can ever be made extensively or rapidly destructive unless by actual flame, which spreads the element to all combustible material that it meets with.

As I have said before, there are many methods (some of them secured by patents) to render timber indestructable by time, especially the timber of piles for wharfing and foundations, or of railway-sleepers and cross-ties for telegraph poles, &c. Many, and perhaps all these methods have been, and will continue to be, successful. But it is known to all of you, probably, that the material applied for this purpose only penetrates the timber a trifle beyond the surface, deeper, however, at the ends than the sides of the timber, and is always applied after the wood is fitted for use. Heated coal-tar, resin, or other hydrocarbons, are the substances generally made use of, and these will, if properly prepared, prevent moisture from penetrating, but we must remember that all hydrocarbons are much more inflammable than dry wood itself, and therefore nothing of this kind will avail us in rendering wood incombustible. We are now again brought round to the recurring question,—Can all kinds and qualities of wood be cheaply rendered incombustible before they are sawed up into the various shapes and sizes in which we find them in our timber and lumber yards? After many years of investigation and experimental labour, I now think this question may be answered in the affirmative.

Nearly all the vegetable world draws most of its moisture from the earth. The "pores" of wood, as they are usually called, carry up at certain seasons of the year nearly pure water from the roots, through the body and branches to the new shoots and leaves. Under the power of the microscope, these pores or tubes, in some trees to the number of a million to the square inch, can be traced in a continued unbroken series, conveying the moisture, by capillary attraction and the natural laws of heat and evaporation, upwards and downwards through the trunk of the tree, adding a ring or circle of growth for every year of age in all the various woods of which we make use for building and other purposes.

When the tree, taken in its live and growing state, is cut down, the process of evaporation or seasoning commences. At this time all the pores of the tree are distended, and at certain seasons are full of sap. To expel this sap from the pores while the log is in its natural state, and to introduce the substance which will render the wood for ever incombustible, is now the desideratum.

All timber in seasoning "shrinks," or is contracted. This is entirely owing to the expulsion of the water from the sap-tubes, and the consequent contraction of the walls of these tubes. Now, when the water is expelled by evaporation, if it has contained any substance held in solution, a portion of that substance will be left as a deposit upon the walls of these sap-tubes or cells. If this substance is of an incombustible nature, although it were so thin as to be invisible to the naked eye, yet, as it is equally spread upon both sides of each partition of the tubes or cells, it renders the entire log, and consequently every plank, board, or lath cut from the log, incombustible.

It will be apparent to all, then, that after the sap-tubes have been emptied of the moisture which has been the sustaining aliment of the tree, and they have collapsed, or nearly closed up, no immersion in liquid, even though it should be kept at boiling point for an indefinite length of time, will thoroughly and uniformly permeate the wood so that the centre of a log or plank will be as perfectly saturated as the outside.

The following is the manner which I have adopted for the purpose of expelling the natural sap or moisture from the green timber, and introducing the liquid which will render such timber for ever after incombustible. At an elevation of about 40 feet above the log, I have a reservoir containing, say 500 gallons, with a depth of liquid of at least eight feet. From this reservoir a two-inch pipe descends perpendicular to the log. The log, which is double the length of the boards intended to be cut, is sawed nearly in two, transversely, at its centre, leaving a strong "curb" or joining piece on the underside—not cut through. By raising the centre with wedges, or a screw, this transverse cut will be opened, mostly at the top, but partially down to the bottom. Into the cut I introduce a cord or wire, prepared for the purpose, and lay it around the cut just inside the bark of the log, bringing the ends together, to meet at the top. Now, by removing the wedges, or turning the screw down, the two ends of the log will close again tightly, with the exception of perhaps a sixteenth of an inch, according to the size of the cord or wire, which is held so tight as to prevent the escape of any liquid.

I then bore a hole on the top of one of the logs, towards the cut, at an angle of 45 degrees, so that it will fit just into the cut, and into this I introduce the bottom of the vertical tube, which is connected with the reservoir above, the tube being diminished in size at the bottom to allow it to fit tightly into the bore, which reaches the cut just inside the cord at the top. When ready, I open the stop-cock at the top of the tube, and allow the full pressure of the 40 feet of liquid to flow into the pipe. The space at the ends of the two logs is instantly filled, and the pressure is very great, forcing the liquid into every pore of the timber each way alike. In a short time the natural sap is forced out of the ends of the log, and is followed by the prepared liquid, which is equally limpid. As soon as the latter begins to appear at the ends, a process which takes but a few hours, the process is ended, the preparation is shut off, the logs are divided, and are then ready to be sawed into boards, joists, laths, &c., and the stuff will season in the usual way. The weight of the timber is very little increased as compared with other stuff not prepared. But the whole of the timber is thus permeated from centre to circumference, and will not blaze at any amount of heat to which it may be exposed.

I have thus adopted a method by which, without the use of steam or machinery, a powerful agent can be brought to effect the dislodgement of the natural sap, throughout an entire tree, however large (and perhaps the larger the better), when cut into sections, while by the same power, and in a few hours, I supply its place by filling the pores or tubes with a prepared liquid, which will render the wood incombustible without changing its colour, strength, or softness. I have been asked what effect this process will have upon the durability of timber. I cannot say that it would last for ever, but we have the strongest reasons for believing that it will protect from all decay by moisture, fungus, or salt water. Of one thing I am certain,—timber prepared in this way will never be attacked by worms or borers; and the white ant, so destructive to timber in warm climates, will not touch it. The importance of this, in relation to ship-building, is second only to that of the impossibility of its destruction by fire.

One of the shrewdest of journalists, a man of world-wide fame who has just passed away, said, more than thirty years ago, that there were three great desiderata in the civilised world which he hoped to live long enough to see accomplished. The first was, the connection of England and America by telegraph wires under the ocean; the second, the utilising of the waste screenings and dust of mineral coal; and the third, the rendering ship and building timber of all kinds incombustible. He did live to see the two first wishes realised. Can it be that the last is not within the power of man to accomplish? Because a thing has not been done, is that a valid reason that it never can be? Would such a deduction be in accordance with the spirit of the age?

There are three substances which, combined in proper proportions, will accomplish this object. As I have said, however, seasoned wood of any kind cannot, for the reasons mentioned, be made indestructible by fire. The external surface may to a certain extent be rendered incombustible. Seasoned wood can only be affected by immersion, and that only partially, as a few specimens which I have here will show you. Please bear in mind that any wood, even if fully prepared, can, when steadily exposed to a high heat, be carbonised, changed into charcoal; but if it cannot be fanned into a flame, if the introduction of air will not cause it to break out into a blaze, no danger need be apprehended from it; even incendiarism, the worst and most revolting of all crimes, cannot fire a dwelling, a warehouse, or a ship; and is it not worth all the time and expense it may cost in introducing such an improvement when we remember the vast amount of life, property, and suffering it must save? In relation to the expense of the process, I believe, after much inquiry as to material, &c., that on a large scale all woods may be rendered incombustible by an increase of not over 20 per cent. on the ordinary price of the same timber and lumber in its natural state, perhaps for much less than this. As I do not come before you with a patent, I trust I shall be excused my omission of any further detail of the process, and the more inasmuch as it would be hardly possible for any individual to properly test the process without some of the experience and outlay to which I have myself been subjected. I shall, however, be glad to confer with any gentleman who may see in this improvement great benefits to commerce and the building art, and a new means of preventing the loss of human life.

At the conclusion of the paper Mr. Macomber exhibited some bits of wood and shavings that had been treated by his process, and showed that they did not flame, though they could be carbonised by exposure to heat. He said that he had not been able to procure a piece of green wood that he could treat, and in consequence the specimens shown had not been thoroughly impregnated, but only coated with the liquid on the exterior.

DISCUSSION.

The Chairman then called on any gentlemen present who might have any remarks to make upon the paper.

Mr. Leete said that the very object in drying the timber was to get rid of the sap, and if in this process the liquid was inserted, and took the place of the sap, and the drying process then commenced, he would like to know what effect it would have?

Mr. W. Smith said that it seemed to him the very essence of the lecture had been lost for the want of a piece of green wood. He was quite sure that if notice had been given, the Society would have supplied a piece of green wood, so that they might have seen the effect, for those little pieces of wood which the lecturer had burned indicated nothing, as they were dry, and contained no sap. The very essence of the process, as he understood, was to expel the sap and insert something else, whereas in those pieces of wood there was comparatively no sap.

The Chairman observed that it would not only have been necessary to provide a piece of green wood, but to have made a tube 40 feet high, with the necessary apparatus besides.

Mr. E. O. Symons said the description of the lecturer was one which any body could understand, but the difficulty was this—it was all very well to say that this process could be accomplished—he believed it could be done effectually—but could you get people who had to do with the wood in its green state in Norway and Denmark and other parts of the world, to apply the process to the timber that they send over here for use. The change could only be brought about when the wood was green. The timber for ship-building was brought from foreign countries, and when it arrived here it was not in a state to receive the process. If the apparatus were erected where the tree was felled, then it might be done effectually, but he feared that would be the difficulty.

Mr. Yapp said he could not help thinking that the objection of the last speaker was a very serious one. But there was another point, and that was as to the cost, which the lecturer had said would be about 20 per cent. He was not a practical man in such matters, but he feared that a process which cost 20 per cent. was one that was scarcely ever likely to be adopted.

Mr. Pearson said he would like to know whether the effect of the process on the wood was such as to offer any difficulties to the workmen in the use of their tools. If you apply any of the many substances which would make wood incombustible you might be afterwards met by the objection that it spoilt the workmen's tools. Would it prevent fine work being executed? Would the timber so prepared allow of atmospheric changes? Was there any great increase to the weight of the wood? These were all important questions he would like to hear answered. Whatever the process might be, if the lecturer would undertake to say that it did not dull or injure the tools, and that the wood could be cut through equally well, that it would undergo any atmospheric change, that it does not splinter or give dangerous wounds, and that the wood was not injured at all—all of which questions were quite independent of the one of cost (which must always be expected in every attempt to meet a great want of this kind), he felt that the process was one of very great value if it could be done. There was no difficulty whatever, if you want to render wood incombustible, in exhausting the sap and then taking a soluble silicate and drawing that up into the pores; you then get every fibre of the wood affected. But, on the other hand, if you used a pure silicate, it was certain to offer obstruction to the tools.

Mr. Botly said, in Norway and Sweden, and even in our own country, the timber was brought down from the copse or wood where it was felled great distances, and at great inconvenience and much cost of labour, particularly where it had to traverse, as in some cases, heavy clay lands, and he felt, therefore, that it was all a question of cost. To force the liquid in at the proper time it appeared to him necessary that some means should be devised by which it could be done cheaply, for after all it would resolve itself into a question of pounds, shillings and pence. And then, when it was remembered that the wood must be conveyed to a certain central point in the green state before the liquid could be applied, it seemed to him impossible that the process could be brought into operation—at least so he should fear—from the very considerable time, trouble, and expense it would cost.

The Rev. Edward Colley said that, as to the expense, for his part he would not care if it cost 100 per cent., if you could make—say the roof of Canterbury Cathedral, or the shelves on which valuable books stood in the public libraries, or the wood-work in the noble halls of colleges at Cambridge and Oxford, and the many other valuable buildings in the country, and their contents, so far as the wood-work was concerned—incombustible. He thought if it cost 500 per cent. to compass it, civilisation, and the generations yet to come would be largely the gainers, so that he should be very glad if the process could be so carefully looked into and examined by scientific men, to see whether it was or was not effective. He thought it possible that green wood could be imported with the ends cemented in some way, so that when it arrived here the process could be carried on and the wood manipulated in the necessary manner, so as to render it incombustible, and, by-and-bye, he doubted not the expense might be so far reduced that the merchants could afford to supply the advantages to wood used for ship-building and ordinary buildings. It was clear that from the very nature of the sap in the tree, botany had provided all that was necessary to render the wood incombustible by admitting of the insertion of liquids in the way described; and the real question was whether there was in the combination which was used, whatever it might be, that which a committee of scientific men who might examine the matter would say accomplished the end in view; and he would like to know whether the lecturer would be willing to submit the matter to such a committee to test it. If chemists would tell us whether the liquid thus prepared and forced into the tree would render the wood incombustible, then it could be seen whether it would be worth while to go into the experiment. But if timber could be prepared for all these uses, beginning with the more valuable ones of rendering the roofs of our cathedrals and public libraries incombustible, there would be a very large gain to civilisation and the future. If it were once decided that the process was able to do this, he thought the economy of the question would take care of itself.

A Member asked whether it was likely to make any difference to the colour of the wood.

Mr. Mast said he had a little acquaintance with Norwegians and Swedes, and he could say, if it could be proved that they would get 20 per cent. more, they would try all their skill to do it. If the secret were let out they would soon show that they could work the process.

Mr. Yardley said that however desirable it might be to preserve our public buildings, he was afraid the process would hardly compass that if it could only be applied in the green state of the wood; and if it increases the specific gravity of the wood there would be a still greater difficulty, for it was well known that lumber was sometimes floated down a river, and if they could not float the rafts down there would be almost an insuperable objection to the application of the process.

The Rev. E. Colley said he would like to know what would be the effect of water on the preparation, and whether storms would soak it out, and also what the effect of a long continued heat would be.

Mr. Macomber, in answer, said it had given him very great pleasure to hear the various questions that had been put and the objections that had been made. He had hoped to elicit this very discussion. If he were to go to the place where the wood comes from, where the man cuts down the tree and saws it into lumber, and then floats it down the river, and brings it here; if he were to speak to him, he would say, very naturally, "What do those say who use it? I do not use this wood; I only cut the tree, and I sell it eventually to the citizens of London, and they use the wood. If they want it made incombustible go to them." A question was put as to whether timber so prepared could be worked as easily as before, and whether the workmen would find it more difficult, or dangerous in splintering, and whether there was anything that would dull the tools or prevent them working. He could answer distinctly to all these questions, no; it does not; neither does it change the colour. In regard to the weight—for that is a very pertinent and important thing—it is about two and a-half per cent. heavier—not more than that. A piece of wood unprepared, weighing 100 lbs., would perhaps weigh 2½ lbs. more; of course it would float the same as before. He had mahogany, oak, and other shavings there, which he had tried to burn, and they had seen the result. Now then as to the dry or green. His own conviction was that you could not render dry wood incombustible. He could put an outside surface on, and all the boiling and heating you could give it would not suffice to penetrate the wood and render it incombustible throughout the whole; and he took the broad ground, that unless it was wholly incombustible it was worthless. In answer to the objections which had been made that it must be green timber, gentlemen must understand that he never dreamed that his process should be carried into effect in London or any other city of the world. It must be done where the tree grows. This process must be applied at the place where the timber comes from, and his own conviction was that it could not be done when it was brought here, for it was invariably cut, and then it was dry. To sum up, he added 2½ per cent. to the weight, he did not injure the workmen or the tools he worked with. He did not by this process injure or colour the wood. It might be applied to every kind of wood. He had not thought it necessary to go into the scientific part of the question, although he had the opinions of some of the learned men who had studied this matter and thoroughly examined it, and had written upon it. One of them who had written on the subject said the sap of the vine during the bleeding season rose with such force that it could support a great pressure. Timber could be thoroughly penetrated with liquor at that time, and rendered incombustible. Sansure had proved that the sap was forced upwards by what was known by the name of irritability, and that when the sap was received at the mouth of the trees, the mouth contracts. Other writers adopt this opinion. Now, if this be so, they could take the timber precisely at the time and then insert the liquid, and it would penetrate the whole of the wood, and he wished it to be distinctly understood that the timber must be taken when it was green, and then have the process carried on. He had no idea that anybody in London could take dry timber and apply his process, and do it permanently through the whole—not at all. The reason he did not get a stick of green timber was that he could not have used any method there by which he could have forced the liquid into the stick. If he could have done so he would have shown the process. He had no means there by which he could force the sap out and force this liquid into its place. This timber will season just as quickly and in the same time and under the same circumstances as though there had not been this process applied to it. His object was to call public attention to the matter. He read to-day of twenty-two persons being burnt to death in a most horrible way through the fire in the stove setting fire to the railway cars. They were literally roasted alive. If those railway cars had been built of wood prepared with this material it never could have happened. He did not propose this as a sudden thing, but he hoped to live to see the time when they would find in their timber yards two kinds of timber, one the same as now, and the other incombustible, and he believed that the cost would be less even than the 20 per cent.—how much he dared not say. Twenty years ago it could not have been done even for 50 per cent., because then the price of the materials was so high, but now, by the progress of manufacture and the arts, they had at last come to such a price that it would be economy to use it. Take for instance tungstate of soda, used for linen, which effectually prevents a dress taking fire. That is worth a shilling a pound, and, therefore, could not be used economically. If everything was not ready to hand he could not talk of 20 per cent. or even of 100. Exposure to the weather does not in the least affect the wood. He had some boards which had been immersed for two months in water. That was one of the best ways of seasoning green wood, the sap was drawn out and the water entered. It was not affected, so far as he knew, either by time or water. But he wished particularly to impress upon the audience that ship timber, used for the hull of the ship, could not be bored as it was, or to such an extent. In southern climates the white ant would destroy a building in about two and a-half years. He would state distinctly that the white ant would not touch this at all. It was not poisonous to the hands, nor harmful to the health, nor injurious to the tools. He did not like to say positively, but his impression was that the wood would season a little more rapidly. He would say distinctly, that no exposure, subsequent to the permeating of it, would have any effect whatever upon the wood. If it did anything at all it would be on the surface, which would be taken off by the plane the first time.

Rev. E. Colley again asked whether the lecturer would consent to a committee being appointed.

Mr. Macomber said the process must be applied in a place fitted up for the purpose, and there was some idea that such a thing would be arranged. Another society had desired to have the paper read before it, and he would suggest that the two societies might combine for the purpose, and a committee be appointed.

The Chairman said he was quite sure that every one would concur with him in most cordially tendering their thanks to Mr. Macomber for his very interesting paper, and the admirable manner in which he had answered the various questions put to him. It must, he was quite sure, be very gratifying to Mr. Macomber that his paper had elicited so many remarks from so many gentlemen present. He was afraid it would not have been so, as the sphere of criticism had been so very much curtailed, because the scientific part of the question was not gone into, and Mr. Macomber had forborn giving them an account of the materials which he used, so that one of the most important elements had been eliminated. He hardly felt justified in saying anything in the way of criticism. He had no connection with the timber trade, but it struck him, when he heard that the timber was to be cut in half, or nearly so, that long timber was much more valuable than short timber. For instance, if they were to take it for ship-building purposes—which was one of the most important uses to which it could be applied, because the saving of life from fire at sea was so immensely important—it was absolutely indispensable for some purposes that it should be 30 feet long, and he questioned very much whether they could find timber 60 feet long. He was afraid that there would be a practical difficulty to get a fine straight tree sufficiently long to admit of its being cut in half for the purpose of making it incombustible. Besides which, the timber was never cut for any particular owner or user, but cut in certain lengths and sent here, and when it was required to be used the purchaser went to the docks and picked out the largest timber he could find suitable for his purpose. However, he felt the great desirability of finding such a process.

Sir Walter Stirling, in seconding the vote of thanks, said that it seemed to him it was not their duty as members of the Society of Arts, which was established for the very purpose of encouraging improvements in the arts and manufactures, to throw objections in the way of a lecturer who came there with a new process. They did not yet see daylight on the subject, but neither had they on many other subjects which, when at first proposed, were met with great objections. It would be remembered that a late Prime Minister had said, when it was proposed to cross the Atlantic by steam ships, that so absurd was it he would eat the boiler of the first ship that crossed. He thought every encouragement and facility ought to be thrown in the way of the lecturer, who came forward with a new process, instead of the reverse.

The Chairman said he thought it was consistent with his duty as chairman to invite the observations and criticisms of the members on the subject, that they might the better elicit the truth and see the practical value of the process.

Mr. Macomber said he felt grateful to the Chairman and to everyone for the observations and the objections that had been made. His object in reading the paper was to elicit such remarks. There was no reason at all, when the magnitude of the work would allow it, why steam-power should not be used to force the liquid into the wood; and there was no difficulty, if sufficient power were used, of inserting the liquid at the end instead of at the centre.

CANTOR LECTURES.

The fifth and last lecture of the first course of Cantor Lectures for the present Session, "On the Practical Applications of Optics to the Arts and Manufactures, and to Medicine," was delivered on Monday, Dec. 23rd, by C. MEYMOTT TIDY, Esq. M.B., Joint Lecturer on Chemistry, and Professor of Medical Jurisprudence at the London Hospital. The Lecturer said:—

In the year 1675, Sir Isaac Newton presented to the Royal Society his memorable paper on optics. Sir Isaac had described himself as a child gathering up pebbles on the sea shore. Be it so. What a wonderful child it was, picking up the pebbles, and what wonderful pebbles they were that the child picked up.

Three great facts were established by Sir Isaac Newton in this paper. First of all, that the ray of sunlight having passed through a triangular piece of glass—called a prism—was broken up into a band of several colours blending in beautiful harmony from red to violet—what we know as the spectrum. This effect was produced because different colours have different degrees of refrangibility, the violet being the most refrangible, and the red the least so. The second fact established by this paper, was that this splitting-up process could only be effected once—the interposition of a second prism made no difference—it could not further decompose one of the coloured rays of light; thus the red, on passing through a second prism still remained red, and the green, green. And the third fact established, was this—that these colours, if brought together again, reproduced white light. Thus, analytically and synthetically—I mean by the process of pulling down, and by the process of building up—Sir Isaac Newton proved the composition of white light. These were Newton's pebbles. Would to God there were more children searching the beach.

And now, just to make my story as far as I can complete, we will repeat Newton's experiments—though unfortunately not quite as Newton performed them, from circumstances you can quite understand. We shall, however, have a very good substitute for sunlight in our electric lamp. We will turn our light on, and first of all we will focus the slit on the wall on the opposite side, by means of this large lens, and now we will bring into the path on the rays our prism. [The lecturer here showed a spectrum with one prism.]

Now, the second point that I might show is, that the interposition of a second prism causes no further change. There is our spectrum [illustrating it on a white screen by a spectrum shown with two prisms.]

Now, the second point I just want to show you, is that if I reverse the position of one of the prisms, we shall then get a recombination of the colours, and there you see the slit over on the other sides of the room just as before, produced by a second prism placed in the opposite direction to the first.

Now I want to show you again the recomposition of this spectrum. I will throw upon the screen, by means of our lime light, a diagram of this spectrum, which we shall be able to rotate rapidly, when owing to the power the retina possesses of retaining an impression for some time, we shall get a blending of all those colours, and the conconsequent reproduction of white light again. [Experimenting by rotating the disc on the screen.] There we have a very fair picture of our spectrum. Now we will rotate it rapidly, and you appear to lose all the colours, and to see a perfectly white disc. This is a repetition on a some what large scale of Newton's experiments.

Now, I want to show it you in another way. Instead of employing a transparent disc, I will throw the lime light upon the painted disc you see there [exhibited in the room]. We shall get—when it is rotated—a kind of grey disc, because unfortunately we cannot paint colours quite so well as nature can. But whilst this is rotating I shall throw upon it the spark from our induction coil, and you will then see when I cut off the lime light the colours re-appear again though the disc will be in rapid motion.

Now we will cut off our lime light, [experimenting with the electric spark each colour was plainly seen]. Now you see other curious effects—the most extraordinary combination of colours. That is as far as I can go with this part of my subject. Why all these coloured rays meeting the eye produce the effect of white light is a difficult subject to discuss, and would lead me into a physiological question as deeply interesting as it is painfully abstruse. Fortunately it is not our subject. Let me merely point out that the mixture of other colours have the same power of producing this effect of white light, as for example indigo and yellow, blue and orange, and notably the three colours, blue, red, and yellow.

Now in this spectrum there are three great powers resident—three special properties—our spectrum is really a trinity in unity. There are, first of all, luminous rays in the spectrum, and the luminous rays in their maximum exist in the yellow part of the spectrum. Then there are heat rays in the spectrum, and these exist in their maximum in and beyond the red, as was first of all pointed out by Herschell, in 1800. Then, thirdly, there are the chemical rays in the spectrum, which, I have pointed out, exist in their maximum in and beyond the violet; they are intensely energetic in inducing chemical action, as in causing the decomposition and the combination of chemical substances. This was originally noticed in the early part of the present century, by Ritter and Scheele. But the spectrum from our electric lamp is different from the spectrum of the sun—there are peculiarities in the sun's spectrum that were not noted by Newton. They were not, indeed, noted until the year 1802, more than 130 years after Newton's time, and the honour of the discovery of the black lines in the solar spectrum belongs to Wollaston. I perfectly admit that this discovery attracted at the time but very little attention from the scientific world. It was in the year 1814, twelve years after Wollaston first discovered them, that Fraunhofer re-discovered these lines. Wollaston had asserted that there were but seven lines in the spectrum, and he said that these seven lines divided the spectrum into seven parts, and that they were placed between the seven colours of which the spectrum was composed. It was, I say, in 1814, that Fraunhofer showed that this was a mistake, that the black lines did not correspond to the spaces between the colours, besides which Fraunhofer noted and mapped no less than 576 of them. He noted, moreover, that these bands were always obtainable from sunlight, from moonlight, from Mars and Venus, and so forth. But when he examined the fixed stars, which are self-luminous, then he found that he obtained different appearances. He concluded that whatever produced these black lines, for I must say that in none of Fraunhofer's papers did he ever actually state what he believed these lines were due to, he says that whatever produced these lines, it is clear their origin is something beyond our world and beyond its gaseous envelope.

Now, it was long ago noticed that different bodies gave different coloured flames when they were burnt. This was even noted before the time of Fraunhofer. I might take as an illustration of this, and it is a fairly good one of its kind, the light produced by different chlorides, dissolved in spirit. I use chlorides because they are soluble in spirit. There is our lithium, copper, and so forth [burning different solutions on cotton wool]. I think there is little or no doubt that the light that a flame gives is due to the solid matter in the flame. I have here a beautiful burner, that has been kindly lent me by Mr. Bellow, in which the rotation of the solid matter of the flame is most beautifully seen, owing to a peculiarity in the form of the burner. He states that it may be used very well for testing the illuminating power of gas, simply, I presume, from the amount of light a flame gives being due to the amount of solid matter which is in the flame.

Now it was in the year 1822 that Brewster first of all examined the spectra from these differently coloured flames, fed with different kinds of solid matter, and he found this fact, that in doing so he could only obtain bits of spectra, and he suggested that these localised bands, produced by these different kinds of material in the flame, might very well be used as tests of the substance under examination. And now-a-days you know the supposition of Brewster is a fact accepted by all scientific men.

We will throw upon the screen, for instance, a diagram of a number of spectra, in which you will see the different effects produced, to which I shall not, unfortunately, have time to do more than refer to to-day. [Here a diagram of certain spectra was thrown on the screen.] There you see a diagram showing the peculiarities of those spectra. Here we have the spectra of lithium, of sodium, of strontium, of barium, but they are different spectra, by which you are able to recognise, with the greatest ease, the various materials that are present.

We must not forget at this point to acknowledge the debt we owe to Professor Kirchoff, to whom we are indebted for the rare originality which has presented us with a new analytical agent, far more sensitive than the test glass admits of,—no less than the 1-180 millionth of a grain of soda, or 1-160 millionth of a grain of lithia, being recognisable by means of their spectra. Nor must we forget, moreover, that it was the means by which Bunsen and Kirchoff, in 1860, proved the existence of two new metals, cœsium and rubidium, in the waters of Durkheim, in Rhenish Bavaria. Here we have a diagram representing the peculiar spectrum of cœsium, one of Bunsen's metals. Nor must we forget, moreover, that it was by this method that Crookes, in 1862, discovered that curious metal thallium. Thallium, a specimen of which I have here, is a cumulative poison. It is detected with the greatest ease in the stomach by means of spectrum analysis. As a toxicologist, I certainly feel disposed to say, would that other things were as easily found, but alas, I am afraid the ease with which it is discoverable would be a sad source of danger and discussion. A jury is not satisfied with the millionth of a grain.

Well, now I think I will try and throw one or two of these spectra on the screen. As a matter of course, they will be imperfect. And first of all suppose we take sodium. We will put a small particle of sodium chloride between the poles. [Experimenting with sodium in the flame.] There you see the sodium band beautifully shown. That yellow band is entirely due to sodium. Nothing else with which we are acquainted will produce that band.

Now then I will endeavour to show you the spectrum of lithium. Unfortunately it is of no use my changing the pole in this case, simply because in all lithium we shall get our friend sodium. It is one of those never-failing friends, that unfortunately sometimes sticks by one very much closer than you want. We will put a small quantity of lithium between the poles. [Here the spectrum of lithium was clearly shown on the screen.]

Now then we will experiment with mixed chlorides. You see how beautifully distinct those bands are. We have chlorides here of sodium, barium, lithium, and all sorts of things mixed together.

Now we will put a small piece of thallium on the pole, a very small piece will answer the purpose, [Here the spectrum of thallium was seen on the screen.] Here we have other things as well, but there is the peculiar band of thallium. It was by that peculiar green band which you see, that Crookes discovered the presence of this new metal.

But I must not stop to go on with these experiments. Silver, and zinc, and copper, all produce exquisite effects when shown by this means, and by it we are able to tell their presence.

Now substances gaseous at ordinary temperatures also impart a peculiar light when heated by the electric spark, and these gases, when examined by the spectroscope, give distinct bands. I can show you what I mean by taking a few tubes, which I have had made for the purpose of experiments; they contain a small quantity of different gases. There you will see the different colours produced by different kinds of gases, and you can understand that these gases in this way give different effects, just as the different kinds of solid bodies in the flame produced different kinds of light, and just so these too produce different kinds of spectra when examined by means of the spectroscope. [Experimenting with tubes with electric spark.]

Probably there are few spectra that are so interesting as the carbon spectrum. You know there is a celebrated process for manufacturing steel, which we know as the Bessemer process. By this process 5 tons of cast iron can be converted into steel in something like 20 minutes. Cast iron contains a great deal of carbon, and in the Bessemer process the carbon is got rid of by burning it out from the white hot iron by a blast of atmospheric air. I only just want to enter into the principles of the process to show you how spectrum analysis has been applied to it. The molten cast iron is placed in a large retort [shown on a diagram] lined with refractory clay. This converter, as it is called, turns upon a pivot. Through this pivot a tube passes in connection with a very powerful blowing apparatus, by which air can be blown into the bottom of the apparatus, through a blow-hole, into the molten iron. Now then, what does the air do? It burns out the carbon, the heated gases issuing in the form of a flame from the converter, whilst the molten iron is being burnt. Now it is very important to stop that blowing process directly the time arrives. Ten seconds too soon or ten seconds too late, and the charge is spoilt. In the one case the charge is so thick you cannot pour it into the ladle placed to receive it, and from that to the moulds; in the other case, from the presence of the carbon, it is so brittle that it crumbles under the hammer. But how are you to know the exact moment? That is the question. Experience, I grant you, does guide the worker, but experience is a dear thing (so our older friends never tire of telling us), and this I am confident of, laud experience as you please, it will not weigh down the scale, when we have in the opposite pan exact scientific experiment. This Bessemer flame, as it issues from that converter, is examined by the aid of the spectroscope. Numerous matters are visible, sodium, potassium, lithium, iron, hydrogen, nitrogen, and carbon, &c. All of a sudden, all in a second, the carbon lines disappear, and that is the moment when the air blast must be turned off, for the carbon is burnt off and the iron is converted.

We must now go back again for a few minutes, if you please, to our dark lines in the solar spectrum. In the year 1832 Brewster examined the spectrum after having allowed it to pass throught nitrous acid, when he noticed this fact, that he obtained certain dark bands, and he came to the conclusion that the dark bands were produced by the absorption of the light by means of this nitrous acid. I am not at all certain whether I can repeat his experiment, but still I feel disposed to try. There we have one spectrum. Now, when I bring this coloured gas into the spectrum these dark lines are visible. That is, I believe, one of the earliest experiments made with respect to the absorption bands [experimenting with nitrous acid]. And Brewster noticed, moreover, this, that the dark line, which we know as the D line, corresponded with the yellow line that was obtained by sodium. We might show the same fact in several cases. If I was to take the iron lines produced by burning iron I could show that these lines had their exact counterpart in the solar spectrum. Here we have the iron lines and there the solar spectrum. Now observe the lines, and you see how wonderfully they correspond with the dark lines in the solar spectrum. Now he found that upon allowing the spectrum of the lime light to pass through the vapour of sodium, instead of a continuous spectrum he observed a dark band in the very spot where the yellow light from sodium should appear, that is to say, that when the light passed through the vapour of any body the vapour of this body had the power of absorbing the very light that the body itself produces. Sodium, for instance, produces a deep yellow band when it is burnt. I have shown you that if you pass the light through sodium vapour that sodium vapour absorbs that part of the spectrum that soda produces. So you see how he came to this conclusion, that these bands in the sun's spectrum were produced by the vapour of bodies that had the power of absorbing the very light that these bodies would themselves produce. I will venture to try and see whether I can obtain this absorption spectrum of sodium. Instead of using burning sodium I am about to employ a quantity of the vapour of the sodium, which I shall burn in a little iron vessel in my lamp. Of course these things are very easy to obtain when we do them on a small scale, but on a large scale they are always attended with some difficulty [experimenting with sodium]. There is the black absorption band of sodium.

I want now to show you that this power of absorbing certain parts of the spectrum is not for a single moment confined to gases. For instance, if I take this liquid which I have here, which is perfectly colourless (it is a solution of didymium), and hold this in my spectrum, I shall be able to show you the power that liquids have of absorbing certain portions of the spectrum. Now I will hold in the spectrum this solution of uranium, when we shall get at once well-marked absorption bands [experimenting].

I want now just to refer to one illustration where this is of very great importance, and that is in the case of blood. Blood was examined by Hoppe, in 1862; by Stokes, in 1864, and since that time by Sorby, for this power of liquids in absorbing parts of the spectrum shows itself here as a matter of great practical moment. The instrument used for the purpose of blood analyses is an instrument invented by Sorby, and brought to perfection by Sorby and Browning. It is known as the micro-spectroscope. Investigation has proved that the colouring matter of blood differs very materially, from that which was described by Lecanu as hæmatin. It differs in two particulars. First, the colouring matter of the blood is soluble in water, which hæmatin is not; and, secondly, it is capable of oxidising and deoxidising itself with ease. The colouring matter of the blood is what we know under the name of cruorin, or hæmoglobin and this cruorin has the power of existing in two states of oxidation, having two distinct colours and two distinct spectra. First of all there is that form of cruorin which we know as the scarlet cruorin, the oxidised cruorin; secondly, there is the deoxidised or purple cruorin. Now you take, say fresh blood. You dissolve it in water, or you make it slightly alkaline with ammonia, when you at once obtain the spectrum of the scarlet cruorin. You note two dark bands. Then add a little protosulphate of iron to it, and we employ small pieces of barometer tube, prepared for the purpose, and fitted on a piece of glass, which we put under the microscope, to which the spectroscope is fixed. We add to it the merest trace of protosulphate of iron, having added enough citric acid to prevent precipitation by the ammonia, when we get another spectrum, the spectrum of the purple or reduced cruorin, and this appears as a single band, so you see that by the action of deoxidising agents, we have altogether changed the spectrum from the two bands in the one case to the single band in the other. The single band in this spectrum occupies a place, midway between the two bands in the former spectrum. I then expose it to air for say half an hour. I get it oxidised again, and I again bring back the original spectrum with the two bands.

But you know very well that any blood stain after a time will lose its red colour altogether, and turn brown. This is a question of great interest, let me say, to the medical jurist. The action in towns is very rapid, but if you take it into the pure air of the country something like four, five, and even six days will be required before it will take place. But still, whether town or country, the action will take place. The result produced is another form of this hæmoglobin, and it producees different spectra altogether. The spectra it produces are marked as 3 and 4. Instead of two bands, we have three in each case. There are three black bands, not two.

But we can get another spectrum altogether, a spectrum with two bands, but you notice in a very different position to all the other bands. It is a true change of the colouring matter from cruorin to the hæmatin of Lecanu. You cannot reproduce cruorin out of hæmatin, though you can produce hæmatin out of cruorin or hæmoglobin. Now, then, we can deoxidise the oxidised hæmatin by the action of a very small quantity of proto-sulphate of iron. We then produce this grand spectrum, for it is the spectrum on which we rely so materially. It is the grand test for blood. One tenth the quantity of blood will produce the spectrum of deoxidised hæmatin which is necessary to produce the other spectra. Black lines, I say, are produced by these means, as distinct as if you took a pen and dipped it in ink and drew it across a painted spectrum. I say this positively, because I know some have questioned it. But I think it must be really due to the fact that they have never seen blood spectra at all. It is certainly necessary, I grant you, to have different eye pieces of different refractive powers. We cannot have one eye-piece to do for everything. There is no doubt that the lines produced by blood are produced by no other known body. But, mind, we should not be justified in giving an opinion as to the existence of blood merely upon seeing one spectrum. But it is by obtaining the series of spectra that we can state so positively the existence of the body. I put that forward very emphatically, that you should in every case, if you wish to be exact (and remember that on evidence of this kind people are hanged), you should see every spectra that the blood can produce under all the altered states, before you should give an opinion as to the existence of blood. Having seen these different spectra, I do not think there can be the slightest doubt in the world of the presence of blood.

I have dealt with this somewhat fully, and in a little detail. It is a subject I have felt the deepest interest in, and with the details of working which I am egotistical enough to hope that my name will some day be associated. I should like to see if I can obtain anything like these bands of blood upon the screen. Let me say you must never rely upon diagrams or measurements, or anything of that kind. You must always have two spectra before you, one the spectrum of what we know to be blood, so as to compare it with the body we are examining. Unfortunately spectrum analysis does not enable us to determine the different kinds of blood. It does not enable us to determine to what animal the blood belongs. [The lecturer then experimented with deoxidised hæmatin, throwing the spectrum on the screen.] You see there the bands of deoxidised hæmatin beautifully shown. Of course these are comparatively rough experiments, as I need not tell you. All these varieties of spectra, however, are perfectly visible by means of the microspectroscope.

In bringing these lectures to a conclusion, I feel that an apology is due to my audience—whom I may be permitted to thank very heartily for the honour of their attendance—for the mass of matter I have been obliged to omit, and the equally large mass of matter I have merely casually noticed. Unfortunately my time was limited, and my subject unlimited. But one lesson I think we may learn—the subject is a rare illustration of it—and that is, the growth of science and the manner in which abstract work becomes practical and generally useful. First the blade, but give it time. Then the ear, but give it time. Then the full corn in the ear. And yet once more let us learn not to despise the day of small things, be it ever so small. Not to despise little discoveries, for who knows how soon they may be monster discoveries of which, as yet, we see but an embryonic growth? Learn not to despise the little pearl caught in the net of the anxious explorer. God only knows what its setting may be! It teaches us finally to see how the God of great things is also the God of small things, and the God of small things because they are the parent of the great. Practical applications! They are the grand goal of the grand race-course of science. But there could be no goal if there were no course; there could be no winning-post if there were no starting point. Nurse, then, with jealous nurseship each little scientific detail of which as yet you cannot guess the growth, and trust to posterity and the help of Heaven to supply food and nourishment that will bring to mature growth and full development the small seeds sown by the Almighty Gardener, and watered, as one age makes room for another, by the profound researches, the untiring labours, and the brilliant efforts of a noble army of scientific investigators.

The annual produce of the sale of snails as an article of food in Paris is estimated at upwards of 12,000 francs.

At Venice, steps are being taken for founding an art school, wherein pupils, dedicating themselves to art may receive a special education under the direction of Signor G. Stella.

The Madras Government has sanctioned a system of tramways for Madras, and the work has been entrusted to a London company.

The value of the iron, wrought and unwrought, exported from the United Kingdom during 1872, was declared to be £36,060,547. In 1871 it was £26,124,134.

Since 1836 about 133,000 patents have been granted by the United States Patent-office. For the year ending September 30, 1872, there were 19,587 applications for patents, of which 13,626 were granted. The fees paid during the year amounted to 700,954 dollars.

Artesian wells are being sunk in Chicago; twenty-one had been bored according to the latest accounts, and in no instance has there been a failure of a plentiful supply of water. The usual depth of the wells is from 1,200 to 1,300 feet, and the average cost is 6,000 dols. for a $5\frac{1}{2}$ inch well 1,200 feet deep, and 5,000 dols. for a $4\frac{1}{2}$ inch bore to the same depth.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

The fourth meeting of the Committee on Cooking was held on January 18th, at the offices, Gore-lodge, South Kensington. It was attended by the following members.—The Hon. F. Leveson Gower, M.P., in the chair, Mr. F. B. Alston, Mr. J. Bateman, F.R.S., M. Beguinot, Dr. G. Birdwood, Colonel J. F. Browne, C.B., R.E., Major E. F. Du Cane, R.E., Dr. Smith, F.R.S., Mr. W. W. Follett Synge, Dr. Thudichum, Professor A. Voelcker, Captain F. Warren, R.N., Major C. E. Webber, R.E. The Committee considered certain proposals with reference to a practical and instructive illustration of popular cooking as adapted to the requirements of the middle and lower classes, and they inspected sites in the Exhibition buildings which appeared suitable for the purpose. After having passed resolutions containing recommendations to her Majesty's Commissioners as to the best executive arrangements for the class, the Committee adjourned until Monday, the 27th inst.

The third meeting of the Committee on Surgical Instruments and Appliances was held on Monday, 20th January, 1873, at the offices, Gore-lodge, and the following members were present:—Mr. Cæsar H. Hawkins, F.R.S., in the chair, Dr. P. Allen, Mr. R. Brudenell Carter, Mr. W. White Cooper, Sir William Fergusson, Bart., F.R.S., Dr. Arthur Farre, F.R.S., Dr. G. T. Gream, Mr. Prescott Hewett, Mr. J. Hinton, Mr. J. Luke, F.R.S., Mr. T. W. Nunn, Dr. W. S. Playfair, Mr. Edwin Saunders, and Mr. Edwin Sercomb. Major-General Scott, C.B. (secretary to her Majesty's Commissioners), attended the meeting. The Committee considered the following resolutions, which were passed at a meeting of London surgical instrument manufacturers, held on the 10th inst., Mr. Louis Blaise in the chair:—"1. That the surgical instrument manufacturers do not exhibit unless the conditions requiring their manufactures to be submitted to a Committee of Selection be withdrawn." "2. That they may exhibit all the articles of their manufacture as a whole, and not in sections or subdivisions, as proposed by her Majesty's Commissioners." "3. That the conditions on which the foreigner and Englishman exhibit shall be one and the same." It was recommended that a reply should be sent explaining that English and foreign exhibitors would, as always intended, be on precisely the same footing; that it is not proposed to separate an exhibitor's instruments into sections or subdivisions; and that while it is unadvisable to dispense generally with the principle of acceptance on the approval of a Committee, an assurance of admission might be given by the committee to manufacturers of very high repute who should notify their desire to exhibit. The Committee was informed that Signor A. Castellani, of Rome, had commenced to make exact reproductions of the surgical instruments found at Pompeii, and that the Japanese minister, Terashima Munerero, himself a physician, had promised to obtain a collection of surgical instruments from Japan. Letters were read from Sir Alexander Armstrong, K.C.B., Sir John Rose Cormack, M.D., of Paris, the Royal College of Surgeons, Royal College of Physicians, University College, and the University of Edinburgh. The Committee then adjourned till Monday, the 17th February.

The fourth meeting of the committee for Silk and Velvet was held on Tuesday, the 21st January, Sir D. Cooper, Bart., in the chair. There were also present, Lady Dorothy Nevill, Mr. Bennoch, Mr. Blakely, Mr. Cassells, Mr. D. Chadwick, M.P., Mr. Frances Cobbe, Mr. Graham, Mr. N. Lewis, Mr. Lintilhac, Mr. Lynch, Dr. Mann, Mr. Peters, and Mr. Tucker. The Committee discussed a proposition, "That objects made to illustrate the uses of the fabrics exhibited should be shown side by side with the fabrics," and finally rejected it.

Count Packler, the Lord High Chancellor of His Imperial Majesty the Emperor of Germany, has presented to H. M. Commissioners a series of photographs of the imperial sledges and carriages, which he has had prepared expressly for the exhibition of carriages for this year.

The following is the proposed classification of implements and utensils used in drinking:—

Division I.—Natural Objects Adapted.—(*a*) Nuts and gourds; (*b*) shells, eggs, &c.; (*c*) vessels of horn; (*d*) vessels of ivory; (*e*) vessels of bone, skulls, &c. Each class to be divided, as far as possible, chronologically and geographically.

Division II.—Raw Material.—(*a*) Vessels of wood; (*b*) vessels of leather; (*c*) vessels of stone. Divided as before.

Division III.—Manufactured Material.—(*a*) Vessels of clay; (*b*) vessels of metal; (*c*) vessels of glass, &c.; (*d*) miscellaneous.

Classification of Division III., Class (*a*).—Prehistoric, Barbaric (modern savage implements), Egyptian, Greek, Etruscan, Roman, Byzantine, Celtic, mediæval glazed ware. Stoneware and various faïences, as—Persian, Majolica, Dutch, &c. Divided according to locality. Porcelain (Oriental); porcelain (European). Divided according to locality.

EXHIBITIONS.

VIENNA UNIVERSAL EXHIBITION.

Exhibition in the Agricultural Machinery Hall.

The following are the special regulations relating to the exhibits to be shown in the Agricultural Hall at Vienna:—

1. The Agricultural Machinery Hall is to contain the exhibition of machines for agriculture and forestry, implements, means of transport, winches, &c., besides machinery and apparatus for preparing food and other substances of nourishment (group 4), such as are used in distilleries, breweries, sugar refineries, mills, &c.

Machinery and apparatus in motion, molesting the public, or likely to damage other objects of exhibition, or which are in any other way not consistent with the object and arrangement of the exhibition in the Machinery Hall, will not be admitted.

Such machines can only be exhibited outside the Machinery Hall, either in the open air, or in a covered space fitted up at the expense of the exhibitors.

2. Objects for exhibition will be admitted to the Machinery Hall, from March 20th to April 20th, 1873, inclusive, and must be set up at the latest by April the 25th.

3. The Machinery Hall will have a strong boarded floor.

4. The power required to set machinery in motion, and the main shafting for the transmission of the driving power, will be supplied free of charge by the chief manager.

5. The moving force will be transmitted by one horizontal shaft, having a diameter of 0.065 mètre, and making about 120 revolutions per minute.

The main shaft is situated about 3.50 mètres above the floor, at a distance of 0.50 mètre from the wall.

6. Exhibitors have to supply the pulleys for the main shaft, as well as any other gear and driving bands, at their own cost.

The pulleys to be applied to the main shafting are to be made in two parts for screwing together.

These pulleys are to be fastened to the main shafting in such a way that no injury is done to the shafts.

7. The preservation, cleaning, and oiling of the main shafts will be found by the chief manager, but exhibitors will have to attend to the preservation and oiling of the gear supplied by them, as also to the preservation of their straps.

Before applying such gear the exhibitor has to submit the plans of his intended arrangement.

The chief manager reserves to himself the right, for the sake of uniformity of arrangement, to make any necessary alterations in these plans.

8. The daily hours during which machinery can be worked will be published before the opening of the Exhibition.

Exhibitors have to notify the names of the persons whom they intend to intrust with the working of, and attending to, the machinery.

Nobody except these attendants will be allowed to work the machinery.

9. All machinery intended to be worked must, at the expense of the exhibitor, be guarded by railings or other proper means, in order to protect the public from injury.

10. Machinery and apparatus fit for the special service of the Exhibition may be supplied by exhibitors for this express object, and will be ranged as objects of exhibition in group 13.

Among such machinery and apparatus may be here specified :—

Steam engines, portable engines for driving the main shafting in the Machinery Hall, and those used for service outside the Machinery Hall.

11. Exhibitors supplying such machines and implements, intended for special service during the Exhibition, will enjoy special privileges, to be agreed, as occasion may require, between them and the chief manager.

12. For the convenience of exhibitors, a small shed containing a turnery shop, fitting shop, grinding shop, smithy, and copper smithy, will be arranged within the Exhibition grounds.

In these workshops, according to the means at hand, small work or repairs may be executed.

The administration of the workshops is under the control of the chief manager, and work eutrusted to them for execution will be charged according to a tariff fixed by the chief manager.

13. The stipulations of the general regulations remain in full force in addition to the stipulations contained in these special regulations.

The President of the Imperial Commission:
Archduke Regnier.
The Chief Manager:
Baron de Schwarz-Senborn.

42, Praterstrasse, Vienna, December, 30, 1872.

The *Builder* of last week gives an account of the Exhibition building, from which we extract the following:—

"The extraordinary building erected in the Prater at Vienna for the approaching international exhibition proceeds apace towards completion. As regards the construction of the building, the commission adopted a plan designed as early as 1845 by the architects of the Vienna Opera, Siccardsburg and Von der Müll. This plan, entirely differing from all those of former exhibitions, was followed. It offers not only a better light for the objects exhibited, and allows of extension of the covered area according to the wants of exhibitors, but makes the employment of many hnndreds of workmen at the same time in the different galleries, without hindering one another, possible, and permits of the goods of the various States being deposited in their respective spaces without interfering with their neighbours, which circumstance must effect considerable saving of time, an important point in this case, as time is so short. Seven thousand workmen went to work at once, an army which to keep in order requires no ordinary amount of tact and energy. Wages, of course, rose in Vienna to an enormous extent. A simple labourer earned 3 florins (6s.) a-day; bricklayers made from 52 to 56 florins (over £5) per week; and large numbers of workmen were brought from all parts of the empire—Tyrolese, Albanians, Czechs, &c.

"To the architect Hasenauer was confided the execution of the plans marked out twenty years ago, the original designers having departed this life. The originality of this plan consists in the application of the so-called 'herring-bone' system, which resembles somewhat the architecture of the Escurial. From a gigantic longitudinal gallery, 905 mètres long, and 25 mètres broad, branch out at right angles, and at regular intervals, sixteen cross-galleries, 205 mètres long and 15 mètres broad. In this wise twenty-four courts, closed on three sides, and having the same length as the cross-galleries, and a breadth of 35 mètres—for this is the distance between the cross-galleries—are formed on both sides of the great gallery. On this plan, the architect, Hasenauer, founded his division of the principal building, dividing it into a large quadratic central construction, and a smaller building at each end, which latter enclose each an octagonal court. The centre, again, of the central building will form a grand rotunda, constructed entirely of iron, whose erection by the firm of Harkort may be considered a triumph of modern engineering. This rotunda is the idea, as we have before said, of Mr. Scott Russell, who takes a great interest in this part of the Exhibition works. The span of this dome, roofed by a new method, amounts to more than double that of the greatest domes of the world, viz., 108 mètres. The width of the dome of St. Paul's is only 35 mètres; that of St. Peter's is only 49 mètres wide; that of the London Exhibition building of 1862 was only 50 mètres. These figures alone give us an idea of the imposing dimensions of the gigantic cupola, which has been erected without any outside scaffolding, and the shell of which was hoisted and fixed by Harkort's engineer, M. Steiger.

"Behind the longitudinal axis of the Exhibition building rises the treble gallery for the machinery, of about the same dimensions as the Exhibition building proper, in the construction of which its ulterior destination as warehouses for the new city has not been lost sight of. During the Exhibition the machinery will be in full activity, and the great space allotted to it will be of immense advantage to the exhibitors of machinery from all countries.

"Opposite the southern cross front of the principal building is an annexe in four rows, the Hall of Arts. In the middle will be a double row of rooms, with ample skylight, for the reception of more important works of art, while at both sides, in smaller galleries, will be exhibited the smaller art-treasures. New modes of lighting, which have already been tried on a small scale, will be here employed. Tastefully laid-out gardens will fill the space between the Hall of Arts and the Palace of Industry, which will serve at the same time as places for exhibiting objects of the plastic art. A covered gallery leads from the Hall of Arts to the left, at both ends of which are *pavillons*, to contain a new feature, 'Expositions des Amateurs.' It is the intention to induce private collectors to exhibit their treasures here. Near the Hall of Arts large palm-houses and gigantic aquaria will find their place.

"Admittance into this world of wonders will be gained, besides the thirty-two entrances at the frontal sides of the cross-galleries of the Exhibition, by four principal portals, to be decorated in the most splendid style which art can devise. One of these portals leads from the principal road of the Prater to the Exhibition. On passing this wide gate, a park, profusely decorated with *bosquets* and *bassins*, lies between the beholder and the building, while on both sides of the way stand *pavillons* of different shapes opposite to one another. Close to the entrance to the left is the building for the commission; to the right the post-office; farther on to the left the *pavillon* of the jury; to the right that of the Imperial family. Close to these buildings, farther to the right, follow others, erected by the Sultan, the Khedive, the Prince of Roumania, &c., at their own expense, with Oriental splendour, which will leave those of the last Paris Exhibition far behind. Even Japan, besides China and Siam, has lately asked for space of 4,000 square mètres for her special exhibition.

"A series of buildings has thus been undertaken, for the construction of which over 28 millions of bricks were necessary. To facilitate and accelerate this mighty work, eleven lines of rails were laid down from the two principal termini of Vienna to the area of the Exhibition, else it would not have been possible to do so much in so short a time."

It is stated that the whole of the space in the Vienna Exhibition at the disposal of the British Royal Commission has been allotted, and that the arrangements at Vienna preclude the possibility of obtaining a further grant on behalf of the numerous additional applicants for admission. Most of the leading industries of the country will be well represented, and it seems to be hoped that during the exhibition some modification may be made in the Austrian tariff, the protective character of which in many instances precludes extended commercial relations with this country. It appears that the great difficulty in connexion with the agricultural and machinery halls has been how to accommodate the largest number of exhibitors in the space assigned. The special official catalogue of the British section, which is to contain information of a useful character not afforded in previous instances, will be printed and published for her Majesty's Commissioners by Messrs. J. M. Johnson and Sons, of Castle-street, Holborn, who are also the *concessionaires* of the Austrian Imperial Commission for the insertion of British, Colonial, and American advertisements in the German official catalogue. These are the only publications that interest British exhibitors, and caution will be necessary with regard to applications for advertisements in projected "guides" and other unauthorised works which cannot possibly be sold in the Exhibition.

New York Industrial Exhibition Building.—This building is to be on a very large scale, the *Architect* informs us. The incorporators in 1870 purchased eight blocks of land bound by Ninety-eighth and One Hundred and Second Streets, and Fourth and Third Avenues, for 1,700,000 dols. (worth now 2,400,000 dols.). The legislature have empowered the incorporators to close Lexington Avenue so as to occupy the entire space. They propose to erect a permanent building for the exhibition and sale of every kind of product and manufacture—to be a perpetual World's Fair, like Sydenham Palace, surrounded by botanical gardens, museums, &c., similar to the Paris Jardin des Plantes. Here will be gathered the arts, manufactures, farm productions, and mechanical inventions from every country in the world. It will be a perpetual Exposition Universale—a constant Nijni Novgorod fair. They propose to rent space to exhibitors for one dollar per square foot per annum. As the building will contain 1,500,000 square feet, this will pay. The building will be five storeys high, crowned with a Mansard roof, the whole mounted by a magnificent iron and glass dome—the largest in the world. This dome will be 450 feet in diameter, and will rest on a double row of columns. Each state and territory will have a column. The apex of the dome will be an observatory. The dome will be grander than Sir Christopher Wren's great dome of St. Paul's, and higher than Michael Angelo's great crown of the Duomo in Florence.

SULPHUR IN SICILY.

The following article is an abstract of a very interesting memoir by Signor Mottura, of the Geological Survey of Italy, entitled "Sulla formazione terziaria nellazona solfifera della Sicilia," and published in the "Memorie del R. Comitato Geologico d'Italia," vol. i., 1871.

The rocks which crop out in the sulphur districts are as follows:—

Pliocene.

14. Sandstone, conglomerate, sand, and marl.
13. Coarse limestone, called calcareous tufa.
12. Blueish marl.

Upper Miocene.

11. Marly limestone, with foraminifera, called *trubo*.
10. Saccharine, crystallised, and foliated gypsum.
9. Sulphur-bearing limestone, tufa, and gypsum.
8. Compact limestone, somewhat siliceous.
7. Tripoli, with fish remains, divided sometimes by a marly magnesian limestone like the *trubo*.

Middle Miocene.

6. Quartzose and micaceous sandstone, with corals, sometimes intercalated with salt marls; conglomerates.

Lower Miocene.

5. Rock salt.
4. Blue marls, with salt and gypsum, containing petroleum and bituminous matter.
3. *Rudda*, or saponaceous earth; concretionary limestone, with flint.
2. Ferruginous and gypseous clay, with bituminous shale and arragonite; sands and ferruginous sandstone.

Eocene.

1. Nummulitic limestone, alternating with limestone containing fucoids and jasper, and shale.

The fossils contained in the Eocene and Lower and Middle Miocene rocks prove these beds to be of marine origin. The Upper Miocene is mainly a lacustrine formation, whilst the Pliocene, again, is marine. It seems that at the end of the Eocene epoch elevations took place, forming a part of the old Eocene ocean into an inland sea, like the Caspian Sea, for instance, which was gradually evaporated. With the sediment brought down into it mechanically were deposited successively the various salts contained in solution in the sea water in the inverse order of their solubility. The first deposits were ferruginous, then carbonate of lime was precipitated, after that gypsum, and finally rock salt. These beds were then covered by ordinary marine deposits, as the sea seems to have again entered the inland basin. Perhaps the area was depressed, or it is possible that, owing to the extent of the evaporation, it already lay much below the general sea level, and on the removal by some means of the barrier, the sea flowed in once more. In some places elevation must have occurred, as pebbles derived from the Eocene and Lower Miocene rocks are found in the Middle Miocene beds. At the end of the Middle Miocene period the area was raised and lakes were formed, in which were deposited the different rocks named in the above list. The tripoli, siliceous limestone, sulphur rock and gypsum are proved to have been deposited in lakes, because they contain no marine fossils, and plenty of remains of fish belonging to lacustrine species.

The sulphur rock is a slightly marly limestone associated with sulphur. Sometimes the sulphur is disseminated through the limestone, in other cases there are thin alternate layers of limestone and sulphur. The number of seams varies according to the locality; the seams are separated by partings of black marl from 20 inches to 6 feet thick, and some of the seams attain a thickness of 28 feet. The total thickness of all the seams put together in one case reaches 100 feet, but the average thickness of sulphur-bearing limestone is only 10 to 12 feet, and the ore contains, on an average, *20 to*

21 per cent. of sulphur. If abstraction is made of all substances other than sulphur and limestone, the percentage is 24; in other words, the proportion which the sulphur bears to the limestone is as 24 to 76.

At their outcrop the seams are thoroughly decomposed; the sulphur, in presence of carbonate of lime, oxygen, and moisture, becomes oxidised, and produces sulphuric acid, which decomposes the limestone and forms gypsum. No sulphur, therefore, is seen at the surface, but you have a whitish earthy friable rock, the *briscale* of the Sicilian miner. The occurrence of this *briscale* is a sure indication of the existence of a sulphur seam; it is to a sulphur seam what the *gossan* is to a lode or mineral vein.

It may be calculated that Sicily possesses 50 to 55 millions of tons of sulphur unexcavated. The present annual production is 160,000 tons, but as it must be reckoned that one-third of the sulphur in the ore is lost in the process of extraction by liquation in kilns, the yearly production corresponds to 240,000 tons extracted from the earth. At this rate it would take from 200 to 230 years to exhaust the sulphur in Sicily. All the sulphur seams, however, will not last as long as this; at least one-third of the mines will be exhausted in a period of fifty to eighty years.

It has already been shown that the sulphur ore was deposited in lakes, as it is associated with lacustrine fossils. The sulphur ore may have been deposited in two different ways. The first hypothesis is that it was formed by the decomposition in lakes of sulphuretted hydrogen and bicarbonate of lime, brought in by springs containing these substances, in proportions corresponding nearly to their chemical equivalents. The second is that the springs coming into the lakes contained sulphide of calcium in solution. It must be supposed that bituminous matter, acting on the gypsum contained in the Lower Miocene beds, and aided by the internal heat of the earth, which is felt nearer the surface in volcanic regions than elsewhere, reduced the sulphate of lime to sulphide of calcium. If water was present at the same time, sulphuretted hydrogen and bicarbonate of lime would be produced, and would be carried away in solution. On arriving at the lakes, the oxygen of the air would oxidise the hydrogen of the sulphuretted hydrogen, sulphur would be precipitated, and a slight evaporation would cause the decomposition of the bicarbonate and deposition of the carbonate of lime.

If no water was present at the time of the reduction, carbonic acid would be evolved, and the sulphide of calcium would remain behind. This sulphide of calcium, acted on afterwards by water, might be dissolved, or else give rise by its decomposition to hydrate of lime and a sulphydrate of sulphide of calcium. In one way or another all the calcium and all the sulphur would pass into the lake in solution. Here the solutions would be acted on by the atmosphere, and in either case a precipitate of carbonate of lime would be formed, and a polysulphide generated. The polysulphide would also be finally decomposed in presence of the atmosphere, producing carbonate of lime and sulphur, which are precipitated, and so eventually all the sulphur which was in the sulphide of calcium would be precipitated as sulphur, and all the calcium as carbonate of lime. In this precipitate the sulphur would be to the carbonate of lime in the proportion of 24 to 76. When sulphuretted hydrogen in solution is brought down by springs, much of the gas escapes as such, and the proportion of the sulphur deposited to the carbonate of lime is very small, but when the sulphuretted hydrogen is generated very slowly by the decomposition of sulphides in solution, the oxygen of the air oxidises the hydrogen at once, and no sulphuretted hydrogen gas escapes. As much of the Sicilian ore contains the sulphur and carbonate of lime in the proportion of 24 to 76, it is highly probable that this ore is due to the decomposition of the sulphide of calcium in the lakes themselves. Although the sulphur is directly a lacustrine deposit, yet it is derived indirectly from the sea, as Bischoff says, because the gypsum beds which furnished the sulphide of calcium are a marine deposit. It is very possible that the sulphur of volcanos and solfataras may be derived from the same source. The eruptions of volcanos are often attributed to sea-water penetrating through fissures to heated rocks and producing large quantities of steam of enormous tension. The sea-water contains a considerable quantity of organic matter, which, aided by heat, would reduce the sulphate of lime to sulphide, and from this would be generated the sulphuretted hydrogen which is met with in the exhalations of volcanos and solfataras. This gas is decomposed in presence of the oxygen of the air, and a deposit of sulphur formed.

"WHOLESOME HOUSES."

A long letter in the *Times* of the 9th instant, by Mr. Rawlinson, the well-known sanitary engineer, and dealing with the above subject, has since originated considerable discussion. The advice given by Mr. Rawlinson was as follows:—"Ventilate your drain if there is one, and ventilate your staircase by openings at the roof or skylight, or at some upper window. Open, and preserve open, all chamber flues; secure means of changing the air in bedrooms, and, if sickness occurs, remember that fresh air (change of air) is absolutely more required in sickness than in robust health; remember also that delicate persons, adults or children, require well-ventilated rooms both by day and night, but more especially through long winter nights. Health must be a matter of personal care; homes can only be preserved healthy by unceasing personal care. The most perfect apparatus may be of no effect through misuse, as also through neglect. It may be said, 'All this is the work of the architect or builder;' and the tenant may say, 'You surely do not expect me to do such work!' I can only reply that architects and builders, as a rule, do not make provision for ventilation, but that by perfection of workmanship in West-end London houses they do make provision for preventing ventilation."

Flue ventilation he strenuously opposes. "Practically, the mode of ventilation cannot be too simple. Air is never so fresh as when it comes into a house or room direct; there is some deleterious property in flues which takes the life out of the air passed through. This has been found to be the case in flue-ventilated hospitals; and, after the experiment has cost many lives, flue ventilation has been abandoned and open windows resorted to. We want only the usual fire-grate and an open widow. Manufactured air never can be fresh air, and therefore all stoves, hot water apparatus, or other modes of warming houses by close stove flues and pipes, manufacturing and pouring in artificially warmed air, cause offensive sensations, and to delicate constitutions prove to be unwholesome. The open fire is no doubt the most costly, because most wasteful of fuel, but it is the most cheerful. Here, again, however, delicate and lightly-clothed persons complain of cold during frost; 'they are roasted on one side and frozen on the other.' Why do they not put on more clothing? A lady can sit in her shawl, and elderly gentlemen in topcoats. Better these expedients than to submit to overheated rooms, warmed by dried and flue-transmitted hot air, which unfits the lungs for external temperatures."

Such are some of the principal recommendations given, and they have at least the value of simplicity.

This letter called up a number of answers, many complaining of the bad state of London houses generally, and giving special instances of defects. For the most part the writers agreed with Mr. Rawlinson in his remarks upon the drains and sewers, but differed with him as to the means of ventilation to be employed. Dr. Drysdale, writing from Liverpool, states very definitely a medical objection. "Medical men hold that in the vast majority of cases the effect of the intrusion of cold air is much more injurious to the delicate, the young, the actually ailing, and probably to all sleeping persons, than moderately impure air, which is sufficiently warm —unless, indeed, the infirmity consist of actual miasma. Hence, from the discomfort and actual unhealthiness of cold air, all such plans of hole-in-the-wall and open-window ventilation have hitherto been abandoned as impracticable, and will ever continue to be rejected in a climate like ours."

Another doctor, Dr. Hardie, of Manchester, referring to Mr. Rawlinson's remarks on flue-ventilation, asks what are the deleterious properties referred to, and in what hospitals was the plan abandoned because it was injurious to life? He also asks for some particulars as to the particular plan adopted in those cases. "Of course," says Dr. Hardie, "it is well known that stoves and air which has been superheated in furnaces frequently have a disagreeable, parched, and sulphurous smell. But that is only owing to the bad construction of the apparatus, and need not, nor does not, exist in all cases."

FIRE-PROOF HOUSES.

Mr. Hiram Powers, the sculptor, takes occasion from the Boston fire to put in a word for reform in house-building. He writes from Florence to a New York paper:—"I have the highest respect for the ability and skill of my countrymen. Indeed, they surpass, in the main, all other nations in this regard; but, nevertheless, we have a few things to learn, and among them is how to make, not a house, but a whole city, fire-proof; for no fire-proof house can be made in the midst of highly combustible buildings. Indeed, there is no safe that will withstand the heat of a furnace. The very walls will melt, or crumble into dust, if not from inner fire, at least from outer flames. Therefore, to be fire-proof in our buildings, our neighbours' houses must also be fire-proof; and this calls for municipal laws regulating the materials and the construction of buildings, and what should be required. First—The abandonment of all wood floors. Second—The floors to be made of bricks, thus sealing down all ventilation in case of fire. You may lay a floor of wood on bricks. Third—The stairs to be metallic or of stone. Fourth—The rafters of the roof, like the joists of the floors, to be all bricked over before putting on the slates or tile. But it may be asked will not joists and rafters take fire? Yes, they will, and often do take fire here in Florence. But with a floor of bricks laid with mortar upon them the fire department need not hurry to such a fire; hours, indeed, might elapse before they reached it. I have known an instance of nearly two days burning of the end of a joist, just under a fire-place, and yet the beam not burnt off, only deeply charred. The fire cannot get through the bricks, but it would soon find its way through a wood floor, and then, with ventilation, it would soon reach the garret. In short, the whole building would be in flames within half an hour. Brick floors do not prevent fires, but they prevent conflagrations. No city can be burnt with brick floors, nor has a house been burnt within the City of Florence during my residence here of 35 years."

STEAM *VERSUS* FIRE.

The *Boston Advertiser* gives, from a report made to an insurance company over twenty years ago, some details of the application of steam to the extinguishing of fires. Steam, it is said, possesses decided advantages over water, as it is not so liable to injure goods or furniture, while it can penetrate to places which the latter could not be made to reach. The experiments were made in a large mill, through which suitable pipes and connections had been laid, communicating with the different rooms. A box of waste cotton was ignited in the second story, making a fierce blaze. Steam was turned on, filling first the upper stories and finally reaching and completely extinguishing the blaze. After trying this experiment with dry cotton several times, lamps were lighted and placed in various positions on the stairs and floor, with the wicks very high, producing strong flames. It was remarked that each lamp, as the steam reached it, was immediately put out. Steam, it was shown, could be let into any and every part of the mill in much less time than water could be with the best arranged water supply. In case of fire, the steam is attached to or upon every surface in all positions, and will follow fire into every recess, hole, or crack. It will, in fact, precede the flames, and, covering everything in its course with water, prevent their spread.

FADING OF PHOTOGRAPHS.

At the last meeting of the Photographic Society of London, a paper was read by Mr. Edward J. Gayer, on "The Fading of Albumenized Pictures." The object of the paper was to show how albumen prints fixed in hyposulphite of soda might be rendered permanent, and to explain upon chemical principles why albumen prints so fixed are permanent. No change whatever, Mr. Gayer said, is requisite in the usual mode of toning the albumen print; the only change is in the mode of using the hypo-bath, which is as follows:—Dissolve one ounce of hyposulphite of soda in eight ounces of water in a perfectly clean glass bath, and having taken it into the dark room, immerse in it one print, not more than eight inches square, for ten minutes, or at most a quarter of an hour; then take the print out and rinse it in two waters for a few minutes before removing it from the dark room; afterwards let it receive the usual washing in plenty of water, the latter operation being performed in the daylight. The hypo-solution is now thrown away, as it is quite useless for fixing a second picture. According to Mr. Gayer's statement, after ten years' experience of this process in India, prints treated as above described have always remained unaltered and fresh-looking, while those treated in the ordinary way have faded sooner or later. Each print requires a separate hypo-bath, and it is also essential to the success of this process that the fixing and first washings should be done in the dark room. It is also necessary that the size of the print should be in proportion to the quantity of hyposulphite of soda used to fix it. An ounce of hyposulphite of soda in eight ounces of water is the proper strength of solution; and this quantity will suffice only for one print eight inches square, which should not be allowed to remain in the solution for more than a quarter of an hour at the most. The temperature of the bath is also a matter of some importance, the best temperature being from 60° Fahr. to 80° Fahr.

The chemical explanation of why these conditions are essential is briefly that chloride of silver, although perfectly insoluble in pure water, is easily soluble in a solution of sodium hyposulphite; but the hyposulphites of silver thus formed are extremely unstable. Chloride of silver forms two series of double salts with an alkaline hyposulphite, such as the hyposulphite of soda. Of these sodio-argentic hyposulphites, the first dissolve easily in water; the second are nearly insoluble, and the insoluble salt once formed in the photograph, it cannot be washed out of it, and, decomposing sooner or later, destroys the picture. It is the object of the new process to prevent the formation of this insoluble salt in the print, and to prevent the decomposition of the soluble sodio-argentic hyposulphite while the photograph is in the hypo-solution.

The *Chicago Tribune* says that there are more wooden buildings in that city now than there were before the fire.

SCIENTIFIC PROGRESS IN FRANCE DURING THE PAST YEAR.

The French academies have the excellent habit of commencing, or rather of prefacing, the work of a new year by a review of the acts and deeds of the departed one.

M. Faye, the retiring president of the Academy of Sciences, has performed this task with respect to the scientific history of 1872.

The catalogue of the minor planets, said M. Faye, had been increased by several new bodies, but the most important discovery in astronomy was due to M. Janssen, and applies to the sun. This star is certainly surrounded by an indefinite atmosphere, formed of extremely rarified gas, the hydrogenous nature of which is similar to that of the protuberance. Here we have a capital fact, which excludes entirely the hypothesis of a void in the interplanatory spaces. The theory of the superior planets has attained a high point of perfection through the labours of M. Le Verrier. The elucidation of the phenomena which we have observed on the surface of the sun has made a great step in advance. The aid of other *savants* in this order of research promises an early solution of the physical constitution of the sun, unless some unexpected discovery, such as often takes us by surprise, should put to the rout all the hypotheses which seem at present to be gaining probability.

The labours of meteorologists have borne excellent fruit. The cause of meteorites is likely to be ascertained before long; it is already known that showers of falling stars replace certain comets that have disappeared.

Important improvements have been made in the photographic processes applied to astronomy; very large and excellent pictures of the moon have been obtained instantaneously.

The study of the polar auroras progresses satisfactorily, thanks to certain of these phenomena which have appeared with unusual magnitude.

The origin of atmospheric electricity seems to be yielding before the sustained efforts of the physicists.

New and curious effects have been observed in physical science; empty tubes have been found to become luminous by friction; magnetic currents are developed under the influence of electric agents; even capillary attraction has made an advance. Important improvements will hence result in the construction of lightning conductors.

In Algeria geodesy has been advanced by the efforts of distinguished officers; the meridian will be prolonged, at the same time that its known errors will be rectified.

In the science of aërial navigation, attempts have been made to direct aërostats at an angle to the current of the wind; this is the commencement of the command of the air.

In chemistry, there has been important progress: a highly permanent gas, carbonic acid, has been decomposed in considerable quantities by electricity alone. Ozone, or active oxygen, is obtained in abundance under the influence of electricity conducted by charcoal. Other gases seem to promise to submit to the same influences.

Ferments, which have been the despair of chemists, have been the objects of new study on the part of an illustrious savant, the consequence of which has been to determine the great question in dispute.

In its applications, science has not remained inactive. The extraction of gold and silver from pyrites is now effected with facility. A new method of decorative painting, and another for the reproduction of designs, have entered the domain of art. Humanity may congratulate itself in the success obtained in preventing fire from choke damp.

In agriculture, the means of combating the philloxera have received great attention. Several processes now exist for the extirpation of this destructive insect, and there is reason to hope that they will prove efficacious.

Phosphate of lime, in a form in which plants can assimilate it, is a substance of the highest importance in agriculture; we know now the mode of determining the quantity.

Many forage plants have been imported from Africa into France, an unexpected acquisition, which cannot fail to bear good fruit.

Mechanical applications have been extended; we now possess an isochronic regulator; the paths of oblong projectiles are far better understood than they were.

It would prove a long task if an attempt were made to record all the scientific novelties which have swelled the annals of the learned world of late; the above only pretends to be a rough outline sketch.

With respect to present operations of the Academy, it was announced that the Commission appointed to arrange the observations of the coming transit of Venus had taken all possible measures for the success of the French expeditions. MM. Elie de Beaumont and Dumas, the two permanent secretaries of the Academy, had been appointed to replace MM. Langier and Delaunay, members of the Commission, deceased. Many savants and artists had been consulted, and much important information had been obtained from naval officers and hydrographers. The Commission counted on the further aid of the Minister of Marine, with a view especially to the stations at the Island of Bourbon and at Sydney. It was announced that a large portion of the required instruments would be ready this year, and everything would be ready for the departure of the four expeditions to the two hemispheres, without counting the secondary expeditions.

GLASS SPINNING.

The latest improvements in spinning glass are due to the Vienna manufacturer Brunfaut, who exhibited his talent is this speciality in 1850, at Pesth. After manifold trials, he discovered a composition which may be made at any time into curled or frizzled yarn. The frizzled threads surpass in fineness not only the finest cotton, but even a single cocoon thread, and they appear at the same time almost as soft and elastic as silk lint. The woven glass flock wool has quite recently been used as a substitute of ordinary wool wrappings for patients suffering from gout, and its use for this purpose has been, it is stated, successful. Chemists and apothecaries have found it useful for filtering. The smooth threads are now woven into textile fabrics, which are made into cushions, carpets, table-cloths, shawls, neckties, cuffs, collars, and other garments, &c. They may be used for weaving the figures in brocaded silk or velvet. As a material for fancy dresses, tapestry, for covering furniture, for laces, embroidery, hosiery, &c., the glass tissue will probably, at some future time, occupy a prominent place. Owing to its brilliancy and the splendour of its colours, it is the most beautiful material for dressing the hair, neck, and head. In softness, the glass yarn almost approaches silk; and to the touch, it is like the finest wool or cotton. It possesses remarkable strength; and it remains unchanged in light and warmth, and is not altered by moisture or acids. Spots may readily be removed by washing. Being non-inflammable and incombustible, it is especially valuable for making dress materials for ladies. Clothes of glass fabrics are much warmer than those of cotton or wool; at the same time, they are of low specific gravity. They are also adapted for veils, as they repel the dust remarkably well. The composition of the material is still a secret, and the spinning requires extrordinary dexterity and constant attention. This part of the business is said to be very trying to the sight. It is stated that, with a wheel of a diameter of five Austrian yards, one operative is able to spin 3,000 yards per minute. The cloth (which is equal to about eleven drachms avoirdupois) is sold for 2 florins 93 cents. gold. Some manufactures of glass yarn are sold at the following prices:—Bedouin tassels from 2s. to 3s.; eagle feathers from 1s. 6d. to 3s. 6d.; ostrich feathers from 2s. to 8s.; bouquets, 3s.; cuffs, 5s. 6d.; ladies' neckties, 2s. to 18s.; gentlemen's neckties from 2s. to 8s. 9d.; watch-chains from 1s. to 4s.; chignons from 2s. to 18s.; trimmings, 1s. 6d. and upwards per yard; ladies' cloths from 6d. to 9d. per yard; ladies' hats from 18s. 6d. to £3. In conclusion, we may state that the Austrian Minister of Commerce has already organised schools for glass-spinning in the principal seats of glass manufacture in Bohemia.—*Journal of Applied Science.*

THE SILKWORM IN JAPAN.

The Italian silkworm breeder, Chiapello, who was lately enabled to travel in Japan, and visit the silk districts of Boshio, seldom entered by Europeans, publishes some interesting particulars in the *Moniteur des Soies.* Chiapello was greatly surprised by the almost complete want of mulberry trees. All mulberry plantations in that silk-producing province are hedges formed along irrigation canals, sixty to seventy centimètres distant from each other; the single bushes are separated by a distance of from forty to forty-five centimètres. Great care is taken in properly manuring and watering these bushes till the fifth year. The Japanese consider the leaves from bushes four to five years old the best food for those worms which are preserved for propagation, especially for those coming from the region watered by the rivers F'squama and Sirostaz. Besides the usual manure from the land generally, they give to each bush from time to time a few spoonfuls of finer compost, especially one prepared from a fish guano. The colour of the eggs is said to be influenced by the kind of manure used; the latter, as well as the degree of manuring, is also stated to affect the produce. This extreme care as to the food of the silkworm is a striking feature in the silkworm culture of the Japanese, which contrasts sharply with the carelessness practised in this respect by European growers. The same care is observed in choosing animals for propagation, and a peculiar method is employed for selecting the strongest, consisting in temporarily exposing the cocoons to the influence of cold, whereby the weaker ones naturally die off. Another characteristic in Japanese silkworm-breeding is that twice the room is given to each worm which is allowed for it in Europe. The detection of diseased animals is also worthy of notice. If a reddish point appears on the head, the worm is killed. Some districts have for centuries been famous for the excellence of their silkworms, and their eggs are largely used in Japan for propagation.—*Land and Water.*

THE "RAMIE PLANT."

The *New York Sun* gives an account of the "ramie plant," to the cultivation of which considerable attention is now being paid by the planters in some parts of the South. This plant grows well in Florida, Georgia, South Carolina, and, in fact, almost anywhere from latitude 33 degrees, southward to the Gulf of Mexico. In Louisiana some of the planters are replacing the sugar-cane with ramie, which does not require replanting, demands comparatively little labour in cultivation, and entails no great expense for machinery to prepare it for market. So far as known, it has no insect enemies, its fibre is less bulky and more easily transported than cotton, and it is sure of a ready sale at remunerative prices. At present the fibre sells in England for 240 dollars per ton of 2,000 lb., or 8$\frac{3}{4}$ c. per lb. Ramie, which is also known as Chinese grass, is a plant of the nettle family, and grows spontaneously in British India, China, Java, and other eastern countries. The fibre, which forms its commercial product, is the inner bank of the stem, and when exposed to view by separation from the husk, presents a brilliant pearl-white lustre. According to the *Sun*, this fibre is longer and more uniform than any other except silk; it is stronger and more elastic than hemp or flax; takes colour as well as a good quality of silk; and when properly perpared from the raw material may be spun into fine yarns, suitable for mixing with wool in the manufacture of delaines, worsteds, and other light fabrics. Without admixture it can be woven into fabrics which, it is said, will surpass the finest linens in beauty, strength, and durability. The ramie fibre has also a felting quality superior to either fur or wool. Most of the ramie now sent to market is very imperfectly prepared, the fibre being generally mixed with fragments of the outer bark, which injures its appearance, and lessens its marketable value. This is probably the result of inexperience, and the want of suitable appliances for cleaning it. Improvements are required to be made in the present imperfect methods of preparing that fibre, and then producers will realise much higher prices for their crops.

CORRESPONDENCE.

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THE SULPHUR DEPOSITS OF KRISUVIK, ICELAND.

Sir,—The compiler of the *Journal* of yesterday's date must have been as much puzzled how to word the report of the proceedings on Wednesday evening last as I am to understand it, for, though present, I did not hear the excellent paper read which is given at length in the *Journal*, nor do I think that more than a tenth of the information which it contains was brought before the meeting; but I believe that the whole time was occupied by experiments showing how the deposition of the sulphur might have been effected.

As I happen to have been for some years concerned in the working of some of the Sicilian sulphur mines, to which reference is made in the *Journal*, I have made several trips to the island, and have spent some months there, and had some of the statements in the printed paper been made at the meeting I should certainly have taken the opportunity, offered by the Chairman, of discussing them, and should have brought forward some facts to show that the conclusions drawn by the author of the paper were based upon incomplete data, so far as Sicily was concerned.—I am, &c.,

W. Shelford, M. Inst. C.E.

7, Westminster-chambers, London, S.W.,
18th January, 1873.

Sir,—I notice in the account of Mr. Vincent's lecture some remarks which, escaped my attention on Wednesday evening, concerning the similarity of origin between the sulphur deposits of Iceland and those of Sicily. This similarity in mode of formation is a point which seems to me very doubtful. The Icelandic bed described by Mr. Vincent is one now forming at the surface of the earth, and is very similar to that of the well-known solfatara near Naples, where sulphur is daily being deposited by fumaroli, as at Krisuvik, only on a much smaller scale. The Sicilian sulphur, and that of the Romagna, appear to be of subaqueous origin, and the sulphur seams are probably old lake bottoms. This is inferred to be the case from the perfect stratification, not only of the beds accompanying the sulphur, but also in many cases of the sulphur seam itself, and again from the fossils they contain.

The mode of deposition, however, does not affect the commercial value of the sulphur beds in Iceland; indeed, it is of course better to have such a rich bed as Mr. Vincent describes near the surface than a seam with only 20 per cent. of sulphur, as in Sicily, at some depth underground.—I am, &c.,

Clement Le Neve Foster.

DR. TIDY'S LECTURES.

SIR,—I think a note should be made that there is an inaccuracy in Dr. Tidy's lecture, printed in your *Journal* (p. 113), in that part which follows the description of "short sight." It is even now a common mistake, and it is very important that it should be quite abandoned. It is hardly yet rooted out of popular handbooks, and it spreads among them as if there were nothing to check its growth. The error to which I allude is the confusion of *hypermetropia* with *presbyopia*. And it is not an innocent error, for it leads some people still to conclude that as a young person cannot have presbyopia he cannot want convex glasses, whereas the want is very common and very urgent indeed, even in childhood.

The following extracts from the lecture to which I refer apply to *hypermetropia* :—"The eye too flat, or the eye-ball too shallow, just the reverse of (myopia) what we have been considering"—"rays (generally) would come to a focus behind the retina."

And these to *presbyopia* :—"The lens . . . . not . . . . a sufficiently good refractor . . . . impaired accommodative power . . . . from, perhaps, most often a less yielding state of the lens . . . . the person holds his book a long way off to bring the point of intersection more forward."

In either case "we use a convex lens in order to bring the rays upon the retina, in front of where the focus otherwise would fall," but under quite different circumstances. Dr. Tidy only mentions presbyopia in connexion with the extracts I have made from his printed lecture, but this disease is not the reverse of myopia, nor are presbyopic eyes necessarily flat or the eye-balls shallow. Hypermetropia is a congenital defect, whereas presbyopia, of course, is a disease of old age.

I am, &c., J. F. STREATFEILD.

15, Upper Brook-street, W.

PHORMIUM FIBRE; OR, NEW ZEALAND FLAX.

SIR,—In my letter to you of 27th July, 1872, published in your *Journal* of 2nd August, 1872, and in my letter of 23rd November, published in your *Journal* of December 6th, 1872, I drew attention to the above-named valuable colonial fibre, as also to some of the uses to which it had been applied in connection with textile manufactures. Since that date I have had yarns and cloths made in other places than Arbroath, and so soon as they come to hand I will send some samples to the Society, so as to mark the progress which is still being made; but in the meantime I think it advisable to send a few samples of articles already manufactured from the Phormium fibre, so that any who may still be sceptical as to the adaptability of this fibre to ordinary purposes, may satisfy themselves of its usefulness by personal examination of the accompanying samples:—

1. Is the "native dressed" fibre.

2. Coarse long leaves and fine leaves of the plant, grown in New Zealand.

3. Brown fibre, extracted from the coarse leaves. Finer fibre, extracted from the fine leaves by me.

4. A piece of rope, made by Messrs. Frost, Brothers, for me.

5. Two pieces of cloth, made from yarn. First attempt by Mr. Forbes to spin Phormium fibre. First attempts by Messrs. E. Parker and Co., to weave Phormium fibre yarn.

6. Two pieces of cloth, showing how well the Phormium mixes with Riga flax. The proportions here are 25 per cent. Phormium and 75 per cent. Riga.

7. Strong canvas, pure Phormium fibre.

8. Coarse sheeting, pure Phormium fibre.

9. Sacking cloth or wool pack, pure Phormium fibre. The yarn made from the tow of fibre prepared for rope-making.

10. Light sacking, pure Phormium fibre. The yarn made from rather fine tow.

11. Brown twill cloth, pure Phormium. Yarn made from fibre, similar to the finer fibre, in sample No. 3.

12. Scotch twilled sheeting }
13. Linen } These are made entirely from Phormium, native dressed. Supplied by Dr. Featherstone. Sample No. 1.
14. Damask towelling }

15. Damask towelling, entirely of Phormium fibre. The weft from my fibre. Sample No. 3. The warp from native dressed.

As I before explained, until I met Mr. Forbes my efforts to get the Phormium fibre spun were unsuccessful, for although many gave me favourable opinions of the usefulness of the fibre for rope and twine, they nearly all expressed adverse opinions as to its ever being adapted to textile purposes. The sacking or wool pack is perhaps the most interesting to the New Zealand colonist, as it is easy of production, and does not require any special alteration in existing machinery.

Hoping these specimens may be the means of making the public generally more acquainted with the Phormium fibre, and thus benefit our New Zealand colonies,

I am, &c.,
C. THORNE.

16, Mark-lane, London, Jan. 20th, 1873.

[The specimens may be seen at the Society's rooms.]

OBITUARY.

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Samuel Robert Graves, late M.P. for Liverpool.—The Society of Arts, in common with Liverpool and the public at large, have had a special loss in Mr. Graves. He was specially distinguished by his clear view and mastery of the true principles of railway reform, of postal telegraph reform, as well of the leading principles affecting the prosperity of our mercantile marine. He had stated that only his pre-occupations for the time on the latter question had prevented him taking an active part during the last Session in support of the principles advocated by the Society for putting the ocean telegraphs on the footing of the inland postal telegraphs, and his special aid on that question during the present session was anticipated. He held to the opinion that it was essential to the improvement of those means of communication that they should be placed on a public footing. He would have agreed that it would be practicable on that footing to reduce the cost of the transit of goods and passengers by one-third, and of ocean messages by more than one-half, and that, too, with a surplus in aid of the revenue, and that thus foreign transactions would be accelerated to a vast extent by weeks and months, and colonial social ties would be actively maintained. It has been suggested that the electors of Liverpool, of whatsoever political party, would at the time consult their own welfare, and what is due to a great commercial city, by seeking a successor to him of special capacity and weight, to give aid on those great neutral questions.

Mr. Joseph Knott, of the firm of Knott and Co., steel manufacturers, of the Highfield Steel Works, has patented an invention for economising fuel and preventing smoke. The patent consists of bringing together two atmospheric pressures, which meet in the fire, and create, it is said, a perfect combustion.

The American cotton crop of 1872 will considerably exceed that of last year. The acreage this year is 8,656,504, an increase of 945,305 acres over last year. The average yield per acre last year was 0·385 of a bale, making the total yield 2,974,351 bales. At this rate the crop will be 3,290,000 bales.

GENERAL NOTES.

Scarcity of Milk in the Canton Lucerne.—It appears from a Swiss paper that in many communes of the Canton Lucerne, partly on account of the starting of new cheese dairies, and partly in consequence of large quantities being purchased for condensation, milk is scarcely to be had for household purposes at any price. The government council has therefore commissioned the Department of Political Economy to investigate the matter.

New Bleaching Process.—MM. Samal and Berouson have recently patented, says the *Chronique de l'Industrie*, a new method of bleaching animal textile fabrics by means of a feeble solution of the sulphurets of sodium and potassium. These products act in a remarkable manner in removing the gum, in preparing silk and in scouring wool. In practice, in the first case, the bath should be boiling; in the second, the temperature of the alkaline sulphuret should not exceed fifty degrees cent. The more difficult it may be to remove the gum and prepare the silk, the less the solution should be sulphuretted; in some instances the protosulphuret may be employed. The inventors have also used, in the same manner, the aluminate of soda and potash.

The Hospice of the St. Gothard Pass.—From a circular published by the government of the Canton Ticino, and addressed to the other Swiss cantons, it appears that the number of poor travellers who received assistance at the hospice of the St. Gothard between the 1st October, 1871, and 3rd September, 1872, was 8,160. These persons received 24,635 rations of food and such articles of clothing as were required. . The total expenditure amounted to 9,974·50frs., the receipts amounting to 9,870·40frs., showing a deficit of 104·10frs. As this hospice has no funds of its own, the means of relieving poor travellers is to a certain extent restricted, and it depends chiefly on a small grant from the Canton Ticino and private contributors.

The Canal Cavour.—The repurchase of the State canals by the Italian government seems now to be completely settled. The *Opinione* of Rome states that on the 24th a convention was signed at Florence between the Italian Irrigation Company, represented by the President, the Commendatore Caranti, and Government by the Ministers Sella and Castagnola, by which the Canal Cavour, and other canals belonging to the company, will become the property of the State. The exact conditions have not as yet been made public, but it is stated that the shareholders will receive five per cent. rentes in exchange for their shares, to the value of £875,000 interest per annum, equal to 3½ per cent. on the paid-up share capital of 25,000,000 francs, so that each share of 500 francs will be exchanged for rente yielding a yearly interest of 17·50 frs.

Diamond Cutting.—This business has always been confined to a small number of hands, and though there are diamond cutters in London, the bulk of the work is performed by the Dutch at Amsterdam. The master cutters have enjoyed two years of wonderful prosperity, which the men have now resolved to share. We hear that workmen refuse to instruct apprentices, and are constantly insisting on a rise in their own pay; and it is said that ordinary journeymen cutters are earning £10, and more skilled hands £20 per week, or even more. The charges for cutting are now as much as 24s. per carat. on the weight of the rough stone, instead of 12s. or 14s. The monopoly the cutters possess is being made the most of by them, and the workmen now often refuse to cut the very small stones at any price. The "waste" in cutting varies according to the shape of the rough stone, and it frequently happens that in order to remove a flaw or spot, and so produce a more perfect brilliant, it is deemed advisable to cut away large pieces from the original rough block: these cuttings are called "cleavage," and if from good stones are valuable, as they are easily made into small brilliants or rose diamonds. The practice of diamond cutters varies a good as to the cleavage, some keeping it (as a tailor would cuttings off cloth sent to him to make up) while others are conscientious enough to return it. A skilful diamond cleaver commands far higher wages as a workman than a mere cutter or polisher, as on his judgment of each rough stone depends the form and size of the brilliant.

Railways in Italy and Switzerland.—An Italian writer on political economy, in comparing the industry and commerce of Italy and Switzerland, states that, in 1871, in the latter country there were 1,391 kils. of railway open to traffic, yielding a gross annual revenue of 39,234,689 frs., and that at this rate Italy should have 13,960 kils. of line, with 392,000,000 frs. gross revenue. Instead of this, Italy has only 6,425 kils. of railway, with a gross revenue of 107,915,552 frs.

Industrial Museum at Milan.—The National Industrial Association are now making great efforts to establish an industrial museum at Milan, in connection with the school for industrial drawing, and a commission has been appointed for the purpose of promoting this undertaking, and to provide the samples and models, &c., required in such an establishment. The exhibition to be held in the coming autumn at Milan, by this association, is already announced to be devoted to "the history of labour," and not, as was stated in a former number of this *Journal*, to embrace silk and other manufactures.

Wurtemburg School.—We learn from the *School Board Chronicle* that in Wurtemburg, a kingdom with a population equalling two-thirds of the population of London, there are, chiefly maintained at the expense of the State, as many elementary schools as parishes; as auxiliaries to these there are 450 industrial schools, 523 farming schools, and 108 trade schools, in which lads of twelve and upwards are fitted for husbandry and handicrafts. There are 76 industrial academies, a great agricultural college at Hohenheim, a great building-trades college at Stutgardt, and a polytechnic university at Stutgardt.

Curious Musical Instruments.—A curious collection of musical instruments has been presented to the Conservatoire of Paris by M. V. Schœlcher, a member of the National Assembly; it consists of forty-nine articles, few of which are known in Europe. Amongst others may be noted:—A *Darbouhah*, a drum with an earthenware body, a two-stringed violin, formed of a calabash and copper castinets, used for the dances of the Almées, in Egypt; an Arab shepherd's pipe, made of an Egyptian reed, and resembling a hautbois; a mandoline of great beauty of form, used by the bayaderes of Smyrna; a Carab *quia-quia*, formed of strawplat; a *yoiof* in wood, and another from Hayti, made of tin and coloured; an instrument resembling a small harp, in bamboo; Mexican flute and small guitar; a long Carab Eolian harp, made of bamboo; a violin with a carved head, used to accompany modern Greek rhapsodies; a Greek shepherd's flute; a large carved harp with twelve chords; a very curious instrument called an *auduigue;* a drum from Gambia, three feet high, and upon which the musician sits and beats with both hands; large guitars (or banjos) made on calabashes, with five and six strings, from Gambia, Senegal, and Gabon; a flute from the last-named country; flutes or hautbois, made of various reeds, and a variety of drums from Senegambia.

Papers in the Boston Fire.—Curious results, says the *Engineer*, have followed some of the experiments made upon charred papers and documents, and the examinations of books in safes which proved worthless in the great fire at Boston. It has been found that what paper-makers call poor paper, paper considerably "clayed," stood the best test. Parchment paper, used for bonds and legal documents, shrivelled up exceedingly, and the print blistered so that it could be read when writing was illegible. So it was with the engraved work on notes. The gilding on the account books burned, and charred showed out as bright and clear as when the books were new, which brings up the question if to introduce gilt-edged account books would not be well, on the ground that the gilt would stay the passage by fire of the pages within. Books crammed into a safe, so that it was difficult to get them out, suffered considerably less than those that were set in loosely, and in some cases came out from safes in which everything else were worthless, so far preserved that the figures on their pages could be deciphered. With charred papers, which could not be made transparent by any light whatever used, it was found, after the employment of vitriol, oxalic acid, chalk, glycerine, and other things, that anything that moistened them to a certain stage—to which it was delicate work to get and not pass—made the lines, words, and figures legible through a magnifying glass. It has been the almost universal experience that lead pencil marks show out all right where ink marks cannot be distinguished. The success of the use of photography has already been noted.

Canadian Graphite.—Some exceedingly fine samples of graphite are on view at St. Clement's-house, imported by Mr. Harvey. They are from a mineral property near the village of Buckingham, on the River de Liviere, a tributary of the Ottawa, in Canada, and which, from the appearance of these specimens, should be one of the richest in the world, as certainly nothing equal to them has been seen in this country, that we are aware of, since the famous Russian plumbago blocks shown in the Great International Exhibition of 1862, by M. Alibert. The lodes on this Canadian property are said to be fourteen in number, some of them six feet to ten feet in width; and, according to the report of Mr. Henwood, at least 5,000 tons could be annually raised from them. One of the specimens shown measures 2 feet by 16 inches by 4 inches, although it is now considerably less than it was by reason of fragments broken away. The ore has been assayed by Messrs. Johnson and Sons, and found to contain 97 per cent. of plumbago. In addition to the veins of pure graphite, the mountain in which they exist consists of a sort of gneissic rock, in which plumbago is largely disseminated, the rock yielding, when crushed and washed, 10 to 60 per cent of that substance. It is stated that 10,000 or more tons could be raised yearly from this source.

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

REPORTS ON THE LONDON INTERNATIONAL EXHIBITION OF 1872.

The reports which appeared in the last volume of the *Journal* on the various sections of the above Exhibition, are now published complete in a pamphlet form (price 2s.), and can be obtained at the office of the Society.

THE LIBRARY.

The following works have been presented to the Library:—

Transactions of the Institution of Naval Architects, Vol. 13, presented by the Institution.

The Euphrates Valley Route to India, a paper read by W. P. Andrew, F.R.G.S., before the British Association, 1872. Presented by the Author.

New Zealand Exhibition, 1865. Reports and Awards of the Jurors. Presented by P. L. Simmonds, Esq.

The Colliers' Strike in South Wales: its cause, progress, and settlement, by Alex. Dalziel. Presented by the Author.

Patents and Patentees of Victoria, Vol. 1 to 4. Presented by the Government of Victoria.

Abstracts of Specifications of Patents, applied from 1854 to 1866, Ac to Bu. Presented by the Government of Victoria.

Nos. 15 to 19 of the Reports of the Science and Art Department. (Two copies.) Presented by the Department.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. The following meetings have been arranged.

January 29.—"On Guilds and their Functions." By John Yeats, Esq., LL.D. On this evening Thomas Webster, Esq., Q.C., will preside.

February 5.—"On Ships for the Channel Passage." By Lieut.-Col. A. Strange, F.R.S.

CANTOR LECTURES.

The second course of these lectures, viz., seven, "On the Energies of the Imponderables, with especial reference to the Measurement and Utilisation of them," will be delivered by the Rev. Arthur Rigg, M.A., on the following evenings, at eight o'clock:—

Lecture I.—Monday, February 3rd, 1873.

On the Sources, Inter-relations, and Measurements of Energies—Units of Measurement.

Lecture II.—Monday, February 10th, 1873.

On the Energy of Gravity, with especial reference to the Measurement and Utilisation of it.

Lecture III.—Monday, February 17th, 1873.

On the Energy of Vitality, with especial reference to the Measurement and Utilisation of it.

Lecture IV.—Monday, February 24th, 1873.

On the Energy of Affinity, with especial reference to Suggestions for Estimating and Utilising it.

Lecture V.—Monday, March 3rd, 1873.

On the Energy of Electricity, with especial reference to the Measurement and Utilisation of it.

Lecture VI.—Monday, March 10th, 1873.

On the Energy of Light, with especial reference to the Measurement and Utilisation of it.

Lecture VII.—Monday, March 17th, 1873.

On the Energy of Heat, with especial reference to the Measurement and Utilisation of it.

Members are entitled to attend these lectures free, and to admit two friends to each of them. Tickets for this purpose are issued with this *Journal*.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Social Science Association, 8. Mr. Thomas Hare, "On the Policy of Permitting Lands to be held by Corporations, or otherwise, on Perpetual Uses."
Institute of Surveyors, 8. Mr. W. Sturges, "Statistical Notes on the Prices of Agricultural Produce, Labour, and Rent, from the early part of the Last Century to the Present Time."
Royal United Service Institution, 8½. Lieut.-Col. A. Strange, F.R.S., "Proposed Method of Mounting Heavy Ordnance at Sea on the principle of the Bessemer Saloon."
London Institution, 4. Professor Duncan, "Physical Geography."
Royal Geographical Society, 8½. 1. Maj.-General Sir Frederick Goldsmid, "Sistan, with an account of a Journey from Bander Abbas to Meshed, through that province." 2. The President, "Note on the Comparative Geography and Ethnology of Sistan."
Entomological, 7. Annual General Meeting.
Actuaries, 7. Mr. T. B. Sprague, M.A., to open discussion on "The 1st, 2nd, and 3rd Schedules of the 'Life Assurance Companies' Act, 1870.'"
Medical, 8.

Tues.... Medical and Chirurgical, 8½.
Civil Engineers, 8. Mr. John Milroy, "Cylindrical or Columnar Foundations in Concrete, Brickwork, and Stonework."
Royal Institution, 3. Prof. Rutherford, "Forces and Motions of the Body."

Wed.... **SOCIETY OF ARTS, 8.** Dr. John Yeats, "On Guilds and their Functions."

Thurs... Royal Institution, 3. Dr. Debus, "Oxidation."
Royal, 8½.
Antiquaries, 8½.
Philosophical Club, 6.
Social Science Association, 8. Mr. W. T. S. Daniel, "On the Reorganization of our Judicial System."

Fri ...... Royal Institution, 9. Mr. Dannreuther, "Music of the Future."
Royal United Service Institution, 3½. Major Colley, "Marches."

Sat ...... Royal Institution, 3. Dr. Freeman, "Comparative Politics."

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,054. Vol. XXI.

FRIDAY, JANUARY 31, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

TECHNOLOGICAL EXAMINATIONS.

The Programme of Examinations in the Technology of the Arts and Manufactures of the country, in reference to which notices have already appeared in the *Journal*, is now ready for issue, and may be had on application to the Secretary. These examinations will be held annually, in conjunction with the examinations of the Science and Art Department, and due notice will be given of the particular subjects selected each year.

In 1873 Examinations will be held in the technology of Cotton, Paper, Silk, Steel, and Carriage-building. Candidates, in order to obtain certificates in any of these subjects, must pass the examinations of the Science and Art Department in certain sciences, which are specified in the programme as bearing upon the particular art or manufacture. In addition to these, special papers will be set in the technology of each manufacture by examiners appointed by the Society of Arts, and certificates of three grades will be awarded:—"Honours," "Advanced," and "Elementary."

The examinations of the Science and Art Department will be held during the first three weeks of May, the technological paper being worked on the evening of the 17th May. The dates of the Science subjects are given in the Science Directory, published by the Science and Art Department.

The following Prizes are offered by the Society of Arts in each of the five subjects mentioned abvoe:—

To the best candidate in Honours, £10.
To the best candidate in the Advanced Grade, £7.
To the best candidate in the Elementary Grade, £5.

In order that these Examinations may really be successful in promoting technical education in this country, it is desirable that encouragement should be given to candidates by the offer of additional prizes and scholarships. With this object the Council appeal to the Companies of the City of London, to merchants and manufacturers, and to members of the Society generally, to aid them by contributing to the prize fund.

The Council invite the aid of masters and managers in promoting these examinations by encouraging their workmen to take advantage of them. An explanatory handbill, suitable for being suspended in factories and workshops, may be had on application to the Secretary of the Society of Arts, Adelphi, London, W.C.

PRIZE FOR STEEL.

1. The Council have resolved to award the Gold Medal of the Society to the manufacturer who shall produce and send to the London International Exhibition of 1873 the best collection of specimens of steel suitable for general engineering purposes.

2. The specimens exhibited must include a complete illustration of the applications of the varieties of steel submitted.

3. Each manufacturer should send with his specimens a statement of the nature of the tests he has applied to each kind of steel submitted, and give the results of such tests.

4. The samples tested are to be exhibited together with duplicate samples, or portions of the same samples; these will be submitted to tests should the Council consider it desirable.

5. The Council reserve to themselves the right of withholding the premium, in the event of the specimens exhibited not being sufficiently meritorious.

INSTITUTIONS.

The following Institution has been received into Union since the last announcement:—

Watford, Public Library and School of Science and Art.

PROCEEDINGS OF THE SOCIETY.

EIGHTH ORDINARY MEETING.

Wednesday, January 29th, 1873, Thomas Webster, Esq., Q.C., F.R.S., in the chair.

The following Candidates were proposed for election as Members of the Society:—

Davies, William Henry, 51, Tregunter-road, South Kensington, S.W.
May, Herbert, 210, High Holborn, W.C.
Price, Rev. Newton, Watford.
Quick, Joseph, 29, Great George-street, S.W.
Quick, Joseph, jun., 29, Great George-street, S.W.
Schanschieff, Alexander, 39, Clifton-gardens, Maida-vale, W., and St. Petersburgh.

The following candidates were balloted for and duly elected members of the Society:—

Baines, Harry Cuthbert, M.A., Slapton, near Dartmoor.
Blundell, George Thomas, 33, Burdett-road, E.
Blandford, Marquis of, Blenheim, Woodstock.
Browne, R. Mackley, F.G.S., Northside, St. John's, Sevenoaks.
Browne, Wm. Morgan, F.R.G.S., Junior Athenæum Club.

Corscadden, John F., 24, Holland-park, W., and 33, Wellington-street, Strand, W.C.
Foster, Wm. Robert, 87, Grange-road, Bermondsey, S.E.
Givry, Victor, 23, Old Bond-street, W.
Hill, Thomas G., 4, Kensington-park-gardens, W.
Inglis, Robert William, 26, Weighton-road, South Penge-park, S.E.
Knight, Charles Joseph, 7, York-terrace, N.W., and 14, Argyll-street, W.
Ladeuil, Morel, 13, Camden-road, N.W.
Manuel, Robert, 19, St. Dunstan's-hill, E.C.
Mappin, Walter S., 19, Stanley-crescent, Kensington-park-gardens, W.
Palmer, Joseph, F.R.G.S., the Grammar School, Wells, Somerset.
Stewart, P., Middle Temple, E.C.
Stewart, Dr. William, 23, Sackville-street, W.; Cordon, Newburgh, N.B.; and Paraguay.
Tilley, Samuel, 10, Finsbury-place south, E.C.
Vallentin, James, 55, Cow Cross-street, E.C.
Wheeler, John, 4, City-terrace, Peterborough.

The Paper read was—

GUILDS, AND THEIR FUNCTIONS.

By John Yeats, LL.D.

The "Guildhall" is one of the most common architectural monuments of our own and of continental towns, but the guilds themselves are less conspicuous; indeed they almost elude observation. Yet they belong to the longest-lived and most time-honoured of the many noble institutions bequeathed to us by our forefathers. They did good work in their day; they organised industry, they accumulated capital, and exercised undoubted authority. We may therefore usefully inquire how and why they originated, what vicissitudes they underwent, what were their characteristics, and what the causes of their decline; lastly, whether, in form or in function, any of them still survive or can be re-animated. If so, from a careful comparison of the circumstances amid which they earned their wealth and prestige, with those amid which we live and labour, some course of action may perhaps suggest itself, calculated at a future time to revive, if not fairly to renew, their dignity and popularity.

Should such be the case, we shall all rejoice; for old friends restored are likely to prove more faithful than new friends made; at any rate, they inspire more confidence. And in these days, when a feeling of uneasiness pervades society respecting overt organisations and secret combinations, national or international, it seems to me that a resuscitation of the spirit of the fathers of the ancient guilds, as directors and promoters of industrial progress, and a re-opening of the portals of our great guildhalls, for other purposes than for pomp and festivity, would do much towards dispelling commercial anxiety, banishing social distrust, and substituting for the shadow the substance of a wide-spread and powerful trade-union.

Within the limits of a single hour it is impossible to survey the whole field of inquiry before us. I purpose taking social and economic points of view chiefly, and avoiding the direct influence of the guilds on the development of skilled labour. Such a course is the more eligible, since I have already devoted myself[*] elsewhere to this important part of the subject, and indicated the main sources of information, English and continental.

This evening I will refer to few other than writers of our own day, and especially to the late Mr. Toulmin Smith, whose posthumous work, edited by his daughter, with a preliminary essay by Dr. Lujo Brentano,[*] was published in 1870 by the Early English Text Society.

The first question for consideration is, what is the meaning of the word guild?

Different authorities trace the etymology of the word to two distinct sources. Bosworth, whose derivation is most generally accepted, connects it with the Anglo-Saxon verb *geldan*, *gyldan*, *gildan*, to pay; and the noun *geld*, *gyld*, *gield*, payment —a word which has other derivates in Danegeld, Wergild, and kindred words. The other derivation is that given by Mr. Hensleigh Wedgwood, who says, "It is a mistake to connect the word with the German *geld*, payment. The real derivation is to be found in the Welsh *gwyl*,[†] a feast or holiday."

As cognate words Mr. Wedgwood mentions the Danish and Platt-Deutsch *gilde*, feast, company, and the Dutch *gulde*, of like signification. Without attempting to decide between these views, it is sufficient here to observe that there is in the form and the connotation of the word itself sufficient warrant for either etymology. The guild members were almost universally required to make stipulated payments upon admission to the fraternity, and at regular intervals afterwards. They were also accustomed to meet periodically, and to celebrate their meetings convivially. To give but a single illustration of both points. In the ordinances of the Guild of Garlekhith, London, it was laid down that every member "shall give at his entry, to the common box, vj s. viij d.;" that each member "shall pay every year, at four times or once in the year, ij s.;" and that all the members of the brotherhood "shall every year come and hold together a feast.[‡]"

But the origin of the institution is of higher importance than that of the name. "The fundamental idea of the guild was that it was an association for mutual help made by the people themselves, when and as they found the need of it."[§] Dr. Brentano says, "The essential nature of the guild is to be found in the family, and developed there even to the highest degree."[||] Individuals, connected by the ties of kinship, gave to each other assistance, and shared in common convivial and religious rites. But as society grew, and its exigencies became stronger, men felt the necessity for a more extensive brotherhood than this limited circle afforded. Dwellers in the same neighbourhood, or followers of the same craft, began to band themselves together to maintain their independence, and to render and receive aid when needed. As neighbours or fellow-craftsmen they recognised and acknowledged their obligations each to each. They united for no aggressive purposes; but to afford a species of local self-help, to form what may not inappropriately be called a mutual benefit society. With this aim in view all their regulations were framed, and to it all their distinctive ceremonies pointed. Now, it is very interesting and important to observe that the guilds originated in no authoritative imposition, no legislative enactments, but that they were a natural outgrowth of the circumstances in which their members found themselves situated —that, they were "made by the people themselves, when and as they found need."

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[*] "Technical History of Commerce, or the Development of Skilled Labour." Virtue and Co.

[*] This gentleman has likewise written "Die Arbeitergilden der Gegenwart;" "Zur Kritik der Englischen Gewerk-Vereine," &c.

[†] A closer approximation in form to our modern word is to be found in the Welsh *gwledd*, banquet, feast

[‡] "English Guilds," pp. 3 & 4. In quoting from the ancient guild statutes, the orthography has been modernised, but the construction of the sentences retained.

[§] "English Guilds," Int., p. xxvi.

[||] "On Guilds," &c., p. 6.

Many circumstances point indubitably to England as the birthplace of the guilds.[*] The earliest of our legal codes refer to them, and there are still extant records relative to the guilds, which prove their antiquity, and testify to the wide-spread and deep-rooted hold they had taken amongst our forefathers. The laws of Alfred (ninth century), and the still earlier code of Ina, King of Wessex (seventh century), refer to the guilds as institutions then existing. Stow, the antiquary, says of the *Cnihten* (young men's) guild of London, that it was as old as the time of Edgar. Domesday Book makes mention of two guilds at Canterbury, and of a Guildhall, whence the existence of a guild follows, by inference, at Dover.[†]

But still more direct proofs of their early existence as an English (or Saxon) institution exist. There have been preserved the guild statutes, or regulations of a guild at Abbotsbury, founded and endowed by one Orcy, a nobleman of Canute's retinue, and therefore dating from the earlier half of the eleventh century; of another guild at Exeter; of a third at Cambridge; and of a fourth at Woodbury;—all of about the same date.[‡] In addition to these, there exist in the national archives numerous returns, made by the guild officers, relative to their several fraternities in 1389, in compliance with an order of one of the Parliaments of Richard II. Of the guilds which made returns, one, that of St. John of Beverley of the Hanshouse, claims to have originated in the twelfth century, having received its charter from Thurstan, the Archbishop of York;[§] another, the Kalenders of Bristol, to have existed "before the last (the Norman) conquest of England;" and adds to this, "the beginning of which fraternity did then exceed the memory of men;"[||] while a third, that of the Holy Cross of Stratford-upon-Avon, assigns its origin "a tempore cujus contrarium memoria non existit" (to a time whereunto the memory of man reacheth not).[¶] Of the *Gilda Sellariorum*, Herbert, in his "History of the Twelve Great Livery Companies," says (vol. i. p. 16), there is "little doubt of the Sadlers being a veritable Anglo-Saxon guild, and consequently the oldest on record of all the present livery companies."

The above facts may serve to show the antiquity of the guilds in England. Not less certain is it that they were sufficiently numerous to give a tone to, and to be a characteristic feature of, early and mediæval English life. Spread everywhere throughout the land, from Berwick to Exeter, and from Norwich to Worcester, their periodic festivities, their pageants and processions, gave rise, according to Canon Rock, to no small part of the sports and pastimes which won for our country its epithet of "merrie England."[*] Each considerable town had many Guilds; scarcely a village, however small, seems to have been without one or more. The volume called the "English Guilds," already referred to, contains twelve returns from guilds in Norwich, a like number from guilds in Lynn, nine from guilds in Bishop's Lynn, and six from guilds in Lincoln. At the time of the Reformation, when the decree for their suppression was sent forth, there were ten guilds at Windham, seven each at Hingham and Swaffham, and no less than seventeen at Great Yarmouth.[†]

It seems clear, then, that from the eleventh century to the sixteenth, the guild was a characteristic institution of the country; while prior to the eleventh century, and as early as the seventh, numerous traces of its existence are to be found.

Two broadly distinct classes of guild existed, and were recognised as such, in the eyes of the law in England, the social or religious guilds, and the craft or trade guilds. So far were they considered distinct, that the Parliament already referred to caused to be issued two writs, one for each class of guilds. Based ultimately on the same principle—that of a reciprocal interchange of friendly offices between their members—the two differed in this—that, except when specially instituted on exclusive principles (and such instances were rare), the former were restricted to no one class or craft; while the latter, as their name indicates, were particularly connected with some one craft or branch of a craft. Of the two, the social guild was the earlier institution; the craft guild could not and did not arise until called for by the expansion and increased vitality of industry. A third species of guild, socially less, but politically more, important than the two already named, were the guilds-merchant, which "were neither wholly social nor of a craft,"[‡] though in 1389 some of them answered to the writ for craft guilds.

We will first proceed to notice the social guilds. Though, as a second title, they have been called religious guilds, it would be erroneous to suppose that they were in their essential features ecclesiastical foundations. The priest was not excluded in his private capacity, but "the guilds were lay bodies and existed for lay purposes."[§] What these purposes were, is graphically depicted in the returns made by the guild officials in 1389. Here are set forth their objects, their regulations, their ceremonies, their property; some in the language of the scholar of that age, others in the quaint but expressive vernacular of the common people. A few quotations may prove of interest. The primary reason for its formation is thus given in the ordinances of the guild of Garlekhith. It was formed "for the amendment of their lives and souls, and to nourish more love between the brethren and sistren of the brotherhood."[||] So, too, the guild connected with St. Stephen's Church, Coleman-street, was instituted "by the good men of Coleman-street, in nourishing of love and of charity among themselves, and in help to them that fall into poverty."[*] And these are no solitary examples. Nowhere are to be found indications of aggressive purposes, but everywhere the clearly expressed intention of striving after morality of life, and the spread of brotherly love. Religion was invoked to hallow and secure the bond of union. Many guilds were specifically connected with an adjacent church. Thus the guilds of St. Katherine, and of St. Fabian and St. Sebastian were "founden in the church of St. Botulf, without Aldrichesgate" (Aldersgate).[†] Their houses or halls, too, were frequently in or overlooking the churchyard.[‡] In this church the guild members periodically attended religious services, and provision was made for the burning of lights, the chanting of masses, and other ceremonies peculiar to the creed of the age. Not less regard was paid to the temporal welfare and enjoyment of the brotherhood. Common festivities were regularly shared in; ample provision was made for the sick and poor of the order, those cases only being excepted where poverty was the outcome of crime. Nor were they charitable only at home. Not a few of the guilds made either permanent or occasional provision for the poor of the vicinity, supported educational institutions, and gave doles for various other purposes. Some extended their care to works of a more or less public character and utility. They devoted a portion of their revenues to the repair and adornment of sacred edifices, the erection of schools, the construction and repair of walls, roads, bridges and resting-places for wayfarers, the decent burial of the dead, the recovery of the bodies of the drowned, assistance in cases of fire and shipwreck, the visiting of prisoners, the performance of religious interludes, &c., &c. A noteworthy feature of the guilds was the spirit of "law-abidingness" which animated their members. In their ordinances they express their desire to conform with the law of the land, to do nothing in contravention of the king's authority, and to support the liberties of their town. Fines were instituted for unruly members; expulsion was the punishment of the frequent offender. Candidates for admission were required to be of a fair character. Litigation was checked by a wise ordinance, which often appears in the guild regulations, that all matters of dispute between members of the same guild should be referred in the first instance to the guild officers, whose consent was necessary before the case could be carried further, after their own arbitration had failed.[§]

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[*] "On Guilds," &c., p. ix., Note 1.

[†] See "English Guilds," Int., p. xv. *et seq.*; Turner's "History of the Anglo-Saxons," vol. iii., p. 98; Kemble's "Saxons in England," vol. i., p. 511; Rock's "Church of our Fathers," vol. ii., p. 395 *et seq.*

[‡] See works above cited.

[§] "English Guilds," p. 150.

[||] *Ibid.*, p. 287.

[¶] *Ibid.*, p. 212.

[*] "Church of our Fathers," vol. ii., p. 418.

[†] "Church of our Fathers," vol. ii., p. 400, Note 48.

[‡] "English Guilds," Int., p. xxvii.

[§] *Ibid.*, Int., p. xxviii.

[||] *Ibid.*, p. 3.

At a time when much discussion is taking place as to woman's proper position in society, it will be interesting to notice what our ancestors of five centuries or more ago thought, and how they acted with regard to this problem in one point at least. In a large majority of cases the guild members were "brethren and sistren." Women were not only admitted to an equal share in the privileges of the fraternity, but sometimes even took part in its management. Clergy and laity, rich and poor, were alike admissible to the guilds, but the members for the most part consisted of "the rank of common and middling folks."[*] That, however, the wealthier and more powerful classes were not excluded from at least honorary membership, we learn from facts like the following:—that Henry IV. and his grandson were enrolled as members of the Guild of the Trinity at Coventry; and that Henry VIII., his Queen, Cardinal Wolsey, the Dukes of Norfolk and Buckingham, with others of high rank, were members of the Guild of St. Barbara of St. Katherine's Church, "next the Tower."[†]

The guilds must, no doubt, have varied much in size and wealth. Many counted their members by thousands, notably so the great guilds of St. George at Norwich and of Corpus Christi at York.[‡] Their wealth consisted of lands, houses, money, guild and ecclesiastical vestments and furniture, missals, &c. The returns made by the guild officers as to the possessions of the brotherhoods give generally what seem low estimates of the value of their property, allowance being made for the greater purchasing power of money then, when compared with the present time. But perhaps a scrupulous exactitude was hardly to be expected when the guilds, as must have been well known to them, lay under suspicion, and when their wealth was regarded with a covetous eye.

Each guild was autonomous. Its officers were elected annually. There were generally an alderman, two wardens or stewards, a dean or beadle, and a clerk, to each guild. The business of the brotherhood was transacted on appointed days, known as "morning speeches," of which four were usually held every year.

How strong a hold this institution had upon English mediæval society may be seen from the length of its duration, which fell little short of nine hundred years. The guilds were looked upon with suspicion at the time of the great uprising of the lower orders under Wat Tyler and other leaders. But the government of that time paused at the first step towards their suppression. The second parliament of the year 1388, which sat at Cambridge, issued two writs, one addressed to the social, the other to the craft guilds, requiring from every guild a complete statement of its origin, its ordinances, its property and charters, if any had been granted it.[§] The dynastic struggle which occupied the latter half of the fifteenth century gave the guild a renewed lease of life. But the reformation overthrew the social guilds, as it did also the monasteries. By the Acts of Parliament, 37 Henry VIII. c. 4, and 1 Edward VI. c. 14, their suppression and the confiscation of their property were decreed. To the enthusiasm of the Reformers, who saw in them a support to the Romish creed, was united the greed of a new nobility, eager to add this fresh spoil to the wealth they had acquired by the overthrow of the greater foundations. The Act of Henry VIII. gives as a ground for the confiscation "the maintenance of these present (Scotch) wars;" while that of Edward VI. hints at the "foundation of grammar schools."[*] In most Protestant countries the guilds were suppressed at this epoch; but the revenues were elsewhere generally applied to charitable and educational uses. Not all Protestants, however, looked with unmixed satisfaction upon the destruction of this ancient institution. Blomefield, in his "History of Norfolk," says, "As the poor of the parish were always partakers in the jolly doings of the guilds, I much question whether their revenues were not better spent then than they have been since they were rapaciously seized."

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[*] "Church of our Fathers," vol. ii., p. 405, Note 52.

[†] "English Guilds," pp. 6 and 9.

[‡] "Church of our Fathers," vol. ii., p. 436, Note 93.

[§] In the volume, "English Guilds," ample and conclusive evidence on all the points here enumerated may be found. With regard to the performance of religious plays, see Canon Rock's work already cited, vol. ii., pp. 426, &c.; and the Ordinance of the Guild of the Lord's Prayer at York, "English Guilds," p. 237.

[*] Ordinances of the Guild of St. Michael-on-the-Hill, Lincoln. "English Guilds," p. 178.

[†] "Church of our Fathers," vol. ii., p. 411, note 63.

[‡] "English Guilds," Int., p. xxxi.

[§] A copy (translated) of each of these writs is given in "English Guilds," pp. 127—131.

Allied to the social guilds were the *gildæ mercatoriæ*, guilds-merchant, or citizen guilds. They differed from the social guilds in being confined to the town populations, and in the political importance which they acquired in their later development. In what has not inaptly been called "the classical age of club law," the towns were exposed to the violence of powerful nobles whose castles were within or adjacent to the walls, to attacks from robbers without, and to oppression from the authorities within. The inhabitants seem to have coalesced with success against these disturbers of their peace and security; and as a consequence of their success the guild members often became the ruling class, and "guild law became the law of the town."[†] The existence of such guilds may probably be referred to Saxon times, though the period of their power did not arrive till the 12th and 13th centuries. Thus Kemble[‡] says, "If we admire and glory in these true fathers of popular freedom, firm in success, unbroken by defeat, steadfast in council, steadfast in the field, steadfast even under the seignorial gibbet and in the seignorial dungeon, let us yet give our meed of thanks to those still older assertors of the dignity of man, duly honouring the gyldsmen of the tenth century, who handed down their noble inheritance to the less fortunate burghers of the twelfth." Again, the same writer,[§] speaking of the tenth-century guilds, says, "These gylds rested upon this solemn principle; they were sworn brotherhoods between man and man, established and fortified upon 'ath and wed' (oath and pledge), and in them we consequently recognise the germs of those sworn communes or *communiæ*, which, in the time of the densest seignorial darkness, offered a noble resistance to episcopal and baronial tyranny, and formed the nursing-cradles of popular liberty."

The mode of government of the guilds-merchant and their regulations resemble so closely those of the social guilds that it is unnecessary here to dwell upon this subject. At first craftsmen as such were not excluded from the guilds-merchant. Then later came the restriction that every guild-member must possess the full citizenship of the town, and this citizenship usually depended upon the possession of houses or other property of a fixed value within the town jurisdiction. The effect of this property qualification was in time to exclude the poorer craftsmen and to make the guilds-merchant close corporations of the wealthy burgher class. Dissensions sprang up, and struggles ensued. In England the result generally was that the civic corporations were opened to craftsmen, and thus the civic liberties did not at all suffer; while on the continent the craftsmen were aided by the sovereigns to overthrow the guilds-merchant; and this accomplished, the story of the horse, who was aided by the man to overcome the stag, was played over again, with consequences which might be seen in the different courses taken by political freedom there and in our own country.

The powers possessed by the guilds-merchant in their best days were, in the words of Kemble,[*] "in truth, royal. They had their own alliances and feuds, their own jurisdiction, courts of justice and power of execution, their own markets and tolls, their own power of internal taxation, their personal freedom with all its dignity and privileges, and to secure these great blessings they had their own towers and walls and fortified houses, bell and banner, watch and ward, and their own armed militia."[†]

The second great class of guilds is next to be noticed. The craft or trade guilds, as their name points out, were societies whose sphere was limited to the workers in one craft. They were scarcely less numerous than the social guilds; for in most towns each trade had its guild. The *Collegia opificum* of Roman times have been by some regarded as the originals of the craft guild. It has been supposed, too, that they had their origin in those bodies of slave-handicraftsmen, which in royal and episcopal burghs were controlled by officials appointed by the king or bishop. But most probably these unions originated from no servile source.[‡] While the majority of the craftsmen were slaves, the few freemen who followed the various trades were members of the citizen guilds. In the course of time the number of free handicraftsmen increased by the influx into the towns of strangers, who had no connexion with the existing guilds, and by the expulsion of the poorer guild members as the burgher class increased in wealth and power. Strife arose between those who held rule in the towns and the numerous mechanic class, which was excluded from civic privileges. Combination was the only weapon with which the latter could hope to wage a successful contest. The principle was not new; examples of it existed on every side; their opponents owed their position to combination, and retained it only in virtue of their union. To combine was therefore a natural course of action for the craftsmen. Their success was remarkable both in England and on the Continent. Craft guilds began to make their appearance between the eleventh and the thirteenth centuries, and before the end of the fourteenth they had secured an equal share in the government of the towns, or had ousted their opponents entirely.

The maintenance of the independence of the craftsmen against the wealthy burger class was thus the primary *raison d'être* of the craft guilds. But when once firmly established, when their struggles had resulted in success, it was natural for them to assume the control of the trades with which they were severally connected.[*] This they accordingly did, and were at a later period established in their assumed powers by royal authority. Of these changes a writer already quoted says[†]:—"The reign of Edward III., the great dawn of the fine arts and of commerce, gave birth to an entire re-constitution of the trading fraternities, which, from now generally assuming a distinctive dress or livery, came to be called livery companies. The alterations under this re-constitution were numerous. Amongst the principal may be reckoned their change of name from guilds to crafts or mysteries, and the substituting for the old title of alderman that of master or warden. A more important change for the interest of the companies was their being at this time generally chartered, or having those privileges confirmed by letters patent, which they had before only exercised through sufferance and on payment of their *fermes*."

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[*] "English Guilds," Int., p. xlii.

[†] "On Guilds," &c., p. 29.

[‡] "Saxons in England," vol. ii., p. 312.

[§] Ibid. p. 309.

[*] "Saxons in England," vol. ii., p. 312.

[†] For a full enumeration of the powers claimed by these corporations, see 'English Guilds," pp. 370—412, where will be found the ordinances drawn up by the guild merchant of Worcester, in 1467.

[‡] "On Guilds," &c., p. 50 *et seq.*

In their form of government the craft guilds closely resembled the social guilds. At the head of each was an officer known, as Herbert says, at first by the name of alderman, afterwards by that of master or warden. The guild officers were for the most part elected by the fraternity itself, though sometimes the warden was appointed by the king, bishop, or civic authorities. The two species of guild had many regulations in common; as, for example, the payments made by the members, the provision for sickness, old age, and poverty, the common religious ceremonies, and the periodical convivial gatherings. Their intimate connexion with the various crafts gave, however, a peculiar character to some of the ordinances of the craft guilds. The spirit in which these ordinances were framed was for the most part a healthy one. They were designed to suppress trade frauds; to ensure skill and care in the workmanship; to secure the use of proper tools; to provide for the due remuneration and recreation, and the permanent employment of the craftsmen; to check injurious competition; in short, to establish the principle that the work done should be a credit to the craft, and mutually advantageous to the producer and the consumer. It must not be denied, however, that some of the regulations were conceived in that narrow protectionist spirit which only a deeper knowledge of economic philosophy than their age possessed is competent to correct.

A few examples quoted from the old ordinances themselves might not be out of place here. The fullers of Bristol[‡] assign as a reason for the formation of their guild, "to put out and do away with all kinds of bad work and deceits, which divers people not knowing the craft from time to time do, by which defects the town and craft are fallen into bad repute in many places, where the said cloths are put to sale, to the great reproach and hindrance of the said craft." The regulations go on to provide for the appointment of four searchers, who are "to search every house of the said craft twice a week, and oversee all defects in the said cloths, if such there be." Further on is forbidden a trick of the trade, which consisted in putting a finish in Bristol upon inferior cloths fulled in the adjoining country districts. Wages are fixed at "fourpence a-day from the first Monday in Lent till the Feast of St. Michael, and threepence a-day from the Feast of St. Michael till the first Monday in Lent. It is also ordained that servants shall be engaged for a year. The Tailors' Guild of Exeter[*] framed lengthy ordinances for the control of the craft. They fix the rate of wages, and the time of holidays; regulate the number of workmen and apprentices each master may have; insist upon all the craftsmen belonging to the guild; check irregular trading and underhand competition; punish delinquents by fines, the stocks, and expulsion; arbitrate between craftsmen and customers, &c. Thus, a contumacious member is put in the stocks "by the space of a day and a night." A craftsman who "for lack of cunning" wasted the cloth entrusted to him to be made into a gown, is mulcted in the value of the cloth.

When at their highest point, the wealth and power of the guilds were considerable. Edward III. was himself a member of the Linen Armourers' Guild of London. In London and other large towns the guild members were sufficiently numerous to form separate companies of the municipal train-bands, marching under their own colours, and commanded by their own aldermen. Herbert speaks of a contest between the members of two of the London livery companies, in which there were five hundred combatants on each side, and which was not suppressed until the authorities interfered, and thirteen of the ringleaders were executed. The Tailors' Guild of Exeter, mentioned above, carried on a long struggle with the corporation of that city in the reign of Edward IV. The royal authority was invoked, and the guild charter was cancelled, but the tailors cared nought for this, and eventually the corporation was glad to come to an agreement.[†]

One point of contrast between the old craft guild and its modern analogue the trade-union, should be noticed. Trade-unions are societies of workmen, while the craft guilds included masters and workmen alike. It is necessary, however, to distinguish between the master of modern times, the wealthy capitalist at the head of a great concern, employing workmen by the hundred or even by the thousand, and the master of mediæval England. To be a master it was necessary to have been first an apprentice, and then a journeyman; and it can easily be seen that such masters would rarely be large capitalists. While this state of things lasted, workmen who would in all probability become masters, and masters who had been workmen, were actuated by similar motives, and therefore worked together harmoniously. As the masters became capitalists this community of interests died out, and from the time of Elizabeth the guild declined, and now its modern lineal descendant, the livery company, has too often preserved little of the character of the parent institution but its conviviality and the distribution of some antiquated charities.[*]

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[*] In the "Growth and Vicissitudes of Commerce" (p. 375), we read:—"The commoner and more necessary trades were the first to form guilds; such were weavers and clothworkers, furriers, linen-weavers fishmongers, tailors, glovers, tanners, butchers, and bakers. As wealth and luxury increased, other trades established guilds, such as jewellers, cooks, confectioners, gold and tapestry workers, spectacle makers, clock and watchmakers. The devotional spirit, as well as the passions and vices of the middle ages, gave rise to special trades; in this way the paternosterers, or makers of rosaries, and the dice-cutters, were added to the number of guilds. The number varied greatly in different towns and countries; allied crafts, in one place united into a single company, were in another subdivided"

[†] "History of the Twelve Great Livery Companies," vol. 1., p. 28.

[‡] "English Guilds," pp. 284 *et seq.*

[*] "English Guilds," p. 321.

[†] *Ibid.*, p. 312.

Hitherto the course of the narrative has not departed from the history of the English guilds. A brief notice may now be taken of the guilds of foreign countries. Dr. E. Brentano thinks that the rise of the continental guilds was less early and more hampered than was the case in England.[†] He refers to the capitularies of Charlemagne and other monarchs as proof of the hindrances thrown in the way of union, and of the restrictions under which such guilds as were allowed to exist were placed. But there are various reasons for supposing that this opposition was at any rate but of a temporary character. At Ravenna a fishers' guild existed as early as 943. The Easterlings or steel-yard merchants of London were a band of foreigners who carried on the trade between England and the Baltic countries, and they had their guild, Herbert says, of older date than the Cnihten Guild of London, already mentioned.[‡] It is the more probable supposition that this guild of the Easterlings was not a copy of a Saxon institution, but a resort to a practice with which its members were already familiar. Amongst the Teutonic nations of the Continent especially, the guild was a prominent institution, prominent by the numerous guilds which existed, and also by the power to which they attained. Thus, in 1130, the Hezlagh, or Great Guild of Sleswig, went so far as to put to death Nicholas, King of Denmark, in revenge for the murder of their alderman, Duke Canute. The Merchant Guild of Cologne was of noted strength, and fought strenuously and successfully for the liberties of their town against both aristocratical and ecclesiastical authority. As further examples, it will be sufficient to mention the facts that no less than twenty-five Silesian towns furnished members to a great Tailors' Guild; and that the German cutlers formed four great fraternities, which had Nürnberg for their centre, and whose ramifications extended all over Germany, and even into Courland and Livonia.[§] In proof of the rapid development of industry at this period, particularly in metals, I venture to quote the following, though somewhat of an episode.

It is recorded that there were in 1104 sword cutlers in Magdeburg, Strasburg, and the Netherlands, who also made breast-plates, shields, and helmets; in 1285 there were in Nuremberg, goldsmiths, blade-forgers, cutlers, sword-cutlers, and girdlers. The most able smiths were to be found in Styria and Solingen; and in 1392 it was reported that there was a depôt of Styrian iron goods in Bremen, whence they were exported to Russia and Prussia. In 1368 the smiths alone formed 15 out the 17 guilds that were in Augsburg. The locksmiths were highly distinguished for their excellent workmanship in door-keys, clasps, knockers, and rails, such as are still to be seen on the church-doors at Nuremberg, Augsburg, and Freiberg. Windlass-makers appeared in Augsburg in 1453 as a peculiar department of smiths, and coppersmiths in 1363. These latter appeared in Nuremberg in 1386, in which town we also find wire-workers and braziers in 1321; in 1328 workers in tin; in 1360 coiners and wire-drawers; and in 1370 needle-makers. In Breslau, as well, we find needle and pin makers in 1390. Bell-founders and great gun makers had their chief seats in Augsburg and Nuremberg. In 1399 Hugo, of Nuremberg, cast in Augsburg an alarm-bell of 40 cwt., and in 1469 Nicholas Hilger cast great bells in Freiberg. Heavy artillery was already known in 1356, and in 1372 the council of Augsburg ordered the casting of 20 cannon. Gunners appeared in Nuremberg in 1403. In this town there were also peculiarly skilful brass and copper smiths, and metal founders, who, as Peter Vischer, for example, executed the most magnificent works of art. These crafts, indeed, were early known in Germany, proof of which exists in the renowned brazen gates of Augsburg, Mentz, and Hildesheim, which belong to the eleventh and twelfth centuries. Gold and silver smiths appeared likewise in the time of Charlemagne, and in Henry I.'s reign there lived an exceedingly clever goldsmith at Mentz. The gold plates adorned with jewels on the old manuscripts of the Gospels were also the work of goldsmiths; and in the thirteenth century there were found in use amongst the knights and their ladies costly clasps and girdles, and harness for their horses, richly ornamented with gold and silver. In Augsburg, in 1276, goldsmiths were employed in the mints, and in 1370 there were 11 masters of this craft in Nuremberg. In Vienna they appear for the first time in 1350. Artisans of this craft, too, prepared the most artistic and valuable church utensils, some of which are still preserved in the treasuries of Berlin, Vienna, and Munich. Besides these, it is said that there were in Nuremberg, in 1373, diamond-polishers; in 1383 silver-melters; in 1387, gold and silver burnishers; in Breslau, in 1470, gold-beaters; and in 1324, in Augsburg, tin-workers. Germany was at that time rich in the precious metals, which were abundantly supplied by the mines of Freiberg and Schneeberg.

To resume. Though less important, the guilds are still numerous amongst the Latin nations of the Continent. The town of Montreuil, in Picardy, had an ancient *gueude* (guild) as early as the eleventh century, and in 1126 Louis VI. granted a charter to the Guild of St. Riquier, in Ponthieu. Herbert[*] tells us that the guilds were much encouraged by Louis VII. and other French kings, "as a check to the insolence of their overgrown vassals, the dukes and counts, &c., and to protect such subjects as held of the latter from their extravagant powers." To such an extent was the guild system carried that Paris alone is said to have had more than fifty guilds. In Italy it has been already mentioned that there was a Fishers' Guild at Ravenna as early as the first half of the tenth century; and as to their numbers, we learn that there were seven trade guilds at Pisa; eighteen at Bergamo; twenty-one at Florence; and twenty-six at Bologna.*

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[*] The trades' companies of London, seventy-four in number, were the basis of the municipal and subsequently of the parliamentary representation, for the burgesses were at first exclusively confined to the members of the various trades' companies. The following is the London list at the present day, a few having become extinct since the middle ages:—Apothecaries, Armourers and Braziers, Bakers, Barbers, Basketmakers, Blacksmiths, Bowyers, Brewers, Broderers, Butchers, Carmen, Carpenters, Clockworkers, Clothworkers, Coachmakers, and Coach-harnessmakers, Cooks, Coopers, Cordwainers, Curriers, Cutlers, Distillers, Drapers, Dyers, Fanmakers, Farriers, Feltmakers, Fishmongers, Fletchers, Founders, Framework-knitters, Fruiterers, Girdlers, Glass-sellers, Glaziers, Glovers, Gold and Silver Wire-drawers, Goldsmiths, Grocers, Gunmakers, Haberdashers, Horners, Innholders, Ironmongers Joiners, Leather-sellers, Long-bow Stringmakers, Lorimers, Makers of Playing-cards, Masons, Mercers, Merchant-tailors, Musicians, Needlemakers, Painters (otherwise Painter-stainers), Pattenmakers, Pewterers, Plasterers, Plumbers, Poulterers, Sadlers, Salters, Scriveners, Shipwrights, Skinners, Spectacle-makers, Stationers, Tallow-chandlers, Tilers and Bricklayers, Tinplate-workers, Turners, Upholders, Vintners, Wax-chandlers, Weavers, Wheelwrights, Woolmen. Of these, twelve, from their superior importance, are known as the "Great Livery Companies." They are the Mercers, Grocers, Drapers, Fishmongers, Goldsmiths, Skinners, Merchant-tailors, Haberdashers, Salters, Ironmongers, Vintners, and Clothworkers.

[†] "On Guilds," &c., pp. 11 *et seq.*

[‡] "History of the Twelve Great Livery Companies," vol. 1., p. 10.

[§] "On Guilds," &c., p. 70.

[*] "History of the Twelve Great Livery Companies," p. 21.

The continental guilds, especially those of Germany, seem to have come down to a considerably later time than did their English congeners. In France the guilds were finally overturned by the Revolution of 1789, while "in Germany several bureaucratic enactments brought them piecemeal to death, and the last remnants were destroyed by the North German Industrial Code of 1869."† The following passage, extracted from the report of Mr. Crowe, the British Consul in Saxony, has an interesting bearing on the guild system of that country. "In Saxony the domestic as distinguished from the factory system was longest preserved.....In no country was the corporate spirit of the earlier times more instinct with life, and nowhere was it found more difficult to compass the abolition of the guilds. Till ten years ago there was scarcely a man of any craft who did not necessarily belong to a guild....The measures which really undermined the guilds were passed to facilitate the establishment of factories; the causes which precipitated their fall were the construction of railways, the consequent extension of markets, and the demand for cheaper and better wares. As the factory system expanded, the guilds shrank, and the population outgrew the old and stationary corporations. From 1840 to 1850 the factory system arose. From 1850 to 1860 the guilds languished. In 1861 they were abolished by law."

Closely connected with the subject of the guilds is that of their modern analogues—the trade-unions. Enough has been already said to show that the principle and practice of labour-combinations is not in itself the novelty, dangerous or beneficial, which it is sometimes asserted to be. As a national institution this is one of our oldest; and if for a time it fell into desuetude, the present century has witnessed its revival with a new power and a promise of long-lived vitality. Like their mediæval forerunners, trade-unions are societies which have a double object, to provide regulations for some one branch of trade, and to form amongst its members a mutual benefit society. It is the union of these two objects, declared incompatible by the opponents of the system, which has given an opportunity for much of the vituperation cast upon the institution. But that such a union has heretofore existed, the statutes of every craft guild prove; and that such a union has not been as pernicious as its enemies predict that it must necessarily be, is proved by the longevity of the old guilds, and by the harmony which long existed between the masters and men of the crafts thus united.

As England was the birthplace of the guild, so it has been of the modern association, and the scene of its most extensive development. It was an aggravation of the circumstance which more than any other contributed to the decline of the craft guilds, that gave rise to the trade-unions. As already shown, the growing power of the capitalist rendered it impossible for the craft guild to exist in its original form. Contrary to old custom and legislation, masters ceased to be men who had passed through the grade of apprentice and journeyman. The rise of the cotton manufacture, the employment of steam-power, and the introduction of costly machinery, made the possession of a large capital still more indispensable to the master. Prices of all commodities had risen, while wages had relatively fallen. Labour was no longer the coadjutor, but rather the bond-servant of capital. The more intelligent of the town populations began to perceive the power of resistance which combination would give them. Some funds they had, collected for mutual-assurance purposes, for friendly societies are of older date than trade-unions. The first efforts of the new unions were directed against the violation of the Act, 5 Elizabeth c. 4, which limited the number of journeymen and apprentices each master was allowed to keep. It was only at a later period, when they felt their power, that trade-unions began to frame regulations relative to wages, hours of labour, &c., and to organise strikes as a means of attaining their ends.*

Two generations ago trade-unions were scarcely known. Amongst the earliest were those formed by the clothworkers of Leeds, in 1802; by the shipwrights of Liverpool, at the close of the eighteenth century; and by the hatters, at a somewhat earlier date. In their infancy they were illegal, and were compelled to carry on their operations under the guise of friendly societies, in order to evade the provisions of the Act against combinations of workmen (39 & 40 Geo. III. c. 106). In 1824 they received partial legal recognition, which has been still further extended by recent legislation. In the last twenty-five years their development has gone on with extraordinary rapidity. The *Fortnightly Review* of December, 1867, says:—"Trade-unions are already a distinct power in the state, and are rapidly advancing to a foremost place amongst national institutions. Nearly 2000 of these are now spread over the kingdom, ramifying through every county, and ensconced in every town and almost every trade." Since this was written the movement has extended to the agricultural labourers. But not only are these societies becoming truly national; some are forming international connections, and others are likely to follow the lead thus set. The International Working Men's Association was avowedly formed with the object of uniting the labourer and artisan classes in every country, for the purpose of mutual aid in case of need. The association, under its present leaders, has, however, assumed rather a political than an industrial character, and as such has no connection with our subject.

Accepting the existence of the institution as an undeniable and potent fact, it will be sufficient for our purpose to point out that there are not a few particulars in which trade-unions might learn a useful lesson from the old craft guilds. They might more closely imitate their scrupulous avoidance of acts of illegality; they might exhibit a little more of that charitable spirit of the old guilds, which looked beyond the immediate interests of their own fraternity; they might connect themselves, as their predecessors did, with works having for their object intellectual and moral, as well as material advancement; and last, but not least, they might emulate their zeal for the doing of honest, man-like work, and for the checking of fradulent tricks, too common in every trade. Mr. Holyoake has well said in a letter to the *Pall Mall Gazette*, dated July 4th, 1870:—"We have strikes against receiving low wages. There are no strikes against doing bad work. All over the land a good deal of work is executed so shabby, so bungling or dishonest, that it is a degradation to be connected with it. If it was known that a unionist was a more reliable workman than any other, that he could be depended on to do good work, and could not do bad, that he put his character into his work, a unionist would be the most popular of workmen, and wages would stand higher than any combination could raise them. It ought to be impossible for employers to find men who will execute any shabby work. It is a sort of crime against the honour of industry, a fraud by connivance upon the purchaser."

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* "Growth and Vicissitudes of Commerce" (J. Yeats), pp. 169, 375.

† "On Guilds," &c., p. 100.

* "On Guilds," &c., pp. 100 *et seq.*

From the foregoing matter it may be learned how the guilds originated; how they became influential, and to some extent what vicissitudes they underwent. Let us now inquire further into their leading characteristics, and the causes of their decline, internal and external, that we may be able to form rational conclusions as to their present and future usefulness under circumstances varying from those of the past.

The names assigned to the several guilds did not always clearly designate the occupations of the members; and some guilds seem to have been of a very composite character. They assumed occasionally forms and functions dependent on social phenomena affecting their inner as well as their outer life. The epithets "religious" and "social" guild must be regarded as terms convenient for use amongst ourselves rather than as invested with ancient historical significance. In the writs of Richard II. the social guilds are spoken of as "guilds and brotherhoods;" the craft guilds as "mysteries and crafts." Among the members of the latter the expression "craft" and "craftsman" was the one most commonly used.

Characteristic of all the guilds was primarily self-government, and next organisation for the attainment of security and progress, as these were then understood and interpreted. In connection with their administration we find conservatives and innovators; and usually a party favouring the one or the other as the interests of the present or the future prevailed, That these interests would not always be equitably adjusted we might naturally suppose; yet the discords that ensued between them ought not to have been so long-lived or so virulent as they were in the middle ages. In M. Montalembert's "Monks of the West" we find the sunny side of the picture; in M. Levasseur's "History of the Working Classes in France,"[*] a work crowned by the *Académie des Sciences morales et politiques* in 1859, the reverse. But the most notable feature in their administration is that of Service, as opposed to self-assertion. The members entered into a bond of mutual service; and masters and men passed through prescribed forms and periods of servitude as apprentices and journeymen before appealing as producers, in an individual or a corporate capacity, to the community at large. Length of service conferred privilege, and was generally accompanied by distinction. Great care was taken to implant in the mind of every craftsman notions of duty, while questions of right were for the most part left to the decision of the guild.

Again. Guilds were co-operative associations, in the best sense of the term; and very successful in promoting harmony amongst the members, as well as in upholding the dignity of the craft. "Brethren and sistren" lived and laboured together, did many works of charity, and the former as craftsmen left behind them masterpieces of skill. In those days an artisan could attain to other distinction than a high rate of wage; his name was inscribed on the guild-roll, and perhaps emblazoned in the guildhall as a brother and a master. Thus in the guild records there was longevity; and no small degree of fame might be won by honest merit.

In proportion as this family feeling declined, the guild deteriorated, and at the core. Numbers became the test of strength. Combinations were entered into for purposes of compulsion. Political and religious strife ensued; and then, as now, it was proved that associations are more potent for evil than for good. The guilds, no doubt, were the origin of the Rhenish and the Suabian Leagues,—through their affiliations,—and, finally, of the great Hanseatic. How close was the connection between them can never be known, until after the completion of the publication of the archives of the last, now in progress.

Lastly. In their best day, too much reliance was probably placed by the members of the guilds on their collective rather than on their individual efforts. As the seminal principles of integrity and truth germinate in the breasts of single members of a community, so progress has mostly its starting point in the strong will of some one man, whose intuitions and whose sense of duty command respect and insure him followers. In the administration of the affairs of the guilds, we meet with instances of repression as well as of promotion.

Several external causes contributed to the decay of the guilds. Periods of peace were followed by plenty and the spread of domestic industry. A knowledge of facts increased, physical phenomena began to be observed, science revived, men travelled more, language improved, the use of the compass was introduced, gunpowder was invented and the art of printing. This last afforded the means of intercommunication not only among distant nations, but between periods of time the most remote. Within three or four centuries a thousand signs of progress appeared; finally there came the application of steam as a motive power, and thenceforward mental labour was brought into competition with manual labour.

Prior to this period, handicrafts existed in almost every household. To man had been assigned from time immemorial the tasks of providing shelter, fuel, and food; to woman the furnishing of clothing and the preparation of meals, with other domestic duties. Steam led to the development of the factory system, depending on division of labour, and on a long series of processes for the completion of products once the work of a family. Since then women have almost lost their natural share in the responsibilities of earning a livelihood; they have ceased to spin or to make garments, and men to weave; but in relegating to machinery their monotonous and often ill-remunerated toil, they have either risen in the moral and social scale, or have failed to do so from causes ultimately amenable to control. Through an alteration in the conditions of production, manual effort has been in a great measure superseded by mechanical and chemical skill, the result of mental labour. Hand-work has become head-work; the former has declined and the latter improved in pecuniary value. To the latter, therefore, the attention of every worker in the community must now be turned. This brings us to the practical portion of our subject, the agency of the guilds on the future training of workmen and workwomen.

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[*] See tome i., livre iii., chapitre vi., "Querelles entre certains métiers," pp. 263—284. Tome ii., livre v., chapitre iv., "Abus des corps de métiers et des confrères," pp. 77—105; see also livre vi., chapitre ii., "Les réglements de Colbert," pp. 167—195.

As we have already seen, the craft guild did, aforetime, largely take charge of industrial education. This was, indeed, its first care. Apprentices were regularly enrolled, and provision was made for their instruction. Journeymen likewise were constrained to improve themselves in the mysteries of their craft. What would be called examinations in our day, were periodically held in different parts of the country, and frequently, too, comparisons were instituted between the work of native artisans and of foreigners, not always to the advantage of the former. Many of our Grammar-schools owe their existence to the guilds, and higher institutions profited by their liberality.[*]

Such work has of late years been sadly neglected, if not wholly abandoned; yet surely it ought not to be. Aid is required from every quarter to render labour more productive. To make it so commercially, the labourer should, as before, be trustworthy, intelligent, and skilful; none of these qualities are, however, innate. He must be well trained while young, and self-taught or further taught later in life. Good schools may be erected by the State, and the Science and Art Department may continue its noble exertions, supported by Working-men's Colleges, Mechanics' Institutes, and other voluntary efforts; but there is still a want of strictly technical training, that can perhaps only be met by the establishment of Trade Schools in the principal centres of industry in our country—the whole appertaining to and ramifying from a Technological and Trade University belonging to the metropolis. Is there not work here for the guilds, and a suitable investment for some of their funds?

Manufacturers and other large employers do not see their way to turning workshops into places of study; although they are quite willing—many of them—to admit that an increased knowledge of raw material and of labour processes is essential to our national prosperity. In this state of things the Society of Arts comes forward to continue the course initiated by the guilds of old, and through a carefully devised system of examinations, to provide for the easy co-operation of their successors or representatives around us. It asks no questions relative to guild or trade-union, but says, virtually, "If there be anywhere in our sheds or workshops, our laboratories, or our foundries, a Stephenson or a Brunel, a Whitworth, or a Fairbairn, a Davy, or a Faraday, struggling and concealed, let him come forward, and, at little cost to himself, his worth shall be made known. We recognise every order and every grade of merit, be it that of the operative, the foreman, or the manager, and are ready to give to each the stamp of validity."

In thus giving scope to natural genius, and offering a fair field to individual industry, there is both justice and generosity. The level of social mediocrity, which some are anxious to maintain, may be occasionally disturbed, but the whole community will thereby be benefited. Among a multitude subsisting by labour there will always be young and old, skilled and unskilled, men of character and men of no character; and these inequalities of condition will assert themselves peaceably or otherwise, as circumstances may dictate. Through the examinations of the Society of Arts[*] an opportunity is afforded for every man of worth to vindicate his claims; they must, then, be invaluable alike to employers and employed, and deserve the hearty support of the one and the other. The subjects they embrace are those referred to in the Census of 1861, vol. iii., p. 30, as the basis of the industrial divisions of the population—materials, machinery, processes, products. The distinctions they offer are no mean ones; but still the chief source of satisfaction must ever be, to young and old, the "*mens sibi conscia recti*," the consciousness of having done our duty.

DISCUSSION.

Mr. Lawrence thought it would not be uninteresting for them to know that a few of the City companies did still exercise very great trade powers. The Goldsmiths' Company, for instance, had the sole power of marking gold and silver; the Fishmongers' Company of inspecting fish; and the City Corporation, wishing lately to obtain greater powers of inspecting the quality of the fish, found that they could not obtain the necessary power, and had to apply to the Fishmongers' Company to help them in the matter, and it was ultimately agreed that six additional inspectors should be appointed by them to exercise the requisite supervision. Until very recently the Stationers' Company possessed the sole power of publishing almanacs. Of other companies, the Painters and Stainers held peculiar privileges as to the carrying on the trade within the City, and although that was wholly abolished now, it still possessed large privileges. It was the old rule that all painters should be members. Amongst artists, Hogarth and Holbein had belonged to that company, and recently some of our modern artists had joined the company, being anxious to consecrate their talents to this guild. Of other guilds of ancient date, it must be borne in mind that the profession of the law was really a close guild. Barristers had the sole and entire power of an appeal to the judges, or saying who should be permitted to plead, and of preventing a man pleading. He might mention, as to other ancient companies, that the Skinners and Merchant Tailors, which were of ancient date, never used to meet without quarrelling, the question being whether the Skinners or the Mercant Tailors had the right of precedence. They applied to the Court of Aldermen two or three centuries ago about it, and it, after hearing a long discussion, decided that the Merchant Tailors should give to the Skinners' Company every year a dinner and *vice versa*, and that the Merchant Tailors should appear first in the list in the odd year and the Skinners first in the even years, or *vice versa*, he forgot which, and so it is printed in the almanacs, even to the present time, one being first one year and the other the next. And the dinner still continues, so that this decision of 300 years ago had the effect of creating peace between them, for now no two companies in the City worked more in harmony. Then among the corporations recently established, which had special powers regarding trade, might be mentioned that of the apothecaries, which had also the power conferred upon it by Parliament of licensing those who should carry on that profession. He thought there was a tendency in certain cases to do this, and to confer particular powers on certain corporations. The Ironmongers Company, to which he belonged, had left to it, some 200 years ago, a sum of money to purchase white slaves from Barbary. They redeemed 10,000 slaves altogether, but none had been redeemed since 1814, and the money had since grown to such an amount, that they had now an income of something like £7000 a year, for which they had no use. But they did not use this money for their own purposes, or abuse the trust in any way; and thinking there was no likelihood of their purchasing any more white slaves, they applied to parliament to know what should be done with the money. The result was that £5 a year was given to something like a thousand schools over the country. But he thought a more useless way of spending such a large sum could hardly be conceived, as it could scarcely be supposed, however glad the various schools were to receive the amount, that any of them would suffer seriously if they did not receive the £5. He thought there were greater purposes to which it might be applied. He thought they might well employ the money in training men in the technical education of the trade, for, taken in all its branches, it was really the largest trade still.

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[*] "History of the Twelve Great Livery Companies," vol. ii.

[*] The Society of Arts published, some time ago, Reports on the Condition of the Industrial Classes on the Continent. It appears to me that an immense service would be rendered to the cause of industrial education, and generally to that of the organisation and the elevation of labour, were the government to publish in a cheap and accessible form the essay of Dr. W. Farr, on the new classification of the people according to their employments (Appendix to the Report on the Census of 1861, pp. 225—233). This seems the more desirable since we may expect the Census of 1871 shortly, and hope to see in it the principles of that classification fully carried out. While on this point let me draw attention also to vol. vi., from the Report on the Paris Universal Exhibition, 1867, containing the returns relative to the New Order of Merit. At page 5 of this unique and most valuable record we read:—"Art. 30 A distinct order of reward is instituted in favour of the persons, establishments, or localities which, by a special organisation, or special institutions, have developed a spirit of harmony among all those co-operating in the same work, and have provided for the material, moral and intellectual well-being of the workmen. These rewards consist of ten prizes, of the total value of 100,000 francs (£4,000) and twenty honourable mentions. One grand prize of 100,000 francs may, in addition be awarded to the person, establishment, or locality, distinguished under this head by a very exceptional superiority." Further efforts in this direction may be found in No. 2, of the Reports of H. M. Secretaries of Embassy and Legation for 1870; and, in a work by the author, the Hon. T. L. Hovell-Thurlow, under the title of "Trade-unions Abroad, and Hints for Home Legislation," reprinted from a report on the Amsterdam Exhibition of Domestic Economy for the Working Classes. Every line in that valuable document, from p. 200—247, deserves the most attentive study. From "Das Gewerbewesen im Koenigreiche Bayern, diesseits des Rheins" (1859), I have prepared brief digests, showing the action of the German Legislature on matters relating to technical training; *e.g.*, enumerating the duties of masters towards apprentices; the requirements of the State with regard to these; the position of a journeyman mechanic or artisan, &c., &c., but have omitted them for want of time and space.—J. Y.

Mr. Mast remarked that he thought the etymology of the word was of Saxon origin. The very name of guild was used by German merchants. He did not think that sufficient stress was laid on the fact that the guilds were protective in their origin. The guilds were originally co-operations to protect trade within the towns, and just as the guilds were mainly protective, so in this feature did trades-unions resemble them. If we wanted to reconcile the societies existing now with the present circumstances, it would be their duty to reconcile the masters with the workmen. The solution of the difficulties which presented themselves would not simply be met by instituting examinations and the spread of technical education, but in the reconciliation of the conflicting interests between masters and men.

Mr. Campion said he had raised his voice in Guildhall with a view of getting the City Companies to do something for the promotion of technical education, and also to do what was part of their functions, namely, the regulation of all matters that concerned the prosperity of the different trade and the intercommunication between masters and workmen. With regard to trades unions it seemed to him that there was this difficulty, that the trades unions must of necessity have an antagonistic action —they must be antagonistic, whereas the guilds were of a harmonising tendency. They ought to bring together the masters and workmen, and endeavour to make their interests one and the same for the whole trade, and it was to be hoped that then it would not be simply for the benefit of the whole trade but of the community at large. The action of the guilds had often been protective against the community, and if their action was revived he hoped it would be for good, and that something practical would be brought about. But owing to various circumstances it was the common practice in the City companies to introduce the members by patrimony. Although he was a member of the Haberdashers' Company he never was one, and his father never was. The companies seemed to be largely filled by that means with men not belonging to the particular craft of the company with which they were connected, and no doubt that would present a serious difficulty in working out the powers and privileges in the future. When there came to be an association of the different guilds together, and they were actuated by the same spirit, and assistance was given by one to the other, he thought they might work for results. He believed there were five or six thousand liverymen, and amongst them were men of all trades and professions; and he thought by intercommunication and proper arrangement some sort of united action might be brought about. The Turners' Company had been getting a large acquisition of strength lately, for many men of ability, engineers and others, who knew a great deal about turning, had joined the company, and he thought the company was likely to do a great deal of practical work. Dr. Yeats had alluded to the fact that in the first instance they were voluntary associations, but in London they seemed, if voluntary in their inception, very early to have gone to the Court of Aldermen, and from them to have got a charter or authorisation long before they got it from the Crown. From that has arisen the fact that they possessed larger power of territorial action than they would otherwise have had. There were only a few of the guilds which were confined to the City proper (as he had already shown by a list he had published in the *City Press*). Most of their charters carried them three, five, twenty miles further, and some few companies extended all over England. The Gunmakers Company extended to all England. They had their proof-houses in London and Birmingham. He believed it was that reason that enabled the Fishmongers to take in hand the supervision of the fish markets, for, otherwise, under the City authorities, it would have been confined to fish caught within the City walls.

Mr. Simmonds was glad the paper had been read before the Society of Arts, which had already moved very strongly in the direction indicated by the paper. Mr. Lawrence had alluded to some of the City companies. He should very much like to know what their revenues and resources were, and how they were applied. He thought it would be found that there was very much that could be done advantageously in aid of the views which the Society was so anxious to carry out. If they were to pay more attention to the set objects of the titles which they bore, very much would be done to the arts, commerce, and manufactures generally. It was true that latterly action had been taken by some of them, particularly the Turners' Company, with a view of carrying out the special objects of the craft. The Turners, Coachmakers, and a few others had done so, but this was a very small modicum of what was anticipated would be done by these great companies in this great metropolis. It must not be forgotten that here was the centre of commerce, and that they had very much technical education to carry out. A great deal might be done, and he thought one main object should be to have a trade museum in the City. While the corporation had been spending large sums in building a new library and an antiquarian museum, they had done nothing towards the establishment of a trade museum in the very centre of commerce—a museum of trade products in their various states of manufacture, so that foreigners and others could inspect the oils, the woods, the resins, and all those various commodities, which they had now no opportunity of seeing. There was a great necessity for a museum which should contain all these various and numerous articles, of which we are the great importers and retailers to all the Continent, and for which there was at present no department whatever. It had been said that we had a museum at Kew, and at Jermyn-street, and so on, but these were not for commercial purposes. They were for scientific purposes. The traders who come over here to buy had no opportunity of seeing what suited them unless they attended a particular sale. Year by year large sums of money were spent by the colonies in sending contributions of their various productions for the international exhibitions and so forth, and these were afterwards wasted or dispersed. They had offered them to us, but there was no place in which they could be deposited. The colonies would willingly contribute towards such a museum, and if it were established there should be a good central museum, which would contain a most valuable collection of products, and these could be examined by merchants and others from all parts of the world, so that a great deal of the annoyance would be saved which was caused by goods being sent which were unsuitable or not of the kind required. If the merchant or the buyer had an opportunity of seeing the articles, what were the applications of them, their uses, names, prices, and so forth, there would be a great gain. A very large and important contribution might be received from the colonies towards such a museum, and it might be helped by these City Companies who had such large funds at their disposal, and by the bankers and brokers who would come to the aid of such an institution. He believed such an object would ultimately be accomplished. At the present time there were very few places indeed where an examination could be made of the various products used in trade. If a young man wished to enter a broker's or a merchant's office, he knew nothing of the products likely to come before him, and there was no possibility of his becoming acquainted with them in the absence of such a museum as the one he proposed.

Mr. Tracy observed that a great change had come over society since these guilds were established. If we wished to see good craftsmen, we must have good apprentices. In the olden time there was a control by the guilds over the apprentices, but all that was gone. When the guilds disappeared, with them disappeared the control over the apprentice, and now no one could tell anything distinct about the power which it was supposed a master had over an apprentice. The proper and the necessary authority they had over the apprentice was gone. Now there was no means of bringing them before a proper authority, and no one knew exactly what the proper authority was. Now-a-days, masters for the most part take apprentices and teach them one particular branch or portion of a trade. But there is no means of learning whether the master is an honest man and taught the apprentice, or whether the apprentice knew his work. There was no passing any examination. If there was any necessity for controlling a lad, and the breaking what might be called an unruly spirit—and we are all disposed to that—what was to be done? The master does the best he can, and either lets the apprentice go, or he drags through his time, and at the end he knows nothing. It ought to be settled by Act of Parliament what a master can do, and what an apprentice can do to enforce the law against the master if he does not teach him properly. But it would be much better if it could be done by guilds. In the old time their used to be in-door apprentices, but he very much doubted whether there were any now. Masters did not live at their places of business, as they formerly did, for it had become the custom for them to have the town and country residence, and consequently there could not be the same supervision.

Mr. E. Hall said it seemed to him that of late years they had lost ground in the progress of handicrafts and technical education, through not availing themselves of such bodies as the existing trades-unions. The question was what could they do at the present time. He argued that trades-unions, instead of attempting to keep up a standard of wages, should keep up a standard of work. It was right that they should acknowledge that attempts had been made by Mr. Applegarth and others, who had commenced drawing classes, to advance technical education, but each one of these attempts fell to the ground, partly through the apathy of the workmen themselves. They might have museums in connection with their crafts, in which might be exhibited specimens of the various materials with which they worked, and models explaining the various constructions of roofs, frames, floors, and so forth. All these might be contributed by the workmen themselves, at an exceedingly small outlay on the part of each contributor. They were justified in expecting that trades-unions should devote some portion of their funds to such an object. That admirable man, Mr. Twining, who established a museum at Twickenham, had in that museum specimens of different processes of work. For example, house-painters' work. He showed there how work appeared when there was simply one coat of paint, two coats of paint, and so on, and he showed what was bad work. Everybody who was acquainted with the matter was aware that there was a good deal of bad work done by using a coat of size instead of paint, and, as he had heard remarked, the man who does that deserves six months at the treadmill. The result was that the complete work perished in a very short space of time. If there were a proper feeling on the part of the craft as to the standard of work, if proper excellence of work were maintained by trades-unions, that sort of thing would be impossible. Moreover, the architect would be ready to look upon the craftsman as his natural ally instead of finding him carrying out the supposed interest of the contractor. He would draw a great distinction between the master builder who had been apprenticed, and had properly learnt the whole of his trade, and the modern contractor, who was simply a provider of money, and though he might do good by employing a certain number of men, it was to be questioned whether he did not do a considerable amount of harm in thus recognising and permitting frauds on the public. If you could get a proper standard, and give the public a better means of judging of the work, then partnerships of industry would boast of considerable progress. And such partnerships were not at all difficult, as was seen in the establishment of Leclair, in Paris, which not only fully obtained its most important object of securing harmony between master and workmen, but was also an admirable system of education in the craft. He had heard that there was a great deficiency in the trade of cabinet-makers. It was a serious thing if that trade were going out of the country, as the recent tables of exports tended to show was the case, particularly so when the work which had been exhibited at the Science and Art Exhibition at South Kensington was taken into consideration. He hoped it was not so, as these exhibitions had shown a high standard of work in the trade.

Mr. Tipnell thought Dr. Yeats had not sufficiently called attention to the municipal character of these guilds, or to the educational functions which many of the large City companies performed, and who expended very considerable sums of money in the advancement of education, and were thus acting most beneficially, and which would probably be made more beneficial still. In consequence of the altered circumstances now-a-days one very great defect in art-workmen was that their work was not daily scrutinised, as it used to be when the master had the apprentice always under his eye in his own home, and had his whole conduct under his control. Gentlemen live away from their business now, and the apprentices are consequently not under the master's eye.

Mr. Saywell observed that the various charters were granted for special purposes, and it was of great importance that they should carry out the spirit as well as the letter of their charters. The grand object of these guilds should be, as much as possible, to encourage the extension of technical education. In doing so they would be simply carrying out their objects, and for which their charters were originally granted. A charter was not granted as a matter of course, but a petition had to be presented, stating the grounds on which they applied for it, and alluding to the decay into which that particular trade or mystery had fallen, and that it was sought for the purpose of upholding and protecting that particular trade. Through the changes which had taken place in society their compulsory powers were taken away, but there was still left to them the power of rewarding good workmanship. There still was left in their hands very great power to carry out the spirit of their charters. By doing this they would not only be conferring great obligations on the country at large, but it would tend much to revive the influence of these guilds, and put an end to those rude and rough modes of strikes and lock-outs which he did not hesitate to denounce as unworthy the age in which we lived. At last it might end in the formation of councils of arbitration for the settlement of great disputes. If they could only be prevailed upon to take up this question, the existing guilds had a framework for bringing about such a desirable end.

Mr. Prideaux (Q.C.) thought the question ought to be treated simply and solely from a practical point of view. The unfortunate thing was that, so far as he knew, almost all guilds had wandered from the original object for which they were instituted. In Bristol, his native town, there was an old though not immemorial society, which he believed still did adhere to its original object —the Ancient Society of Merchant Venturers, established for the purpose of encouraging mercantile proceedings—and he believed they had strictly adhered to the object for which they had been created, and a most valuable society it was in promoting the welfare of that city. Every society, whether a guild or not, should devote itself to the promotion of the real practical welfare and interests of that body of persons with whom they were associated. They were all originally founded for the purpose of encouraging workmen in their particular trades, and although it was scarcely possible now to get each individual company to devote itself specially to the interest of that particular class in respect of which they were incorporated, he confessed he did not see why, with their great powers, and influence, and wealth, they might not combine together, and pull together in one persevering and energetic effort to promote generally the interests of trade and mercantile proceedings and technical education, and if they were to do that he thought these guilds in name, corporations in fact, might be made of the greatest possible service to the country in promoting its welfare.

Mr. M. B. Edson regretted the subject could not be continued for another evening, as it was of such an important nature. He found that the higher kinds of fine arts were patronised and encouraged, but the poor mechanician, and the apprentice was not very much encouraged, and he felt that the efforts of these guilds should be directed so as to encourage mechanical art. In New York, before a man could take charge of the boiler of an engine of only 5-horse power, he must pass an examination, and the boiler too must undergo an examination. But how different was the case here. He was surprised, on going up the river on the steam-boats, to find lives so carelessly guarded, no life-preserver, no life-boat. And he was afraid, if the engineers were put to the test, they would hardly know the difference between one guage and another.

Dr. Yeats, in reply, thanked the gentlemen who had spoken, for the observations they had made. He was glad to learn from a paper which had been handed to him, that the Haberdashers' Company were about to expend a very large sum for schools, to accommodate 12,000 children, in addition to large sums already laid out. He had also received a note from Mr. A. Sonnenschein, in which it was mentioned that the Meistersangers were guild poets, and that even in war there was a resemblance of ranks with those in the guilds; thus page and apprentice, journeyman and squire, knight and master, were parallel. As to trades' unions being necessarily antagonistic, he did not think it. The matter arose from mutual misconceptions. The establishment of a museum would be a great move towards the erection of a trade university. If the trades unions were to have a high standard, then the pay ought not to be according to time, but according to work.

The Chairman, in proposing a vote of thanks to the lecturer, said it would not become him, at that late hour of the evening, to detain them by any remarks of his, but he thought perhaps he should differ with Dr. Yeats as regarded the origin and history of these guilds. He did not think England was their original source. He should rather look upon these guilds as ecclesiastical, social, and trading, in their earliest stages—perhaps first as representative of the association which Christianity represented; 2ndly, caused by social wants; and 3rdly, founded when Edward III. established our commercial relations. But now we have to deal with the question of what use we can make of these wealthy representatives of the City companies. There should be something like a union formed amongst them. Let the leading men combine in the guild-union or trade-union —call it what you will, although there is a great difference between the ancient and the modern. In the old guild you had a combination of the masters and workmen. In the trades-union you have only workmen combined as against capitalists. That is a new state of things entirely. The real question is in what way can these wealthy institutions best promote the objects for which they were brought into existence. We are in an entirely new state of things, and we must adapt ourselves to it. In conclusion, he would observe, that in a work of four volumes, published by Dr. Yeats, and in Smile's "Lives of the Huguenots," would be found a vast amount of information on the subject, and this, with the paper read before them, probably contained all that had been written on the subject.

It is estimated by M. H. Busson that there are nearly 18,100 miles (English) of railways in Europe, which have cost a gross total of 424 millions sterling, apportioned as follows:—The United Kingdom, 7,670 miles, costing about 264½ millions; France, 2,519 miles, 64 millions; Prussia, 2,370 miles, 26½ millions; Germany (various states), 2,175 miles, 21 millions; Austria, 1,490 miles, 15 millions; Russia, 712 miles, 11½ millions; Belgium, 560 miles, 10 millions; Italy, Sardinia, and other States, 610 miles, 11½ millions.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

The Society's Committee for advising her Majesty's Commissioners in reference to the display of substances used as food (section, Grocery and Drysaltery) met at the Society's Rooms on Friday, the 24th January. There were present:—Sir Antonio Brady, in the chair, Dr. H. A. Pitman, Dr. A. Campbell, Professor R. Bentley, Messrs. F. A. Abel, Hyde Clarke, R. M. Curtis, James Duncan, W. Hall, Reginald Hanson, T. Hicks, E. W. Larner, F. Machin, J. Manley, W. H. Michael, W. Reed, P. L. Simmonds, Seymour Teulon, W. Yapp, and J. A. Youl; attended by Mr. E. J. Craigie, Deputy Commissioner, and Mr. P. Le Neve Foster, Secretary. The Committee, acting as a Committee of Selection, took into consideration the list of applications from intending exhibitors, and reports from the several Committees.

The first meeting took place yesterday (Mr. Dubreià in the chair) of the Committee of French gentlemen who have agreed to promote an adequate representation of French art and industry this year. The Committee consists of MM. Corbière, Devèze, Dognin, Dromel (Directeur du Comptoir d'Escompte de Paris), Gaudet, Lazard, Lebeau, Lintilhac, and Roux (Chancelier de l'Ambassade de France). The Committee took into consideration the numerous applications to exhibit which had been already received from French manufacturers, and they personally undertook to endeavour to make the representation as complete as possible.

EXHIBITIONS.

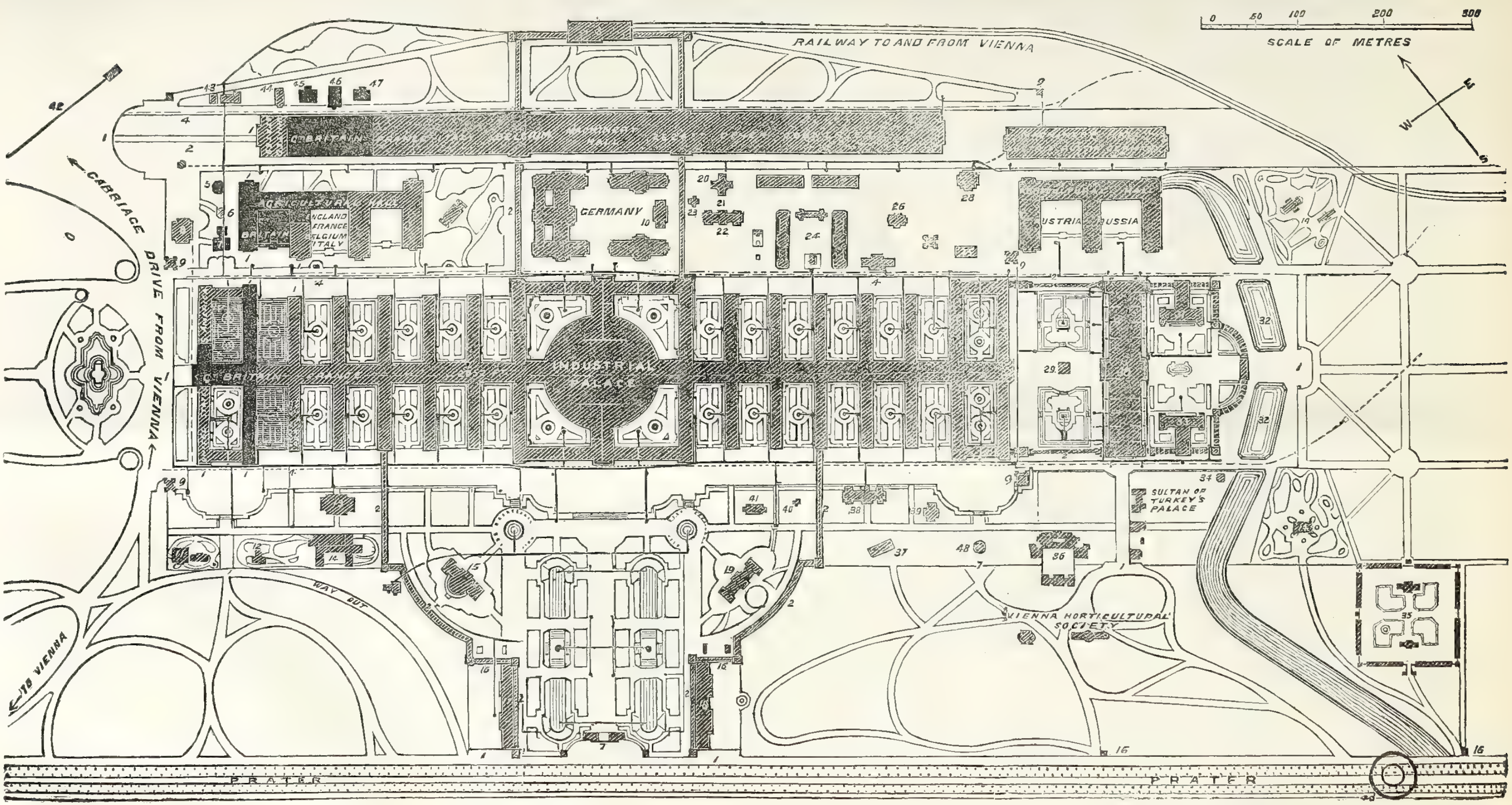
Vienna Exhibition.—The French commission reports that its exhibition of works of art will occupy as much space as those of all the other European nations together, Austria, we presume, excepted. The French pictures and objects of art will fill four large and as many smaller galleries. The space devoted to French exhibitors amounts to 1,000 metres in the grand rotunda, 7,000 metres in the galleries, 1,000 metres in the courts, 5,000 metres in the machine gallery, besides a large space in the park. The courts, which are open, are now being covered in the French section, and in front of them will be established the French restaurant. Taking recent events into consideration, the efforts made by the French government in regard to the Vienna Exhibition reflect most favourably both upon its commercial good sense and its patriotism. The *Gazette* of January 24 published a list of exhibitors in the British section, exclusive of fine arts. The number is in all 742.

PLAN OF THE VIENNA EXHIBITION.

By the courtesy of the proprietors of *Iron* we are enabled to publish the accompanying map of the Vienna Exhibition. *Iron* is the new name under which the *Mechanics' Magazine* is now appearing. Though not the first started, the *Mechanics' Magazine* was, at the time of the change, considerably the oldest of our technical journals. After a career of half a century it has taken a new name and a new condition, but if it only succeds in maintaining the traditions of the *Magazine*, the new paper should have nothing to fear. While feeling a certain regret at the decease of an old friend, we have no hesitation in wishing our new one a long and prosperous career.

LABOUR IN GERMANY.

The effects of the war upon Germany may be observed in the course of the reports written from that country. Mr. Cope, the British representative, residing at Darmstadt, notices how the enormous sums paid by France to Germany have had the effect of depreciating the value of money. Prices which already, before the war, had in the ten years from 1859 to 1869, enormously risen, have increased since that event. The sort of nightmare, the black cloud which hung over Hessian Germany, through the ever-present dread of a French invasion, has, by the defeat of the French armies, and the pushing back of the frontier by the annexation of Alsace and part of Lorraine, been removed, and the consequence of a feeling of security has been a rise in the price of land, and more especially of houses, and therefore of rents; this, added to the higher taxes, caused by the reorganisation of the army, has tended to make everything dearer, and presses very hard upon people with small fixed pensions; but others, such as owners of houses, merchants, manufacturers, producers of food, &c., recoup themselves by asking more for what they give in exchange for money, and, of course, the working man, if an artisan working for himself, asks more for what he makes; if working for a master, demands higher wages. The rise in prices presses, therefore, most heavily upon employés with fixed salaries, persons with fixed incomes; and it must be remembered that the people thus living in Germany are usually living on much smaller incomes than the same class in England, and that, from the nobility, as a general rule, only taking service under the State, and not supplementing their incomes from the church, law, or trade, the class living on small incomes is a numerous one. In the Grand Duchy of Hesse what can be done is done to improve the working man. Education is provided for his children free of charge, and for apprentices and working men desirous of improving themselves there are winter schools, where book-keeping, mental arithmetic, &c., are taught; and similar schools are open in summer for women and girls. Of the men called out to fill up vacancies in the ranks of the Hessian division in 1870-71, out of a total of 4,542 only 14 were without a school education. There are also the so-called "Handwerbn-Schulen," or schools of design, for artisans. These were first started with a surplus of not quite £50, which remained from the receipts of the first Industrial Exhibition, in 1837; and two schools were started as an experiment, one with fifty pupils and another with twenty-eight, and these were found to answer so well that now there are fifty-two of these schools, with 3,000 pupils attending them. Co-operative societies and benefit clubs, managed by the working men themselves, exist in considerable numbers; also saving banks of which the artisans seem to avail themselves more and more each year. Although there are complaints of the want of good workmen, Mr. Cope advises no British workman to emigrate to this part of Germany on a speculative search for work. In the first place he would not be able to live as cheaply as the Germans, and would not, therefore, be so well off; and, secondly, as the man who would come abroad to look for work would be very unlikely to be a first-class workman, who could always get full employment at home, he would probably not be so useful to the master employing him as the best native workman, and would, therefore, not be worth so much wages. Of course, a man having a distinct contract from a known employer of labour would be in a different position, but he should always stipulate for being sent back home, with his journey paid, if he found the place or climate did not suit him, even if he had to take lower wages at first in order to get this condition inserted; and he should take care to have the contract properly legalised by a consul, in Great Britain, of the country he is going to. But, with our colonies open to him, with the present influx of English into South America, and, lastly, with the United States, peopled by


RAILWAY TO AND FROM VIENNA
SCALE OF METRES
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200
300
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W
S
CARRIAGE DRIVE FROM VIENNA
TO VIENNA
WAY OUT
G. BRITAIN
BELGIUM
AGRICULTURAL HALL
BRITAIN
ENGLAND
FRANCE
BELGIUM
ITALY
GERMANY
AUSTRIA
RUSSIA
INDUSTRIAL PALACE
G. BRITAIN
SULTAN OF TURKEY'S PALACE
VIENNA HORTICULTURAL SOCIETY
PRATER
PRATER
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Anglo-Saxons, within a few days' sail, it is impossible to conceive a British workman emigrating to Germany, except on a distinct contract giving him profitable terms.

Upon a general view of the distribution of Wurtemburg industry, out of a population of 1,748,328 inhabitants fifty per cent. are employed in agriculture, and 269,077 in other kinds of industry. It has been calculated that the capital of the nation, by aid of the labour population, returns a revenue of ten per cent. From the account of the mode in which labour is distributed among the different branches, it appears that 44,344 persons are employed in the preparation of food. Four establishments, employing 325 hands and 5,200 spindles, are engaged in spinning flax. Linen is mostly hand-sown in Wurtemburg; this trade employs 19,507 workmen and 19,379 looms. The number of power-looms in present use is twenty-seven. Seventy-five establishments are engaged in spinning woollen yarn, employing about 60,000 spindles and 2,200 workmen. Three manufactories for carding wool employ 20,000 spindles and 13,500 workmen. Seventy-four working with 527 hand and 31 power-looms, and employing 1,114 hands, are employed in the manufacture of wollen tissues. Twenty-two working with 444 hands and 45 power-looms, and occupying 836 workmen, are engaged in the manufacture of flannels and mixed stuffs. The cotton-spinning employs upwards of 270,000 spindles and 3,850 operatives, and the annual production of this branch of industry was estimated in the year 1861 at upwards of £1,000,000 sterling. The calico printing, established at Heidenheim, produces annually 150,000 pieces of calico for foreign exportation. There are upwards of 60 manufactories employed in the construction of machines, thirty-four establishments in working in the precious metals. Besides these there are many large manufactories working in all classes of iron, bronze, and zinc, and employing a large portion of the industrial population, the number of which does not appear in the official returns. It has been estimated that 2,600 hands are employed in tanneries, and 21,000 in shoemaking. There exist 20 paper manufactories in Wurtemburg; and the book trade at Stuttgardt is reported to produce annually £300,000 sterling. The severe trial which all industry underwent in Germany during the late war was especially felt in Wurtemburg, owing to its vicinity to the scene of the first hostilities. The crisis was, fortunately, of short duration, and the restored confidence consequent on the first successes of the German army, helped to bring labour back to its usual channel; but the effects of the disturbance of the labour market cannot even yet be said to be so entirely forgotten as to admit of pronouncing the present state of labour a normal one. The effects of the political changes in Germany which followed, although slower in making themselves felt, are of a more important character. The foundation of a United German empire broke down many barriers in the way of a free development of German industry. Speaking, therefore, in general terms, the condition of the working man has undoubtedly improved, and in comparison with the condition of the same class in Saxony, the Lower Rhine Provinces, and Alsace, where wages are considerably lower, and provisions, if anything, dearer, it is decidedly a favourable one. An intending emigrant will find that labour of an ordinary description will command wages varying from 9s. to 18s. a week, and that skilled labour will command wages from 25s. to 45s. a week; that, with the exception of skilled labour, *e.g.* as overseer, or to superintend the starting of any branch of business, or as a good calico or cotton printer, there is little opening for English labour.

The number of persons employed in the various branches of industry at Bremen is not so great as might be expected from the total number of inhabitants of that city. The position of Bremen in relation to the German Customs Union, as also the small demand from the thinly-populated districts of the neighbouring provinces of Hanover and Oldenburg, prevent the industrial industry of this city from attaining anything like importance. The various kinds of work are, as a rule, well performed, but the superior class of workmen and artisans are not so skilful as the same kind of persons in England. Mr. Consul Ward thinks the chief faults of the working classes at Bremen are slowness, and an indifference as to completing their work within a given time; the latter circumstance is probably caused by the want of sufficient competition. The artisans, moreover, shows a deficiency in artistic skill in the execution of their work, which, though of a durable and solid nature, is generally wanting in taste. All the more elegant articles of industry found at Bremen are imported from other countries; articles of British industry are in great request, on account of their superior finish and taste, and in many cases on account of their comparative cheapness. It is, however, probable that the increasing demands and greater pretensions of the inhabitants, as compared with former years, will urge the Bremen artisan to attend more to the outward appearance of his work, and also to modern requirements. Should the restrictions placed at present upon the development of the industrial interest by the isolated position of Bremen with reference to the German Customs Union be removed at a future day, a further impulse would be given to the advancement of the industrial classes in this city; on the other hand, it should, perhaps, be added that the Bremen artisans are, in one sense, very independent in the performance of their work—more so probably than in other cities where manufactories have taken the place of manual labour. At Bremen a workman engaged in some special trade or industry does not merely perform one single part of an article, but he generally executes the same in its entirety. This fact of his being obliged to carry out the working of each article from beginning to end, gives him also a greater interest in his work, and enables him to put more of his own character into it than if he had only performed a part of it. Strikes among the industrial classes are hardly known. Mr. Ward believes that although an English artisan or workman coming to Bremen would live almost as well as in England, on lower wages, and in a climate similar to that of his own country, he would probably find a rather narrow field for developing his skill, and also a disinclination on the part of a large portion of the population to adopt new ideas in matters of industry as in various other subjects.

ANILINE BLACK AS A DYE FOR COTTON GOODS.

Chemists have long tried to make use of the beautiful black precipitate produced by the action of bichromate of potassa for the solution of certain aniline salts as a dye for calicoes, but without success; if the solution was concentrated, the black was soon precipitated to the bottom of the bath; if, on the other hand, it was dilute, the black, owing to the absence of a sufficiently powerful oxidation, was not formed at all, or in insufficient quantity.

This trouble it was attempted to remove by cooling down the solutions nearly to zero. But this produced another difficulty, the chromate of aniline crystallising out at that temperature when the solutions were sufficiently concentrated to produce the desired dye. Wherever these spots existed in the cloth, on subsequent drying a mutual reaction took place between the constituents of the chromate of aniline, causing such a rise of temperature as not unfrequently to set fire to the cloth.

To overcome these various difficulties the following expedients were adopted:—By means of a horizontal brush, to which a reciprocating motion was given in a vertical direction, the solutions, either together or one after the other, were cast upon the cloth, while tightly stretched, in the form of a fine spray. By this means, however rapidly the reaction took place, it could not possibly do so until the solutions were intimately mixed together upon the cloth, the latter being at the same time thoroughly wetted with it.

The salts found to be most suitable for this reaction are the sulphate, hydrochloride, and the nitrate. No black is obtainable with the acetate, and the tartrate, oxalate, and citrate are more or less unfitted for the production of a good colour. If a too nearly neutral solution is used, there is great difficulty in producing the colour; if the solutions are too acid, the black is formed so rapidly that the solutions have not time to mix sufficiently and to penetrate the cloth. As the result of numerous experiments with hydrochloric, sulphuric, and nitric acid salts, the following conclusion was arrived at, that:—1. The employment of neutral aniline salts was ineffective. 2. The bi-acid aniline salts, especially the bi-sulphate, give good results. Of the tri-acid salts the hydrochloride is the best. 3. The sulphates give a reddish black; the hydrochloric and nitric acid salts yield a black with a blue lustre. 4. Equal volumes of bi-sulphate and bi-hydrochloride of aniline give excellent results. 5. The bi-chromate of potash solution must be concentrated, containing not less than 80 grammes of salt to the litre.

A dark-green is first produced on passing the cloth into a hot soap-bath. After washing it thoroughly this passes into pure black. By printing the cloth with fatty matters or resins, previous to the application of the dyeing solutions, white patterns on a black ground can be obtained.—*Iron.*

UTILISATION OF WASTE COAL.

In a paper on this subject by Mr. W. H. Wahl, in the "Journal of the Franklin Institute of Pennsylvania," the author says:—"The processes for the utilisation of the anthracite waste consist universally in the employment of a foreign material or materials, which shall serve the purpose of a cement to bind the loose particles of the waste together. The cements heretofore used have been both of mineral (incombustible) and of organic (combustible) character. In the majority of instances, as is usually the case with a field of invention just ripening into importance, the patentees of such processes display a characteristic ignorance of, or lofty indifference to, the conditions of the problem they profess to solve. The number and variety of substances which have been secured by inventors, either as cements, or to aid in the cementation or combustion, is well calculated to surprise one unfamiliar with the literature,—if such an expression is allowable when applied to Patent Office records—of the subject. The several alkaline substances and their silicates seem to have been held in special favour, since they repeat themselves, with some modifications, in several places. Lime, either alone or with some subsequent chemical alteration into carbonate, sulphate, or silicate, is claimed; or plaster of Paris or hydraulic cement is used directly. Clay must also be named. Among organic substances may be named pitch, coal-tar, resin, the Trinidad bitumens, asphalte, petroleum residues, dextrine, glue, Grahamite, &c.; while as accessories, employed either to assist cementation or combustion, we have sawdust, chaff, flour, blood, cow-dung, starch, sand, saltpetre, and other substances too numerous to mention. Comparatively few of these processes have ever reached a public trial, as, indeed, few deserve it, and of those which have received attention none have been more than indifferently successful, either from inherent deficiencies or from commercial reasons."

The total export of iron and steel in 1872 averaged 282,385 tons per month.

AGRICULTURAL ENGINEERS IN FRANCE.

The engineers of Ponts et Chaussées and the mining engineers of France have always held highly important positions, and although opinion has been divided respecting the policy which concentrated all the public works in the hands of these two bodies of scientific men, there can be no doubt that their systematic training has done much towards elevating engineering science. A third body is now about to be called into existence in the special interest of agriculture. This step was determined in 1870, but circumstances have delayed its being taken until the present time. The Minister of Agriculture has announced that in future diplomas will be granted to agricultural engineers. Candidates must in the first place have passed through one of the recognized agricultural schools, and have obtained, after nomination, a certificate of agricultural instruction, or otherwise submit to a similar examination to the preliminary certificate. In order to obtain the diploma of engineer, the candidate must present a memoir giving a systematic monograph of a locality or of an agricultural establishment, and also answer satisfactorily the questions put by a jury on agriculture, technical zoology, accounts, the economic sciences, mathematics, physics, chemistry and natural history as far as they relate to agriculture. The jury may also demand proofs of the candidates if it see fit. The memoirs are to be sent in in the month of October, and the examination to take place on the first of December in each year.

Considering the great and pressing importance of all matters connected with drainage, irrigation, and manuring, in the thickly populated countries of the old world, this new step on the road of technical education deserves special attention.

THE FRENCH EGG TRADE.

A correspondent of the *Grocer* writes as follows upon this subject:—"The French egg trade is a thing of comparatively recent date, the number imported in 1856 being only 117,230,600, against 558,000,000 imported in 1872. Hence the number has very nearly quintupled within the last sixteen years, yet it is remarkable that the price has in no way decreased; for, while the average price of the year in 1856 was 5s. 8d. per 120, in 1870 and 1871 it averaged 6s. for the same number; and, indeed, an average for the last five years shows wholesale price almost always slightly over the figure of ten for 6d. If this price can be obtained for imported eggs, it is plainly not for want of a good market that the English leave so much of this trade in the hands of foreigners. There is no doubt that one cause of the great poultry productions of France lies in the large class of small proprietors or farmers, to which in this country we have no similar body. Such small proprietors, each having a few acres, are in the very best position for keeping fowls, their occupation not being too large to allow of the most complete oversight without any very expensive buildings or outlay in labour. It is by collecting eggs from a large number of these small raisers that the immense totals above remarked upon are chiefly derived, though there are a certain number of larger producers. These latter, however, are chiefly concerned in the raising of chickens for the market, and have very little comparative influence on the egg supply. Of this latter the English trade is only a part, the French being far more of an egg-eating nation then ourselves—so much so, indeed, that it has been computed every Parisian consumes 160 eggs annually, though whether this calculation be accurate it is very difficult to say."

A substance called Ceresine, obtained as a by-product in purifying ozokerit for the manufacture of paraffine, is now used in Vienna as a substitute for bees'-wax in certain medicinal preparations.

COMMERCE AND TRADE IN SIAM.

The recently-published Consular Report on this country gives some details about its commercial progress. The exports in 1871 were above the average of the last five years. The rice crop suffered from want of rain, and prices ruled high. Some of the export trade has been taken away by the port of Saigon, which has considerable advantages as regards the export of rice to China. Its greater proximity admits of less freight, and consequently, when prices in both countries are the same, buyers naturally prefer the nearer market. There is also telegraphic communication thence to Hong Kong, where the greater part of the speculators in the grain reside. Lastly, they have got rid of the corvée system, and thus all the inhabitants are free to work for themselves, and this is not yet the case in Siam.

The attention of the government has been repeatedly drawn to the want of telegraphic communication with the outside world, but as yet without much result. It is believed, however, that the government now intend to run a line from Bangkok to Penang.

In regard to the corvée system, the great evil of Siam,—difficult as its abolishment will be, for the government, as at present administered, could not be worked without it—still it is a mere question of time when the people shall be rid of it. The government is aware of its great evils, and is anxious to free the country from the oppression. There is little doubt that what most Europeans are pleased to call the inherent laziness of the Siamese is merely the natural effect of making man labour without reward. Numbers of Siamese now compound for three months' labour due to their lords, and work with Europeans throughout the year. Those who had been for some time under Europeans of energy and probity, work as hard, and are as regular in their conduct as the natives of any warm climate, and will do in one day as much work as an ordinary Siamese, working under the corvée system, will do in three. The Siamese officials are becoming so well aware of this fact, that many of them, when they have any real work to do, prefer to compound with the men told off to do it; and with the money thus obtained hire labour at the market rates.

If the export of rice does not continue to progress, there are strong grounds for believing that the production of sugar will be largely extended. The steam-ploughs upon the Indo-Chinese Company's estate have turned out a great success, and have enabled the company to get a large amount of land under cultivation at less than half the rate they would have been obliged to pay had they employed Chinese hand labour. From the deeper cultivation of these ploughs better crops are also expected, and also an earlier planting of the cane. Till now, the cane-growers have been in the habit of planting in March and April; and as the cane is cut in December and the three following months, it is barely ripe, and does not contain the same amount of saccharine matter that cane fully twelve months in the ground usually produces.

PROPERTIES AND USES OF KIESERITE.

Kieserite is a mineral composed of sulphate of magnesia and water, which occurs to the extent of 12 per cent. in the salt deposits of Stassfurt, Germany. It differs from Epsom salts by its difficult solubility in water and smaller percentage of water of crystallisation.

The first attempts to economise kieserite were made in 1864, when it was proposed to employ it in the preparation of sulphate of potash. Since that time the applications have greatly increased, and it has now become an important article of commerce. The largest quantity of the raw material is sent to England, where it takes the place of the sulphate of magnesia, formerly manufactured from dolomite, or Grecian magnesite, in cotton printing. Another portion of kieserite is converted into Glauber salts, which on account of its freedom from iron, are highly prized by gas manufacturers.

Manufacturers of *blanc fixe* employ kieserite instead of sulphuric acid to precipitate the sulphate of barium from chloride of barium, and in all similar cases where it is proposed to prepare a difficultly soluble sulphate, the kieserite can be advantageously used. Kieserite is recommended as a substitute for gypsum in agriculture, as a top-dressing for clover, and is largely employed in England for this purpose. It is proposed to use kieserite in the manufacture of alum. There is a mineral called bauxite, which chiefly consists of the hydrated oxide of aluminum; this is easily dissolved in hydrochloric acid. Cheap potash salts and the calculated quantity of kieserite are added; alum crystallises out of the solution, and chloride of magnesium remains in the mother liquid.

The uses indicated above are wholly inadequate to consume the enormous quantities now obtained from the Stassfurt mines. Millions of pounds of kieserite are annually brought to the surface, and it is becoming a serious question to know what to do with it. If it could be used as a substitute for gypsum in building materials and cements, its cheapness would at once commend it to notice. Experiments looking to this application have been tried.

Two equivalents of kieserite and one equivalent of caustic lime were stirred to a paste in water. The mass hardened, but remained granular and brittle. On calcining it, however, again pulverizing and moistening with water, it set to a solid marble-like mass, which could be applied to many useful purposes. It is proposed to employ this material for ornamental decorations in the interior of houses, and in general for the manufacture of cements and as a substitute for plaster of Paris.

Kieserite appears likely to prove a valuable accession to our supply of useful minerals, to be ranked by the side of kainite, a potash mineral also found at Stassfurt, and now largely imported into the United States.—*Scientific American.*

CORRESPONDENCE.

FIRE INSURANCE.

Sir,—At page 159 of the *Journal of the Society of Arts*, I find a startling statement, for which apparently the Law Fire Office is responsible.

Will you be so kind as to communicate to Mr. Macomber that the amount of premium paid to the London Fire offices was £648,528, not £16,544,000.—I am, &c.,

George Wm. Bell, Secretary,
Law Fire Insurance Society.
114, Chancery-lane, London, W.C.,
27th January, 1873.

[We have received the following from Mr. Macomber:—"Instead of stating that £463,235,000 is the amount insured in the City of London, this amount should be applied to the entire Metropolis, and the premium on this sum should appear as £648,528."]

SULPHUR IN SICILY.

Sir,—The annual produce of sulphur in Sicily, as given by Signor Mottura in last week's *Journal*, is 160,000 tons. If Signor Giordano's figures are correct, this amount is too small by some 50,000 tons. I find in the *Journal of the Society of Arts*, vol. xviii., p. 876, that Signor Giordano states that the annual value of sulphur produced in Sicily is 26,000,000 francs, which, at the price he gives, of 120 francs per ton, corresponds to 126,000 tons.—I am, &c.,

Zolfo.

NOTES ON BOOKS.

The History of Ceramic Art.—A very important work upon this most important form of applied art has recently been published in Paris.[*] The author, M. Albert Jacquemart, is one of the highest authorities in Europe on the subject on which he treats, and possesses a remarkably fine collection of porcelain and *faiences.* M. Jacquemart claims for his favourite form of art that it, more than any other, exhibits the progress of intelligence and the tendencies of man towards artistic objects, and he then proceeds to illustrate his subject from the earliest periods of civilisation to the present time. Those who are not yet conversant with the technology of ceramic art will thank the author for an excellent *resumé*, contained in five pages, on the subject. M. Jacquemart treats his subject in its entirety, commencing with Egypt, China, and Japan, and including primitive pottery of all kinds, but the twelfth century, the *renaissance*, supplies him with his fullest and grandest theme, and the productions of the great Italian potteries are dwelt upon with the learned enthusiasm of a master in the art of criticism. After this the French *renaissance* supplies the author with another grand division of his subject, which he has naturally studied with minute attention; while Holland, England, Spain, and other countries are not neglected. The work is completed by full contents and index, which are of great value to the ceramic student, and the whole is contained in a single volume of seven hundred pages. But the work has another high claim to attention. It contains a series of etchings by the son of the author, M. Jules Jacquemart, whose power of depicting texture, ornamentation, light, and, almost, colour in objects of art in black and white, has certainly never yet been surpassed if it has been equalled. The etchings of the jewelled and other objects in the Louvre, executed by M. Jules Jacquemart for the French government some few years since, are known to all the art world of Europe. In the case of the present book he probably selected his own examples and worked *con amore;* the effect is superb. In addition to these etchings the volume is profusely illustrated with admirable wood engravings.

Explorations in Palestine.[†]—The committee of the Palestine Exploration Fund have thought it time to render an account of their doings, and of the results they have obtained from the money entrusted to them. This they have done in the work before us. It contains a good deal of matter of considerable interest to biblical students, and certainly shows that the exploration funds have been carefully and judiciously applied. One of the most curious things in the book is the reproduction of a map of Palestine of the fourth century.

To prevent ink from turning mouldy, it has been recommended by a German chemist to add a drop or two of mustard oil. A similar addition to starch paste is said to prevent its becoming sour.

It is said that a Philadelphia manufacturer is preparing a plan for a column 1,000 feet high, to be constructed entirely of iron, in open work, from the summit of which the grounds of the Centennial Exposition are to be illuminated by means of a Drummond light.

The Finland mines are said to have produced 1,121,197 cwt. of iron ore in 1871, besides 18,317 cwt. of copper and 8,811 cwt. of tin ore. Gold to the amount of 56,685 grammes was washed out in Lapland during the same period.

GENERAL NOTES.

The Porcupine as Food at Rome.—A novel delicacy is likely to grace the tables of the epicures of Rome. The other day a porcupine was for sale in the market of the Eternal city, and the price put upon it was only one franc per kilog. (little more than half the present price of veal). The man who had him for sale explained that it should be cooked like a hare, or with wine sauce like a wild boar.

Cinchona in India.—Some experiments have been made by Mr. Broughton, the Government Quinologist at the Ootacamund Plantation in India, to ascertain if the application of artificial manures to cinchona trees will increase the yield of alkaloid. It appears that with certain species of cinchona, though the trees exhibited no greater luxuriance, the amount of quinine obtained from the bark was considerably increased by manuring; and the experiments seemed sufficiently important to warrant an extension of this treatment.

Mendelssohn Scholarships.—The committee of the Mendelssohn Scholarships Fund are now appealing for additional contributions to the fund. As is generally known, the scholarships were founded in 1849, shortly after the death of the composer. Till 1856 the capital was allowed to accumulate, and in that year the first scholar (Mr. Arthur Sullivan) was appointed, and he held the scholarship for the appointed period of four years. Two other scholars have since been elected. In 1871 a second scholarship was instituted, tenable for two years, but it is found that the funds in the hands of the committee are not sufficient for its continuance. The scholarships are open to persons of both sexes, natives of Great Britain or Ireland, and are intended principally to enable students to pursue their studies in Italy and Germany. The Council of the Society have subscribed £20 to the fund, but, as they are at present engaged in the larger work of promoting the establishment of a National Training School for Music, they are not in a position to interest themselves further in the matter.

Protection against Fire in New York.—The Governor of New York, in his last message, says that the fires of Chicago and Boston suggest the necessity of revising the existing laws relating to the construction of buildings and the storage of combustibles in the cities of the States, and that it is requisite that the provisions of the laws should be of the most stringent character. At present the Superintendent of Buildings is authorised to modify the legal requirements with the consent of the Supreme Court. The Governor is of opinion that the members of this body cannot be equally competent with other persons to give correct judgments in such cases. He, therefore, recommends that no modification of the law prescribing how buildings are to be constructed shall be made without the consent of a board, jointly constituted of the New York Board of Fire Underwriters and the Commissioners of the Fire Department; the first as having, besides their special knowledge, a large pecuniary interest at stake, and the other from their familiarity with the causes of conflagration and the best modes of contending with it. With these, he says, the American Institute of Architects might perhaps be associated with advantage.

Apprentice Schools, Paris.—The municipal authorities of Paris have just opened a "school of apprentices," as it is called, on the plan of similar schools which have been established by associations. It is at once a primary and an industrial school, intended to solve the difficult problem of combining general and professional education, and training well-taught workmen. The boys, who are admitted from the age of thirteen to that of sixteen years, are apprenticed to the director for three years, and receive gratuitous education. The municipal authorities have purchased a large site on which the building is erected, on the Boulevard de la Villette. The main building is composed of three floors, and includes three great class rooms capable of receiving two hundred pupils, and the refectories; the boys are not lodged at the school, but arrive at seven in the morning, and stay till seven at night. Another building, forty yards long, is devoted to workshops; on the ground floor are forges, steam hammers, and all the rest of the machinery and tools for working in iron; the upper floor is devoted to wood sawing, carpentering, joinery, and cabinet making. Two foremen direct these two series of workshops. Between the two buildings is a large garden, playground, and gymnasium.

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[*] "Histoire de la Céramique," par Albert Jacquemart. Hachette, Paris.

[†] "Our Work in Palestine," issued by the committee of the Exploration Fund. Bentley.

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

REPORTS ON THE LONDON INTERNATIONAL EXHIBITION OF 1872.

The reports which appeared in the last volume of the *Journal* on the various sections of the above Exhibition, are now published complete, in a pamphlet form (price 2s.), and can be obtained at the office of the Society.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. The following meetings have been arranged:—

February 5.—"On Ships for the Channel Passage." By Lieut.-Col. A. Strange, F.R.S. The chair will be taken by Vice-Admiral Erasmus Ommanney, C.B., F.R.S.

February 12.—*Adjourned Meeting.* "On Ships for the Channel Passage."

February 19.—"On the Virginias; their Agricultural, Mineral, and Commercial Resources." By Major Hotchkiss, C.S.A., engineer in charge of the survey of Virginia by the Washington and Lee University. On this evening Sir Antonio Brady will preside.

February 26.—"On the Arrowroots of Commerce." By P. L. Simmonds, Esq.

INDIA COMMITTEE.

A Conference will be held this evening (Friday), January 31st, at eight o'clock, when a paper will be read by J. H. Stocqueler, Esq., "On the Progress of India during the last fourteen years." Major-General Sir Henry Creswick Rawlinson, K.C.B., F.R.S., will preside.

CANTOR LECTURES.

The second course of these lectures, viz., seven, "On the Energies of the Imponderables, with especial reference to the Measurement and Utilisation of them," will be delivered by the Rev. Arthur Rigg, M.A., on the following evenings, at eight o'clock:—

Lecture I.—Monday, February 3rd, 1873.

On the Sources, Inter-relations, and Measurements of Energies—Units of Measurement.

Lecture II.—Monday, February 10th, 1873.

On the Energy of Gravity, with especial reference to the Measurement and Utilisation of it.

Lecture III.—Monday, February 17th, 1873.

On the Energy of Vitality, with especial reference to the Measurement and Utilisation of it.

Lecture IV.—Monday, February 24th, 1873.

On the Energy of Affinity, with especial reference to Suggestions for Estimating and Utilising it.

Lecture V.—Monday, March 3rd, 1873.

On the Energy of Electricity, with especial reference to the Measurement and Utilisation of it.

Lecture VI.—Monday, March 10th, 1873.

On the Energy of Light, with especial reference to the Measurement and Utilisation of it.

Lecture VII.—Monday, March 17th, 1873.

On the Energy of Heat, with especial reference to the Measurement and Utilisation of it.

Members are entitled to attend these lectures free, and to admit two friends to each of them. Tickets for this purpose were issued with last week's *Journal.*

MEETINGS FOR THE ENSUING WEEK.

Mon. ...**SOCIETY OF ARTS, 8.** Cantor Lecture. Rev. A. Rigg, "On the Energies of the Imponderables."
Royal United Service Institution, 8½. 1. Mr. W. Stirling Lacon, "Lowering Boats at Sea." 2. Captain G. Bremner, "Steering Screws." 3. Major Hutchinson, R.A., "New Surveying Instruments."
Farmers' Club, 5½. Rev. J. L. Brereton, "Country Education."
London Institution, 4. Professor Duncan, "Physical Geography."
Victoria Institute, 8. Rev. C. A. Row, "Remarks on Some Current Principles of Historical Criticism."
Society of Engineers, 7½. President's Address.
Royal Institution, 2. General Monthly Meeting.
Entomological, 7.
British Architects, 8.
Medical, 8.
Asiatic, 3.

Tues....Civil Engineers, 8. Discussion on "Cylindrical Foundations." 2. Mr. W. T. Thornton, "The Relative Advantages of the 5 feet 6 inches Gauge, and of the Metre Gauge, for the State Railways of India, and particularly for those of the Punjaub."
Royal Institution, 3. Prof. Rutherford, "Forces and Motions of the Body."
Biblical Archæology, 8½. 1. Rev. D. H. Haigh, "On the Era of Ezra and Nehemiah." 2. Rev. J. M. Rodwell, "On an Assyrian Patera with an Inscription in Hebrew Characters." 3. Rev. J. M. Rodwell, "Some Remarks upon a Passage in the Pænulus of Plautus."
Royal Colonial Institute, 8. (At the House of the Society of Arts.) 1. Continuation of discussion on Lord Bury's Paper on "The Treaty of Washington; a Balance of Advantages, &c." 2. Mr. J. G. Bourinot, "The Marine and Fisheries of Canada."
Pathological, 8.
Anthropological, 8.
Zoological, 8½. 1. Mr. B. Meldola, "On a Certain Class of Cases of Variable Protective Colouring in Insects." 2. Professor J. Allman, "Report on the Hydroida collected during the Expeditions of H.M.S. *Porcupine.*" 3. Mr. George Gulliver, "Measurements of the Red Blood Corpuscles of Batrachians." 4. Dr. Günther, "Notes on some Reptiles and Batrachians obtained by Dr. Adolf Bernhard Meyer in Celebes and the Philippine Islands."

Wed. ...**SOCIETY OF ARTS, 8.** Lieut.-Col. A. Strange, "On Ships for the Channel Passage."
Geological, 8. 1. Mr. Samuel Sharp, "On the Oolites of Northamptonshire." 2. Mr. D. Mackintosh, "Observations on the more remarkable Boulders of the North-West of England and the Welsh Borders." 3. Mr. J. Lucas, "On the Origin of Clay-ironstone."
Microscopical, 8. Annual Meeting.
Pharmaceutical, 8.
Obstetrical, 8.
London Institution, 7. Prof. Barff, "On Fresco and Siliceous Painting."

Thurs...Royal, 8½.
Antiquaries, 8½.
Royal Institution, 3. Dr. Armstrong, "Formation of Organic Substances."
Linnæan, 8.
Chemical, 8. 1. Mr. W. H. Perkins, "On Anthrapurpurine." 2. Dr. C. R. A. Wright, "On Isomerism in the Terpene Family of Hydrocarbons." 3. Messrs. R. S. Dale and C. Schorlemnur, "On Aurine."
Royal Society Club, 6.

Fri ......Architectural Association, 7½.
Geologists' Association, 7½. Annual Meeting. Mr. Charles Lapworth, "On the Diprionidæ of the Moffat Shale."
Royal Institution, 9. Professor Ramsay, "Old Continents."
Philological, 8¼.
Archæological Institute, 4.

Sat ......Royal Botanic, 3¾.
Royal Institution, 3. Dr. Freeman, "Comparative Politics."

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,055. Vol. XXI.

FRIDAY, FEBRUARY 7, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

TECHNOLOGICAL EXAMINATIONS.

The Programme of Examinations in the Technology of the Arts and Manufactures of the country, in reference to which notices have already appeared in the *Journal*, is now ready for issue, and may be had on application to the Secretary.

The Council have the pleasure to announce the following contributions to the Prize Fund :—

The Worshipful Company of Vintners (annual)	£10 10 0
Dr. Crace Calvert, F.R.S.	5 5 0

The following additional Prizes are offered by Wyndham S. Portal, Esq. :—To the Second and Third best Candidates in the Elementary Grade, Paper Manufacture :—

A Prize of	£3
A Prize of	£2

A copy of the programme is sent with this *Journal* to each Institution in union with the Society.

PRIZE FOR STEEL.

1. The Council have resolved to award the Gold Medal of the Society to the manufacturer who shall produce and send to the London International Exhibition of 1873 the best collection of specimens of steel suitable for general engineering purposes.

2. The specimens exhibited must include a complete illustration of the applications of the varieties of steel submitted.

3. Each manufacturer should send with his specimens a statement of the nature of the tests he has applied to each kind of steel submitted, and give the results of such tests.

4. The samples tested are to be exhibited together with duplicate samples, or portions of the same samples; these will be submitted to tests should the Council consider it desirable.

5. The Council reserve to themselves the right of withholding the premium, in the event of the specimens exhibited not being sufficiently meritorious.

NATIONAL TRAINING SCHOOL FOR MUSIC.

The Worshipful Company of Fishmongers have informed the Council that they have resolved to establish two scholarships, of £25 each, in aid of this school.

ECONOMICAL USE OF COAL.

The Committee charged with this subject met on Monday, the 3rd instant. Present—Major-General Eardley Wilmot, F.R.S., Dr. David Price, Mr. Robert Rawlinson, C.B., Rev. A. Rigg, Captain Robert Scott, R.N. The Committee took into consideration a communication from H.M. Commissioners for the International Exhibition, in reference to space suitable for display and for testing the objects to be sent in competition for the prizes offered by the Society.

WATER AND GAS SUPPLY.

The Council have appointed a Committee, consisting of Major-General Eardley Wilmot, F.R.S., chairman of the Council, Mr. Edwin Chadwick, C.B., and Mr. Robert Rawlinson, C.B., to communicate with the municipal corporations of the kingdom, and inquire into the causes, if any, which impede the adoption of efficient means for obtaining an adequate and economical supply of water, gas, and other sanitary requisites in their respective municipalities, with a view to obtain, if necessary, general legislation thereupon, and to report the result to the Council.

FIRES COMMITTEE.

This Committee, appointed to consider and report on the best means for preventing the spread of fires in the metropolis, held its first meeting on Wednesday, the 5th instant. Present—Mr. U. J. Kay-Shuttleworth, M.P., in the chair; Mr. E. Chadwick, C.B., Lord Mountcharles, and Lord Alfred Churchill. The Committee took into consideration the course of proceedings to be adopted.

PROCEEDINGS OF THE SOCIETY.

NINTH ORDINARY MEETING.

Wednesday, February 5th, 1873, Vice-Admiral Erasmus Ommanney, C.B., F.R.S., Member of Council, in the chair.

The following Candidates were proposed for election as Members of the Society :—

Fitzjames, Frank, 7, Stanhope-terrace, Gloucester-road, S.W.
Johnston, William, M.D., F.G.S., 6, Gloucester-terrace, Weymouth.
Kay-Shuttleworth, Ughtred James, M.P., Gawthorpe-hall, Burnley, Lancashire.

The following candidates were balloted for and duly elected members of the Society:—

Bannister, Robert Hope, 80, King William-street, E.C.
Walduck, Henry, 4, Warwick-court, Holborn, W.C.
Watt, Philip B., 3, Bilbie-street, Nottingham.

The Paper read was—

SHIPS FOR THE CHANNEL PASSAGE.

By Lieut. Col. A. Strange, F.R.S.,
Inspector of Scientific Instruments to the India Government.

I believe that the object of the Council of the Society of Arts, in asking me to read a paper on this subject, is that of promoting public discussion of it. They did not, I hope, expect that I should be able to throw any original light on it. Nor, were I able—which I certainly am not—should I attempt to do so on this occasion. My efforts will be directed chiefly to bringing together the various methods which are about to be tried practically of giving increased comfort to those who have to cross the Channel, in order that the promoters of each may, if so minded, help us to compare them impartially, and thus both prepare the public mind for a new state of things, and also themselves derive possibly some of those advantages which are generally found to follow open debate.

I need say very little to persuade you that there is room for improvement in our present means of crossing the Channel. The sum of human misery accumulated in a generation by the horrors of that short voyage is beyond calculation and beyond words. When a boy at school, some 40 years ago, my parents lived on the Continent, and I had to cross frequently every year for my holidays. After leaving school I spent 26 years in India. When I returned to Europe I found the Channel steamers almost exactly what I remembered them in my youth—improved, no doubt, in speed, but in nothing else worth mentioning. The same cockle-shell tossing about, the same pitiless deck exposure, the same fetid cabin atmosphere, the same utter absence of special accommodation fit for those willing to pay for it, the same disgusting filth and brutal disregard of the commonest decencies; and all these evils in kind, far from having undergone mitigation in degree, absolutely aggravated by the crowding of passengers, baggage, and goods, which the railway system has, since I was a boy, poured into these vile floating receptacles.

I should qualify the very strong expressions I have here used by acknowledging that some little effort has recently been made to improve existing Channel steamers. In the autumn, the Albert Edward, belonging to the South Eastern Railway Company, had a little awning spread over the deck, which is, so far as it goes, an improvement, but it is very slight.

It is, perhaps, known to many of the audience that a committee of this Society, of which our gallant chairman is a member, has been for some time accumulating evidence on the subject of the Channel passage, which has been published in the *Journal* of the Society. While this evidence exhibits much diversity of opinion on the numerous remedial measures proposed, nothing is more striking than the general consent of impartial witnesses as to the main cause that has retarded improvement—namely, the refusal of the railway companies to consider anything but the question of dividends—and to reject any scheme for substantially increasing the comfort of the public, to whom they owe their privileges and very existence, if it threatened any immediate expenditure, however great the prospective gain by increasing passenger traffic, might promise to be. I do not intend to dwell on this unquestionable fact. But, speaking on the Channel passage, it is not out of place that I should record, in connection with it, one of the numerous instances in which our gigantic private railway monopolies have signally failed to fulfil their obligations to the public—failures which, affecting safety to life as well as comfort and convenience—have now produced a strong body of opinion favourable to the transfer of railways to the State. I shall merely add, that for the contrivances for improving the Channel passage, forming the subject of this paper, we are indebted, I believe, solely to private enterprise and individual invention, and in no degree whatever to the initiative or encouragement of the various railway companies who have so long supinely permitted us to suffer such grievous misery.

A few introductory words on the subject of sea-sickness seem necessary in order to estimate properly the various expedients by which it is proposed to mitigate or prevent it. I am not a physiologist, and shall, therefore, not presume to dogmatise on a malady the causes of which are, I believe, to some extent in dispute amongst physiologists themselves. A distinguished surgeon, whose opinion I recently consulted for the purpose of this paper, told me that he believed the main cause to be the forcing back of the blood upon the cerebellum, that part of the brain in immediate connection with the spinal column, through which the abnormal disturbance was communicated to the stomach and other organs. My learned friend did not adopt the more popular explanation that the mechanical pressure of the diaphragm was the chief cause of sea-sickness, and he gave me his reasons for holding the above views, which I fear to repeat, lest, in my ignorance, I should misstate them. The brain theory, as I may call it, certainly seems supported by the fact of the well-known intense mental prostration and distress which is a peculiar feature of sea-sickness. Others attach some importance to optical causes, and believe that the sight of swinging objects in motion helps to aggregate, if not to produce, the malady. I once tried an experiment, which, from its bearing on this supposed cause, I may briefly describe.

Some years ago I was about to cross, in an open boat, the harbour of Kurrachee, in Scinde, to Manora-point, on which the lighthouse stands. A lady who was of the party announced that she should be sick directly the boat was pushed off. I suddenly remembered, in this emergency, having read of a mode of preventing sea-sickness, which, although I felt no faith in it, I thought worth trying. It consisted in giving the lady a tumbler nearly full of water, which she was to keep steady so as to spill none of its contents. She followed my instructions, and at the end of our passage, which only occupied a few minutes, she declared that for the first time in her life, under similar circumstances, she had experienced no uneasiness whatever. The explanation is probably that of illusion caused by the quiescence in the tumbler of water. Though such an illusion can hardly be expected to be of long duration, even if the experiment could be continued, it yet seems to indicate that any means which can be adopted to cheat the mind into thinking that the ship is not in motion may be serviceable.

But, whether the disturbance of the victim be of a functional, mechanical, or mental kind, or of all combined, no doubt can exist that as a whole it is caused mainly and primarily by the motions of the vessel. Let us, therefore, consider what these motions are. They are principally of two kinds — angular and rectilinear. The angular motions are :—1. Pitching. 2. Rolling. 3. Horizontal or azimuthal swaying.

The rectilinear motions are :—4. The longitudinal advance of the ship on her course. 5. Lateral drifting. 6. Upward and downward motion of translation.

Besides these motions there are others affecting, not the ship as a whole, but her structure. Such as, 7, Temporary vibration caused by the concussion of waves, and 8, Continuous tremor caused by the working of her engines—if a steamer.

We shall be able at once to eliminate several of these motions, and so materially reduce the number that have to be counteracted.

No. 4, The longitudinal advance of the ship, may be set aside first, because if we are to get across the Channel at all we cannot dispense with it; and, secondly, because our experience of it in land travelling proves that it has nothing to do with causing sickness. No. 5, Lateral drifting, being a motion precisely the same in kind, though much less in degree, can have still less to do with the matter. In an omnibus, for instance, we are subjected to this lateral motion without bad effect. No. 3, Horizontal or azimuthal swaying, must produce the same effect as No. 5, Lateral drifting—that is, no effect at all.

Leaving the effects of Nos. 7 and 8, Vibration and Tremor, respectively, to be considered at a later period, we come now to No. 6, Upward and downward motion of translation, which requires careful consideration. The usual definition of motion of translation is that it is the motion of a body advancing continuously or oscillating backwards and forwards in a direction parallel to itself. The solar system, though composed of planets rotating on their respective axes, and revolving in nearly circular orbits, has also a bodily progressive motion in space sensibly rectilinear in direction. This bodily movement, which is quite distinct from the others—is a motion of translation. The piston of a fixed steam-engine has a vertical motion of translation upwards and downwards within the cylinder. In this case there is no other motion to complicate or mask that of translation. An example of rectilinear motion of translation, combined with angular motion, is afforded by the piston of steam-engines with oscillating cylinders, such as are generally employed for marine purposes, and to be seen in all the penny steamers plying on the Thames. In this we have the motion of translation of the piston up and down in the cylinder, as in the fixed engine, but its inclination with respect to the horizon is, at the same time, constantly varying with the oscillation of the cylinder along which it moves. Bring the angular oscillation of the cylinder to a standstill, and we have only the rectilinear motion left, as in the fixed engine.

In a ship we have the same movements as in an oscillating engine cylinder—the varying angular inclination caused by pitching or rolling, whichever we may be considering, and the rectilinear translation caused by the heaving of the waves up and down vertically. This may, perhaps, be even more clearly illustrated by means of the beam of a Cornish pumping-engine. As always made, the beam possesses longitudinal angular motion only, analogous to the pitching of a ship. But let us imagine the centre or point on which the beam turns to be placed at the top of a piston-rod working up and down vertically in a cylinder. This would give to the beam translatory motion in addition to the angular motion. Further, let us suppose the centre or joint, instead of acting in one plane only, to have a rocking motion at right angles to the length of the beam, then that would represent the rolling of the ship, and we should thus have all three motions—pitching, rolling, and translation, acting on one and the same beam, simultaneously, as in a ship.

No proposal has yet been made for getting rid of the vertical translatory motions of ships, nor is it conceivable how this can be done. I have, however, dwelt upon it, because much confusion of thought exists regarding this particular motion, as to which I may have more to say presently.

We have now reduced the motions to which a ship, as a whole, is subject, to two of our list, namely, No. 1, Pitching, and No. 2, Rolling. I shall now proceed to examine the various projects which have been made public for reducing or preventing these two motions. Of all the projects now before the public none attempt to deal with more than the two motions.

I believe one of the first in order of time is that of Mr. Sedley, a model of which is now before you. The basis of Mr. Sedley's construction is identical with that of Captain Dicey; and as I understand these two inventors, instead of opposing each other, have judiciously entered into alliance, I shall presently consider them together. Another plan was put forward by Mr. Mackie some time ago. I made a cursory examination of his model, exhibited at one of the soirées of the President of the Royal Society. The impression left on my mind being rather vague, I expressed a wish to make a comparative examination of Mr. Mackie's and Captain Dicey's model in these rooms, side by side, before writing my present paper. But this was not agreeable to Mr. Mackie, and I am still a good deal in the dark about his ship, and cannot safely attempt a description of it. This is, however, at present of the less importance that no steps have yet, I understand, been taken to bring his principles to the test of commercial application. I believe, however, that Mr. Mackie proposes to reduce the motions of the ship more by her dimensions than by any special peculiarity of form; and we all know the influence of size in this matter, other things being equal.

I now come to the Sedley-Dicey ship. She also is to be much larger than the present Channel ships. The dimensions given by Captain Dicey* are 400 feet length, and, as I understand him, 75 feet beam over all. Possibly these figures have since been modified, but it is more with the principle than the size, though that is important, that I am at present immediately concerned. The principle is avowedly borrowed from the native boats to be found at Ceylon and on the western coast of India. These have two long beams fastened firmly athwart ships, and projecting many feet on one side. To the extreme external ends of these beams is fastened a log of wood or outrigger parallel to the boat. When the wind is on the outrigger side, this beam, acting as a counterpoise at the end of a long lever, prevents the boat being capsized on the opposite side. When the wind is on the boat side, the outrigger acts as a supporting or resisting float, and prevents the boat capsizing towards it. These boats are well known for their safety in a sea which without the outrigger would swamp them, and they are said to have much less rolling motion than ordinary boats of even much larger size. They carry a very wide spread of canvas.

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* *Journal of the Society of Arts*, 8th March, 1872.

Captain Dicey's arrangements for carrying out this principle on a large scale may be thus described: Let us imagine a ship 400 feet long, and 40 feet beam, divided right through from end to end in the direction of her length, and let us suppose the interior sides of the two halves thus exposed and open to be covered in with wood or iron; these interior sides of the two halves would then be quite flat, and their exterior sides would be of the original form of the ship. Now let the two halves be separated until the two interior sides are 35 feet apart from end to end. Next let a continuous bridge of iron girders be made to span and firmly connect these two halves. We should thus have obtained an area for deck and saloon and cabin accommodation 400 feet long, and 75 feet across at its widest part. The engines are to be amidships, and the paddles, two in number, are to work in the space between the two half-ships. You will observe that Mr. Sedley's model, now before you, resembles what I have briefly described, except with regard to the paddles, which he places outside the half-ships. This, of course, gives him less space for entering harbours. Which position of the paddles is best for speed, is a question, I believe, still to be decided. Captain Dicey proposes to have rudders at either extremity of both half-ships, to obviate the necessity for turning in harbour, which would, in some cases, be impossible with such long ships. The pair of rudders in actual use, will, of course be geared together. Capt. Dicey estimates the draught of water of a ship of the foregoing dimensions to be only 6 feet, which will admit of her entering existing harbours on both sides of the Channel.

It is evident that Capt. Dicey aims at mitigating only two motions to which ships are subject, namely, pitching, by great length and possibly peculiar form of bow; and rolling, by abnormal extent of beam. The motion of translation, whatever it may amount to, will be of the whole amount due to a ship of the intended size and immersion. Capt. Dicey's plan may, therefore, be described as aiming at its object by means of external form only.

I come now to Mr. Bessemer's plan for diminishing a ship's motion. This constitutes as great a departure from ordinary usage as Capt. Dicey's, and is probably even more original. The ship, which is the design of Mr. E. J. Reed, C.B., late Chief Constructor to the Navy, is to be 350 feet long, with a beam of 45 feet, and she is estimated to draw 7 ft. 6 in. of water, which is the same as the draught of existing Channel steamers. The two chief aims of her external form are high speed and diminished pitching. As to the first, I need only say that there is nothing to prevent the concentration of every known expedient, so far as form is concerned, for attaining this object. It is intended to reduce pitching to a minimum by giving to the bows a form such as will cause the ship rather to cleave through the waves than rise to them or over them.

It is for the diminution of rolling that Mr. Bessemer, like Captain Dicey, has introduced novel arrangements. Mr. Bessemer's suspended saloon has already been very frequently described, but my paper would be incomplete if it did not explain the main features of this remarkable invention.

The saloon, for a ship of the size I have mentioned, will be 70 long, 35 feet wide, and 20 feet high. It will be placed in the middle of the ship. Instead of being an immoveable section of the ship it will be a distinct structure, supported at its two ends by cylindrical pivots, resting on supports firmly connected with the body of the ship, the line joining the two pivots being parallel to the ship's keel. These pivots being placed a little above the centre of gravity of the whole mass, the saloon will be free to adjust itself to the horizontal position, however much the ship may lean over. So far there is no novelty of principle, though perhaps this is the largest structure ever so suspended. The hammock and swinging cot are on the same principle. And such a suspension would entirely fulfil its purpose but for three disturbing influences—namely, 1. The action of the wind on the outside of the saloon. 2. The shifting about of the weight of the large number of passengers it will accommodate; and, 3. The effect of the ship's own movements.

The first two disturbing causes are too obvious to require more than naming. The third needs some explanation. A box chronometer and a binnacle compass are suspended in a manner even more complete than, but still similar to, Mr. Bessemer's saloon. If we place a binnacle compass in its box on the table, and gently tilt the box, we shall find that the compass preserves perfectly its horizontal position. If we now walk quickly with the box about the room, or wave it to and fro, tilting it at the same time, we shall find that although the compass preserves generally its horizontality, yet it is never quite quiescent, but sways backwards and forwards, to an extent less than the tilting perhaps, but still quite appreciable, and varying with the suddenness and velocity with which we wave or carry about the box. This arises from the inertia of the suspended compass preventing its at once adapting itself to the rapidly-changed position of the point of suspension. It first lags behind its true position, and then is carried by its own momentum beyond it. In this way swaying motions are communicated to the compass, known as secondary oscillations. Any suspended body is subject to the same phenomenon—amongst others, the pendulums of large clocks, which, if not suspended from a very firm support, will have secondary oscillations very destructive to accurate time-keeping.

Sir John Herschel endeavoured to counteract this motion in the case of a swinging cot by introducing certain arrangements. His invention, described in the *Journal* of this Society, displays the ability you might expect from a man of his genius, and no doubt it is very fairly effective in the case of a cot, and diminishes the swaying motion. But it would not be applicable to so large a structure as a saloon, nor will it fulfil the intention as fully as Mr. Bessemer's invention pretends to do.

The peculiarity in Mr. Bessemer's suspension, which distinguishes it from all others, consists in appliances for controlling the three disturbing agencies I have mentioned, whilst giving the suspended body entire freedom to assume a generally horizontal position. There are many modes of doing this which might be more or less effectual. Ropes passing over pulleys and worked by windlasses by manual power, or lateral pressure-screws, might be applied with some effect. The plan adopted by Mr. Bessemer differs entirely from these. It would occupy too much of my space to describe it in detail—nor could I expect to make all its parts intelligible without a number of drawings and models, such as could not be studied with advantage by a public meeting. The following general account, furnished by the designer, and quoted in an able article, by Mr. Merrifield, in the January number of the *Popular Journal of Science*, may suffice for present purposes:—"A toothed sector, of large diameter, is secured to the main central axis of the saloon structure, and beneath it is a strong bed-plate firmly attached to the floor of the ship. On this bed-plate are two hydraulic cylinders, to which a double-ended ram is fitted, the central part of the ram being provided with teeth, which gear into the sector. Therefore, when the ship is in a state of rest, the sliding in and out of the rams will cause the saloon to move on its own axis with a gentle but powerful motion. These movements, however, are controlled by a pair of delicately-balanced equilibrium valves. Hence it will be seen that when the ship is rolling at sea, this power of acting on the saloon enables the steersman to retain the saloon constantly in a perfectly vertical position, while the floor of the ship is rising and falling beneath it. The essential point of this arrangement is that the hydraulic apparatus has not to put the saloon in motion, but simply to prevent it acquiring any motion. Moreover, the *vis inertiæ* of a structure like the saloon, which will weigh some seventy or eighty tons, will greatly assist in resisting the initial tendency to motion."

The appellation of "steersman" given by Mr. Bessemer to the man who operates on the hydraulic valves, is not happily chosen, and has led some persons, to my knowledge, to imagine that the hydraulic apparatus is in some way connected with the steering of the ship. The man in question, however styled, stands, in Mr. Bessemer's working model, in a well, formed in the centre of the saloon, grasping a long horizontal lever which acts on the valves. In front of him is a spirit-level, sufficiently delicate to indicate any tendency in the floor of the saloon, to which it is fixed, to depart from the horizontal position. Keeping his eye on the level, he instantaneously checks any such tendency by giving a slight motion to the lever one way or the other, according to the indications of the level. In Mr. Bessemer's comparatively small working model the shifting of the weight of two heavy men from one side to the other would, if the saloon were devoid of controlling apparatus, certainly disturb its equilibrium, but I found that the man at the level had perfect control over that amount of disturbing cause.

Mr. Bessemer claims for this apparatus, and I believe justly, a quickness of action, smoothness, and facility of manipulation, combined with power, superior to any other agency now known. He has, moreover, long employed the same principle on a large scale for other purposes connected with the steel manufacture, and has, therefore, that confidence in its efficiency which experience alone can give.

Mr. Bessemer's ship is to be propelled by two distinct engines, outside the ends of the saloon, and each driving a pair of paddles, the centres of which will be 106 feet apart.

Two of the disturbing effects to which ships are liable, enumerated in the early part of my paper, may now be referred to, namely, No. 7, "Temporary vibrations caused by the concussion of waves," and No. 8, "Continuous tremor caused by the working of the engines." Mr. Bessemer's arrangement seems well calculated to reduce to a minimum these two effects, both of them distressing, the first to the timid, the second to the sick, whose sufferings are generally believed to be aggravated by the incessant trembling of a powerful steamer. The suspensory supports of the saloon will be furnished with thick beds of india-rubber, which will deaden tremor; and a space of five feet all round between the saloon and the ship will prevent the wave shocks against her sides from being felt by the isolated passengers.

I must now once more advert to the motion of translation of ships. It is evident that none of the projects I have described have any direct tendency to diminish this motion in the slightest degree. The question is, what does this motion, separated from all others, amount to? We are singularly in the dark here. Every one speaks of the malign influence of the "up and down motion" of a ship at sea. In the discussion on a paper read by me on the 27th ult., at the Royal United Service Institution*, no clear apprehension of this motion seemed to exist even on the part of the scientific naval officers who spoke. This troublesome translatory motion seems doomed to be confounded with pitching; and whether or not it affects the bodily comfort of those exposed to it, it seems certainly to obfuscate the mental powers of most people who write and speak about it.

They are apt to forget that the up-and-down motion so much and justly complained of, is largely due to the angular pitching and rolling. For, to revert to the illustration of the beam of a fixed steam-engine, the piston-rod is seen to rise and fall vertically under the influence of the angular pitching, so to speak, of the beam, and yet there is no translatory motion here.

I have not met with any investigation of the amount of the translatory motions of ships, nor do

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* On a proposal to mount heavy naval guns on the principle of the Bessemer saloon.

I believe that any exact observations upon it have been made, the difficulty of eliminating all angular motion in a floating body standing probably in the way of such observations. But any one may notice that a small light floating body, such as a cork, will be raised and lowered vertically to the whole extent of the ripple on which it is borne, the motion of translation being exactly equal to the height of the ripple or wave, whereas a large ship in the same water will not be moved perceptibly. This clearly indicates that the extent of the motion in question depends on the relation of the height of the wave to the size, weight, and immersion of the body exposed to its action. In the case of a large ship, the fraction of the wave height through which she will be raised bodily will probably be very small. Mr. Merrifield, in the article I have before alluded to, estimates that, in the case of Mr. Bessemer's ship, the motion of translation may amount to five or six feet. He does not, however, give the data on which this estimate is founded. When it is remembered that in the Channel, ships are exposed more to chopping cross seas than to large regular waves, such as those met with in the open ocean, I am inclined to think the estimate an extreme one in the case of the Channel ships we are considering.

With reference to that, I may just mention that the height of the great Atlantic waves was measured with great care, years ago, by Dr. Scoresby, and he gives their mean height to be—as well as as I can remember, speaking from recollection—28 feet. That is a very extreme case in the ocean where waves attain their maximum height. Now, I doubt very much if Channel waves ever attain half that height. They always appear to be very much higher than they really are, but nothing is more deceptive. Its impetuosity rather tends to create the illusion of height, just as a fleet racehorse always looks larger in galloping than when standing still. Now, if Channel waves are never more than 14 feet in height, I should very much doubt whether the larger ship would rise or fall six feet. However, that is mere conjecture.

It is only right I should mention, before leaving Mr. Bessemer's ship, that although in the first specimens to be built he only proposes to control the rolling motion, he expressly states that his invention can be extended to control the pitching also. I have seen his fully detailed drawings for this more complete arrangement, which, if carried into practice, would, by eliminating both angular motions, enable us to measure with some certainty the amount of the vexed and vexing rectilinear translatory motion.

It need hardly be said that both Captain Dicey and Mr. Bessemer seem fully alive to the necessity for providing the thorough ventilation, protection from weather, and commodious accommodation which their large ships are so well suited to afford.

I may here allude to another proposal for crossing the Channel, which was laid before the public in this room, under the auspices of the Institution of Naval Architects, by the famous engineer, Mr. Scott Russell. Everybody who was present must remember the lucid and also very entertaining way in which he described his plan, which consisted in having large ships, without any peculiarity of form but such as would make them good sea-boats—large ships capable of having a train on board—so large that no existing harbour would have accommodated them. He proposed to create a harbour, or, as he expressed it, make an island some distance off shore, about a mile, I think. It was a circular island, with the centre scooped out, and an entrance to it, and this scooped-out portion of the island was to be large enough to receive his ships. There was to be a viaduct to connect the island harbour with the shore. His ships were to run into the circular harbour, land their passengers and goods on the edge of the island, and they were then to be conveyed by train to the Continent. That was, substantially, I think, his scheme, and no doubt it offered great advantages. But it is some time since it was promulgated here, and I have not heard anything of it since, and whether it is to be carried into effect, I know not.

It is difficult to institute a comparison between two arrangements differing so completely in principle as Capt. Dicey's and Mr. Bessemer's. And I think, perhaps, it will be best to leave their relative merits and demerits to be brought out by the discussion for which I have endeavoured, as impartially as possible, to provide the material. I may, however, help to give useful direction to the discussion by naming some points in each of the new ships, regarding which differences of opinion have been publicly expressed.

In Capt. Dicey's ships, it is apprehended that the narrow passage in which the paddles work will permit free way to the water, and that high speed will therefore not be attainable. I have heard that experiments have been made on this point, and perhaps those who have made them may be present to tell us with what result. Another objection is that the Dicey ship has four instead of two wetted sides, and that the additional water friction thus generated will also retard her. I, however, expect to hear that this retardation will be overcome by additional engine power. A third objection, insisted on very forcibly by Mr. Reed, in the *Times*, is that the connecting bridge will be subject to great and perhaps dangerous strains. No doubt the strains will be far greater and of a much worse kind than those of ordinary ships, and I must confess that I should not like to cross the Atlantic in her in a gale of wind until her character was well-established. But a contrivance must be judged by its avowed object, and the twin-ship is not intended for the Atlantic but the Channel, where very high seas do not occur.

As to Mr. Bessemer's ship, the main objection deserving of notice is that, one pair of paddles being in the wash of the other, her speed will not be what is expected. It is, however, certain that her two engines and four paddles combined will give greater speed than one engine and two paddles of the same power. The question is, how much gain will there be, or, in other words, is the gain economically obtained, or would a single engine of greater power give the same speed at a lower cost. It is also but fair to point out that only the occupants of the saloon will enjoy the whole benefit of Mr. Bessemer's suspension. I conclude that they will have to pay for the privilege, and that those in the unsuspended part of the ship will pay less. The question is, therefore, a commercial one, which experience alone can solve.

I will conclude by expressing my conviction that both ships will secure an amount of comfort in Channel-crossing hitherto undreamt of, and my hope that both inventors will reap the substantial and honourable reward of which their labours in so good a cause are fully deserving.

DISCUSSION.

The **Chairman** asked the inventors of the various schemes to come forward and give the meeting a description of their plans. He hoped each inventor would confine himself strictly to an account of his own invention.

Mr. S. J. Mackie, in responding to the invitation of the chairman to describe the model of his ship, said that he was very glad to comply with the request, and should confine his remarks simply to his own plan. He did not allow his model to come here to be compared. It was utterly impossible to compare unlike things. Every invention should stand on its own merits. The lecturer had said that no steps had yet been taken to place his plan before the world. That was incorrect. Negotiations were in progress, and when it did come before the public he felt it would be alike satisfactory to the world at large and to those who supported it. His attention had long been directed to this subject; and he had seen every vessel used for the Channel passage, from the old *Rob Roy* to the *Albert Edward*, which was the last improvement. He had for a long time been studying both the requirements of ships and passengers, and his earnest endeavour had been, since he patented his plan in 1869, at all cost, at all amount of industry, and with all his ability, to bring it to perfection. In 1869, when big ships and big harbours were before the world, he said, when this Society had an investigation into the matter, and an exhibition of models with the view of improving vessels on such service, he felt he could design a vessel which should do as much between existing harbours as big ships with new harbours. Magnitude was one element that he deemed essential to success. It was absolutely essential that a vessel should be what it was required to be for the Channel passage, namely, safe, steady, and speedy. We must begin with certain dimensions, proportionate to the waves she would have to encounter; she must be long enough to take her bearing upon three, and on no occasion to be off the bearing of two waves. She should not be made thoroughly steady in the direction of her length only, but in her beam also. Hence he was bold enough to make the attempt to design a vessel broad enough always in any weather to take her bearing upon two waves, because he considered if a vessel be short of the size of the wave that she would incline with the incline of the wave, and would not be a steady vessel, whereas if the vessel got a steady grip upon two waves then the roll would be limited to the amount of difference between the two inclines. Another point was that a vessel, to go between existing harbours, ought not to be a tidal-service ship, but, if possible, or as closely as possible, should be a time-service ship, going at the same hour of the day all the year round, except at low spring tides, when the water was unusually low, and for that provision might either be made or ignored. Now, to get length and breadth upon a shallow draught, not exceeding a draught of 6 feet 6, in a ship as broad as 80 or 90 feet, it was needful to construct a ship, not on the ordinary plan, where strength consists in the skin of the ship, which is kept open by transverse girders, but on a special plan. The smallest amount of material which may be put in the strongest form is the box girder, and he determined to use the tubular bridge system, making it a combined one. Hence he started to build his ship with a double bottom. He took a flat, or nearly flat, bottom, rising slightly towards the centre, as a solid platform on which to build. Upon that he could put any form of hull he liked, but he chose to take one as nearly approaching to a rectangle as he could, because that form gave him the greatest amount of buoyancy. He then determined to make the saloon an integral part of the ship, because in making it so, he could make it as two superposed box girders, which would give his ship great strength. He took the space below deck for the whole of the middle hull for boilers and engines, and he had two outside hulls in the vessel, in which he could put cargo and baggage. He had thus considered the working of the ship, the baggage, and cargo. The passengers he put in a saloon above deck, where they could get air, the saloon being of the utmost dimensions, and of the greatest comfort that he could possibly give to it. When he had such a ship as this, he found he had three difficulties to encounter. That, taking this ship as 90 feet, if he put to it two paddle-boxes of 15 feet, he had 90 feet plus 30, or 120 feet altogether; if he had to take such a vessel into a narrow-mouthed harbour, he should not like to do it. If he put screws, he would be working them in a depth of 6 feet 6 in., and if he adopted the turbine system he felt that was a very slippery affair for a big ship with a flat bottom. But there was a great deal to be done in this ship which did not occur in an ordinary ship, and it occurred to him why should he not put the paddles inside the ship and work them inside tubes, and so convert them into a species of centrifugal pumps, and he would get a power of propelling the ship according to the velocity he could impart to the currents. He could thus put in two extra girders to form the tubes or water passages, and this way give the easiest means for the water to get in and get away, and the result came to this, that he could, at the same time, increase the dimensions of his saloon. The places all round his saloon he could convert into private cabins, some 12 or 14 feet square, and furnish with every comfort, keeping the interior of the saloon as a grand promenade, and yet gain, in the matter of propulsion, very great advantages. It had been argued against his system that he had an extra friction upon the sides of these tubes. He knew he could not pass the water without an amount of friction, but he knew also that the friction of one plane surface over another was friction of the smallest amount in its character. If then he got any gain upon that which was the most serious resistance that a vessel had to encounter, namely, the head resistance, then, he contended, he got an advantage for his ship. If you take a vessel 90 feet wide, it was clear that the water would have to be driven off 45 feet on each side. If he inserted tubes on each side it was quite clear that those tubes would relieve the bow wave. He had a right, therefore, to deduct the loss from the gain, and to claim the balance of gain in favour of his ship. As to the mode of propulsion, he was aware he laboured under many difficulties. It was a common practice to estimate forces by known rules which are in ordinary practice, but as the water passing through the tubes is water in motion, that water was under a different condition to what they had in solid water outside a ship. This mode of construction had, therefore, given him a new mode of propulsion, and the perfecting that new mode, he believed, would be one of the successes of the boat. But there was another gain which his system gave. The larger the Channel ships were made, and the faster they were driven, the more need was there to provide against danger and collision, and the system of construction he had adopted had resulted in greater safety. The girders were strong enough to support the vessel as a tubular bridge. As long as the inner one remained intact, although you might fill the other compartments of the vessel, the middle compartment was enough to float the ship. If the vessel were run into, she might be cut into abeam 25 feet in depth, and that would not stop her on her voyage. The vessel, the model of which was on the table, was designed to be propelled with four paddles, originally he had put six. In working the vessel with multiple paddles you had altogether a different system to deal with. The water here is confined, and whether you work the four or six simultaneously, and drive it out at the end, or drive it out by paddles at accelerated speeds, the result comes to the same. By deflecting the currents of water you have the strongest and most forcible steering power that can be put to any vessel. The system of vessel can be made ocean-going so as to cross the Atlantic or Pacific, and it can be made capable of carrying the most powerful batteries ever carried in any ship, and of resisting the attacks of torpedoes. It could also be made use of for fishing vessels, and the absence of wash would make it most useful for canal purposes. The dimensions of the proposed Channel vessel were 400 feet in length, 80 in beam, 6 feet 6 in. draught; the paddles were 24 feet in diameter. He would desire to say, however, that upon the question of details, and with regard to the propulsion, he could not go into these details as freely as he would, as the vessel was not yet fully before the public.

Mr. R. Rawlinson asked whether Mr. Mackie meant it to be understood that the water driven out by the force of the paddles would propel the ship as a rocket was propelled.

Mr. Mackie replied that the vessel would be a sort of double-water rocket, if he might use the term.

Mr. Bessemer said that in reference to the plan which he had lately brought out, he would like to mention the fact that about twelve years ago his attention was first attracted to the question. At that time the plan he had in view differed very considerably from that he recently brought forward. Originally he had hoped to make a vessel steady on the ocean, simply from her peculiar construction. After a full consideration of the plan, as it then occurred, he saw what he believed an insuperable difficulty to achieving that object with success. The difficulty was this, that if he could succeed in so forming a vessel that would lie upon the water as quietly as a railway train upon the rails, simply moving forward, she would be very much like a pier or breakwater, that the motion of the waves would dash against with an impetuosity that would destroy her; and this resisting power to motion on the water would cause water to leap up as it does upon a sea wall, which offers a steady and solid resistance to a moving object. That idea, therefore, was entirely given up, and it was not until his passage from Paris, in July, 1867, in which he suffered very severely, indeed in which his life was afterwards despaired of, in consequence of a severe attack of sea-sickness, which did not leave him until twenty-two hours after he was on shore —it was not until then that he became most desirous of being able to alleviate for the future the sufferings occasioned to so many by the Channel passage. The first step that he made was one of simple suspension, and when he used the word suspension he was afraid it was one of those terms which admit of more than one construction, and, indeed, have been very imperfectly understood. One scarcely says that the beam of a steam engine, supported on an axis, is suspended, although it may be truly so. He soon found that this simple suspension was subject to two or three drawbacks, so important as to require a means of checking them. Whenever a pendulous body has its centre of motion moved laterally, the pendulum will naturally move backward and forward in consequence. Now there is no such absolute fixed centre in the ship that that centre must be said to move backward and forward; the result would be naturally a motion of the saloon on this suspended point, in consequence of this centre moving from side to side. Then comes the impossibility of having a large saloon with passengers equally poised on both sides; if this were possible for one moment, it would cease to be so the next. That is also a reason why simple suspension would never be effective. Again, if the saloon projects, as it is desirable that it might, to many feet above the surface of the deck, the action of the wind would be very powerful upon it. A saloon exhibiting to the wind a surface of 70 ft. by 7 or 8, with a strong breeze blowing, of 15 to 20 lbs. to the square foot, would have a pressure of some three tons upon it; that would produce oscillation when the wind ceased, and the saloon would react again. It became evident that some means must be obtained of correcting this tendency, and also that the amount of force required to do so would be very considerable. It would be quite possible that the saloon might be some 6 or 7 tons out of balance by the leaning of the passengers over the side of the ship to look at a passing vessel, or that a strong wind might give three tons pressure in the same direction. Hence, at least, ten tons of force would be requisite to counteract it. Now, in order to do so, he employed a hydraulic apparatus, which consisted in attaching to the axis on which the saloon was supported, a quadrant with teeth upon it, gearing into a rack, the ends of which are made into two ordinary hydraulic rams. When these are worked, an amount of force is brought to bear upon either end of these rams, varying from 20 to 30 tons. There he had an amount of controlling force greater than these accidental circumstances could bring upon the saloon. There were very few cases in which forces so varied were required as in this case, where a very slight motion of the vessel would cause it to roll over on one side. In governing these very irregular motions some apparatus was required capable of instantaneous adjustment, and of diminishing at once the large amount of force required, or applying the more gentle force as the case might be. Immense facility for doing that was afforded by the use of an equilibrum valve, so easily moved that it could be opened or shut to an extent that would allow the water pressure to act. There is no violent effort on the part of the man who directs the level position of the floor. The kind of valve that he had employed would be rather tedious to describe, but while it would admit the largest amount of water, to give 20 or 30 tons pressure in a second of time, it could be easily moved so as to give half a ton only if necessary, so that it was capable of absolute adjustment as the case needed. The man who operates has in front of him a curved spirit-level; the bubble is visible and close before his eyes, and as the tendency of the saloon might be to move in either direction, the slightest motion of this bubble is observable to him, and when an opposite motion of the bubble is observed, he checks its motion and brings it back again to the centre, by which he knows the horizontality of the cabins floor is maintained. In that way, in his small model saloon, only capable of holding eight or ten persons, the controller had been able for three hours at a time to maintain the level without the smallest difficulty, while the vessel was rolling at an angle of 14 deg. each way, so that under no condition did it differ over one degree, and generally from one-third to half a degree is all the deviation. With reference to the many motions that we are all subject to on board ship, there were few persons, except those well acquainted with the subject, who would not be surprised to know from how very few primary motions the whole of these more complicated motions were derived. Those who were acquainted with what was known to turners as the oval "chuck" would very well know that two motions at right angles to each other will describe in what is known as rose-engine-turning, an immense variety of curves, and an almost endless intricacy of lines crossing each other. If we reflect on what has been done already by the movement of two cross lines by Jacob Perkins, so long gone from us, but whose work will ever remain with us, we shall see this. If we look at the back of an American bank-note, we shall see an infinite number of beautiful curves, all intersecting each other, and we should be surprised to learn that every one of these numerous curves can be and are given by the simple passage of two slides at right angles to each other. The old-fashioned pentagraph consisted of two slides at right angles. A tracer was placed on one, and a map, or anything else on the opposite side, and with that implement you could describe the most intricate forms known, not a series of lines described on a plane surface, but you could produce it on that instrument. Now, he likened that instrument very much to the two motions of a vessel, since it is certain that every form that can be described by any portion of a ship at sea, can be delineated by those two simple motions when combined. The first or pitching motion may be likened to the vertical slide, and the rolling motion is equivalent to the cross slide, and these in combination, not keeping time with the number of vibrations in a minute, and neither of them travelling at equal distance. The result is that they resolve themselves into spirals or screws. The bowsprit of a vessel will describe in any variety of curves that are known. But, taking this instrument again, suppose we take the cross slide from it. Now, what we have remaining is the one motion only; that instrument so capable of describing every variety is now reduced to this, that it can make an up and down line [describing]—a single straight line is all it can produce when deprived of one of its elements. From that he reasoned, if we have a ship with this pitching motion retained, and if we could take the whole of the rolling motion out of the ship, we should have what had been done with the pentagraph when taking away the cross slide, and then all the power of combining these cross motions with the up-and-down motion would cease. Therefore, all that is necessary is to counteract these two motions—the pitching and rolling motion of a vessel—which might be done by two separate movements, that was by applying a pair of axes at right angles. In the vessel designed by Mr. Reed for the Channel passage it was not thought advisable to do so, because in the Channel we had to deal with very short waves, and a vessel whose length was 350 feet, would ride on three waves at a time, and would not be capable of pitching to a very great extent. In order to lessen even that amount of pitching a low free board was needful. In approaching a wave in front of her, if her bows were as high as the rest of the vessel the large amount of floating power we should have would tend to make her leap across it or up over it, producing motion in the ship, but with this low free board she would plough the wave and carry part of the water upon her low free board, so that she could not rise so much for having a heavy weight of water resting upon it. Hence a considerable amount of reduction would take place in the pitching. He intended to employ an amount of engine power which would attain a speed of not less than 20 miles an hour. A vessel moving at that speed, would pitch less because she would sooner be on another support after leaving one. Hence he had three means of reducing the ordinary amount of the pitching of the vessel, but there was a fourth means, which still further counteracts that as far as the passengers were concerned. The engine-power was divided and placed fore and aft of the saloon. Hitherto it had been the custom to put the passengers towards each end of the vessel. In his vessel of 350 feet long, if he placed the chief saloon, which was 50 feet long, and which was therefore one-seventh of the length, in the centre as the vessel pitches and ascends, it is quite clear that each end of that compartment or saloon would only move one-seventh the distance the vessel moved. Hence, you not only reduce the amount of pitching, but you gained besides a reduction of that to one-seventh by the fact of their occupying the centre of the ship. Therefore, the actual amount of motion that would be given at the extreme end was so small as not to make it desirable to provide a double axis for a ship crossing the Channel, although for a ship intended for crossing the Atlantic it would be necessary to do so.

The meeting then adjourned till next Wednesday, when Mr. Dicey will continue the discussion.

INDIA COMMITTEE.

A conference took place on Friday, January 31st, Major-General Sir Henry Creswick Rawlinson in the chair. The paper read was:—

THE PROGRESS OF INDIA DURING THE LAST FOURTEEN YEARS.

By J. H. Stocqueler, Esq.

It has been observed by a sagacious writer that conquest has ever been the easiest and most frequent of man's achievements; the consolidation and administration of conquests the most difficult and least successful of his genius. It is common to man to recognise the destroying agencies of fire and sword, and to yield to the might of the stronger hand the possession and subjugation which make the law of conquest; but he will not so readily accept or acknowledge a legislation the principles of which conflict with the customs, laws, and religion of his race.

A very little reflection, and an appeal to the records of history, will establish the truth of the foregoing proposition. Illustrations of its force occur in the conquest of Britain by the Romans, of Mexico by the Spaniards, of Central Asia by the Greeks, of Greece by the Turks, of Poland by the Russians, and, in a more remarkable degree, of India by the Mahommedans, in the first instance, and by the English at a much later period. Seven hundred years after the invasion of Hindustan by the Moslems the Hindoos still struggled to maintain their religion and their lands; and for more than a century the English vainly strove to associate equitable dominion over the whole country with the supremacy of the sword. The Romans, the Greeks, the Spaniards, and the Saracens had a hard task in contending with one code of laws and one religion at variance with their own; the British rulers of India have had to do battle with a multitude of antagonistic creeds of vast antiquity—with the fierce fanaticism of the Mahommedan as well as the stubborn bigotry of the Hindu—with a system of laws devised for the subjection of the minds of men, as well as the control of their actions—and with usages which, sanctified by time, and tolerated by a narrow and crafty policy, had, though repugnant in themselves to humanity, justice, and common sense, acquired the force of law. The marvel, therefore, is not that the gigantic empire of India had not been entirely Anglicised when the *bouleversement* of 1857 suggested a change of policy, but that so much had been accomplished since the battle of Plassy, in 1757, towards the introduction of the science and civilisation of the West. From the first hour of their acquisition of territorial possession down to the last act of annexation, the British rulers have had at one and the same time to employ force of arms in wars of retaliation and "settle" provinces which had, at a comparatively recent date, fallen under their sway. The operations were so manifestly incompatible, though occurring at wide intervals of territory, that the extinct government of the East India Company may fairly be credited by the historian with a large share of the merit of paving the way for the operations of its successors.

The work of the past fourteen years must be viewed in detail before any general conclusions can be drawn as to its influence on the British *raj* of the future. It is not too much to say—but more cannot be fairly predicated—that the seed sown by the former rulers, or as much of it as remained intact after the fearful uprooting of 1857, is now fructifying to a remarkable and most gratifying extent.

After the re-adjustment of a large portion of the distracted provinces, and the establishment of greater security in the permanent employment of a considerable body of European troops, the Government appears to have directed its attention to the institution of a comprehensive system of education. Nothing could be accomplished during the eighteen months or more which were occupied in stamping out the Sepoy mutiny, but in 1859 a vigorous administration, deriving its power, its means, and its inspiration from an enlightened council in England, under a special Secretary of State, put a well-devised machinery of instruction in operation, and here we have the results:—

In 1859-60, a few hundred schools, and two or three colleges in Bengal, mustered but 40,733 pupils.

In the following official years the number increased;

1860-61	49,654
1861-62	52,895
1863-64	83,679
1864-65	103,114
1865-66	111,281
1866-67	134,640
1867-68	145,142
1868-69	171,709
1869-70	186,400
1870-71	215,000

The foregoing summary comprehends all classes of schools, those conducted exclusively under the auspices of government; private schools independent of assistance; schools aided by government grants; vernacular schools; colleges for the special education of youth in law, medicine, and civil engineering; and schools for the education of native females. The latter constitute a very interesting and novel feature in the scheme of education, and cannot fail to exercise, ultimately, a very material influence over the households and characters of the Hindus and Mahommedans. In 1859-60, there were but two such schools in Bengal, the pupils numbering only 367. In 1868-69 there were 240 girls' schools, and the returns showed a daily attendance of 9,035!

Education under the Madras government does not exhibit the same splendid results; but still the system has been progressive. There were 25,048 pupils in all the schools in the Presidency in 1860-61; but ten years later the number had quadrupled.

In Bombay, native education received its first impulse under the enlightened government of Mr. Elphinstone, earnestly followed up by that of Sir John Malcolm. No wonder, therefore, that the Presidency schools started in 1860 with 35,984 pupils. This number was augmented by 10,000 in each of the three successive years; but in 1865-66 it sprang from 65,802 to 94,002, and at the close of 1870 there were no fewer than 167,904 youths and girls receiving education.

Two years after the transfer of the government of India to the Crown, the colleges and schools in the North-West Provinces contained 153,000 pupils. At the end of the decade, dating from 1860, there were 8,524 government and other schools in existence, attended by 201,000 boys and 10,000 girls. Colleges had been established at Agra, Benares, and Bareilly, and were flourishing in 1864-65. But the general progress of the educational institutions in the North-West Provinces had neither been as marked nor as steady as the advance in other quarters, for famines, local disturbances, and the transfer of the management of an immense (the Saugor) district, had naturally caused fluctuations in the means of parents and the attendance of the children.

In the Central Provinces education has moved onwards in spite of the many disadvantages attending the endeavour to set the machinery in motion. Their boundary was scarcely defined until the Province of Nagpore had been united with the Saugor and Nerbudda districts. Down to May, 1862, no state education had been introduced, and the instruction of the people in the vernacular had been neglected by the native powers. Vigorous measures were at once adopted by the executive when affairs had become a little settled, but the business of education was so much interrupted by famine and disease that it was not until the close of the official year 1864-65 that the district officers had the courage to summarise the efforts that had been made to plant schools in the provinces. It was then found that there were 32,926 pupils attending, with more or less regularity, the normal, the town, the village, the indigenous, the missionary, and the female schools. From that starting point the increase has been manifest; each succeeding year exhibited an augmentation of twelve thousand pupils until 1869, when sickness and agricultural distress partially checked the progress of education. Still, in 1870, the number of youth of both sexes receiving instruction was 77,798, and from that period the augmentation has been satisfactorily renewed.

Sanguine men, whose wishes are the parents of their thoughts, may scarcely be satisfied with the general results of the exertions of the local government of the Central and North-West provinces. Let them, then, ponder the reply given by one of the chief men in a pergunnah to a Commissioner on a tour, who remonstrated with him on the paucity of pupils:—"Ah, Sahib, it seems small to you, but I look upon it as this out of nothing. I remember the time when we had to take a letter ten miles to get it read; now there is hardly a village in this pergunnah in which you will not find some one who is able to read."

In the foregoing summary of the results of the educational measures taken in the Bengal, Madras, and Bombay presidencies, the Central and North-West provinces, no mention has been made of the universities. The influence they have had in accelerating education, by exciting the ambition of young Hindus and Mahommedans, may be conceived. A sketch of their progress is not unnecessary in this place.

The University of Calcutta, modelled on the system of the London University, was established in 1857. Its operations were disturbed by the Sepoy mutiny. The code of bye-laws and regulations was revised in 1859-60, introducing changes in the entrance examinations, the effect of which was to raise the standard of English. For the entrance examination of December, 1859, there were 705 candidates; in December, 1860, the number rose to 809. More than one-half the number passed. From 25 to 40 youths went in for degrees, selecting law, physic, and civil engineering. It had been especially provided that the examinations should not include subjects connected with religious belief. Affiliated institutions were under the management of persons of every variety of religious persuasion, as in England. The candidates continued to increase in number until, in 1865-66, they had risen to 1,500. That number has been augmenting in a proportionate ratio ever since. In December last there were 500 candidates for the first arts examination, and 200 passed. Of the 2,144 for the entrance examinations, 938 were successful. The same result has attended the establishment of the Universities of Madras and Bombay. They date their existence from that of the institution of the Calcutta University. Every year the number of youths who present themselves for examination has increased, and if their means kept pace with their ambition, there is no doubt they would appear in greater force. But the anxiety of the poorer classes of students to obtain small Government appointments, as soon as possible, renders them indifferent to the attainment of more knowledge than will suffice for the accomplishment of that object.

The establishment of a Medical College at Calcutta, during the administration of Lord William Bentinck (in 1834), has fully realised the most sanguine expectations. Boldly throwing aside all religious prejudice and caste restraint, numerous Hindu and other youths took to the study of medicine and surgery, and the public service is now supplied with native professional ability of a very respectable order.

Down to the year 1859 comparatively little advance had been made in the education of the people in the Madras territory. The Madras Presidency had, for a long time previously, borne the sobriquet of "the benighted," owing to the apathetic indifference of the masses to all knowledge not immediately productive of pecuniary advantage. "The *cui bono* principle, in its narrowest form, was that which had most weight." Three university examinations took place in 1860, when 23 pupils matriculated. The Presidency College had then begun to make fair progress. The Medical College had been established, and was attended by 156 students; and there were, moreover, 56 students in the Primary Medical School. A civil engineering college had been established, and there were 214 pupils in a school of industrial arts. An impulse was given to education by the government of Fort St. George; the natives adopted it with alacrity, and we have seen that from 25,048 pupils at the close of 1860-61, the numbers had risen, in 1870, to 105,455.

The Bombay University held its first matriculation examinations 2nd October, 1859, when, out of 126 candidates, 21 passed. A second examination was held in March, 1860, when, out of 45 candidates, 14 from the government colleges passed. The candidates are now numbered by hundreds, and the matriculations are proportionately numerous. So popular had the university become, very soon after its establishment, that the Elphinstone College, the Grant Medical College, the Government Law School, and the Poonah College (nearly all of which had their origin under the rule of the East India Company), applied for affiliation. But the educational institutions of Western India did not stop short with those colleges and schools. A college was sanctioned for Ahmedabad; an Engineer and Mechanical school was opened at Poonah, and now supplies subordinates to the Public Works department, the Railway and Municipal committees. Mention may also be made of the central school of the Elphinstone Institution, "decidedly the best school in the Bombay Presidency," (it numbered 550 pupils twelve years ago), the Poonah College schools, and several of the schools in Guzerat. Nor should the philanthropic efforts of Sir David Sassoon and other native gentlemen be forgotten. All the educational establishments founded by their munificence have succeeded.

But whilst the utmost encouragement has been given to institutions where the English language has primary consideration, the Madrissa and Mahommedan colleges at Calcutta have prospered, and the Sanscrit College has not been neglected.

Turn we now to the progress that has been made in native education in those parts of the empire which, 25 years ago, were in open hostility to the British government, or stubbornly resisted all the friendly efforts of its powerful neighbours to introduce a better system of administration. A perfect triumph has been achieved in the Punjab and British Burmah, and satisfactory progress is to be recorded of Oude and Hydrabad. Down to the period of the annexation of the Punjab to the British possessions, learning of any kind was utterly derided by the Sikhs. Runjeet Singh himself held reading and writing in contempt, and is said to have kept his royal accounts by cutting notches in a stick. To induce an aristocracy, raised and fostered by such a chief, to appreciate the value of letters, was a task of no ordinary difficulty. The success of the enterprise must be classed amongst the noblest results of a sound diplomacy. Some concessions to the pride of the ignorant and bigoted chiefs were indispensable. Hence the pupils in the schools were separated into two classes, only one of which was filled by the sons of the "upper ten," who are eligible for the Governor-General's durbar.

No records are available of the number of pupils attending the schools in the Punjab previous to the mutiny, but it is stated that, in 1859-60, they exceeded by 12,000 the youths receiving education in the previous year. The quality of the instruction generally imparted was not however of a very high character, for it appears that in only two of the schools was the range of education sufficiently extensive to qualify students for the University examinations. And one of them was at Delhi (comprehended in the administration of the Punjab), and the other at Umritsir. As elsewhere, famine and the cost of provisions exercised a pernicious influence on the attendance of the pupils during 1860, but, nevertheless, the number stood, in March, 1861, at 38,602. A normal school for teachers had been established, and at the period in question counted 431 undergoing preparation, of which number 334 were Mahomedans and the rest Hindus. Two missionary schools were at the same time flourishing—one at Lahore, and the other at Rawul Pindee—a fact of some significance when the character of the population is taken into consideration. To these gratifying circumstances are to be added the still more important fact of the establishment of 38 female schools, containing altogether 812 girls.

Tracing the progress of the Punjab schools chronologically, we find that in 1862 there were 42,192 youths of both sexes receiving instruction, and three years later the number had increased to 76,213, in spite of the ever recurring obstacles of drought, and its consequent scarcity, and the ravages of cholera and other diseases. The prejudices of the Sikh noblesse were waning rapidly, but the zemindars found it difficult to reconcile their desire to see their children educated with their claims upon their offspring as assistants in the cultivation of the soil. They complained, too, of the growing indifference of the boys to rural pursuits—"they would not plough, and required a servant." A curious and short-sighted prejudice existed against their girls being taught to write. The parents had no objection to their learning to read, but could not possibly see they would ever make good use of caligraphy.

Though the education given in the Punjab was chiefly in the vernacular, no fewer than 11,269 pupils were learning English in 1865, exactly double the number of those who were drinking at the "well of pure English undefiled" in 1863. Candidates for matriculation in the Calcutta University now presented themselves, and in 1867, four out of seventeen students passed for the first Arts examination, and 22 out of 84 for the matriculation examination. A greater number would no doubt have competed, had the youths not found that the scholarships were less lucrative than government clerkships.

By the end of the official year 1866-67 there were 102,388 pupils in the Punjab schools, and in the two following years the number had swelled to 141,665. In the year 1868-69 education had taken a further stride, for a university college now took root at Lahore, a central museum was opened—which in two years attracted nearly 30,000 visitors—while six vernacular periodicals started into existence, sixty-one printing presses were set up, and as many as 425 books were published.

The year 1870-71 did not exhibit any remarkable progress. Severe scarcity and sickness again assailed the people, and depleted many schools of their attendants. A difficulty in obtaining the services of proper teachers for the female schools was experienced, and it was necessary to close many of the establishments, that the tutors might form an adequate staff for those which were retained. In spite of all these interruptions, the returns of the year showed that no absolute decrease had taken place in the number of pupils. The accessions had nearly equalled the depletions.

The peaceful occupation by the British of a considerable part of Burmah dates only from 1852. This does not comprehend the Tenasserim provinces, which had been for a generation in our possession. The education of the people of British Burmah had, down to 1858, been left pretty much to the Burmese themselves and the American missionaries, who had boldly taken a stand at Rangoon and other parts. There was, consequently, wide scope for the exertions of the government on the change of administration, and accordingly we find that the schools for instruction in the English language had already acquired a footing in 1859. The pupils of those educational establishments maintained by the Society for the Propagation of the Gospel numbered 120 in the course of eight months, and in the following year no less than 245 were in regular attendance. By the end of 1861-62 schools had been established in every town and every village on the coast and in the mountainous districts of Karen, and 4,838 lads were drinking at "the Pierian spring." At the close of 1865 a material advance had taken place, and ten female schools were founded; 7,080 pupils were being taught in 1867, and from that time onward the progress has been so steady that by the last returns there were 178 schools receiving aid from government and 272 unaided.

The province of Oude has been a greater source of trouble to the promoters of education than any of the conquered districts. The obstinacy with which all the endeavours of the British authorities to persuade the Nawabs to govern discreetly were resisted until the annexation of the territory,—forced upon the government of Lord Dalhousie—found its parallel in the repugnance of the talookdars to recognise any system of education. Grants in aid of schools having been made in 1860-61, four schools for the sons of talookdars and other landed proprietors were established, but they could not boast, in the aggregate, of more than 327 pupils at the end of the year. The vernacular schools mustered about 1,200 boys. The four following years saw a complete stagnation in the matter of instruction, and it was not until the year 1867 that the eyes of the talookdars were opened to the importance of putting their children on the high road to knowledge. Thenceforward the growth of education was rapid. At the close of 1868 there were 525 schools in existence—village, private, and vernacular town schools—besides 24 female schools. A year or so later the male schools had increased to 642, the female to 33; and the total number of pupils was 30,683, of whom 653 were girls. Another year added 10,000 to the total number. Moreover, a college, named after the lamented Lord Canning, and established in 1864, had begun to work well. Normal schools for masters and mistresses were advancing; 20 presses had been established at Lucknow, 17 of which were devoted to vernacular printing; and a museum, opened a short time previously, had received 138,504 visitors in 1869-70.

It would be gratifying if this sketch of what has been accomplished towards enlightening the youthful mind in India could close with a favourable report of the progress of education in the Hyderabad Assigned Districts. The old mediæval idea that a gentleman can do very well without education has operated in that quarter as an incubus upon the efforts of the government officers. Nevertheless there were 72 government schools in 55 of the larger towns, and the higher classes of people are receiving a certain amount of private instruction, but no organised system of state education existed. Through the exertions of the enlightened Sir Salar Jung a great change for the better is operating.

Coorg has scarcely advanced sufficiently to make it necessary to enter into details of progress. It is satisfactory to know, however, that the state of education is encouraging.

Glancing at the results of the past twelve years in the department of public education, it must be conceded that, if the advances made by the people in every direction have not been commensurate with the wishes and efforts of the rulers, they have been sufficiently rapid and comprehensive to entitle the government to all praise for the liberal encouragement it has given to the movement, and the exertions its officers have made to carry out its views and behests. Difficulties apparently insurmountable, have been overcome—the active opposition of some classes to a system of education, which they apprehended would uproot their religion—the inertness of others, who could not perceive the inestimable advantages in more than a narrow pecuniary view, of the blessings and power which are derivable from the possession of knowledge—proved formidable obstacles to the success of the enterprise vigorously commenced in 1859. And, therefore, so far from there being ground of surprise that more has not been accomplished, it is as astonishing as it is gratifying that so much has been really done.

Summarising the results as far as they are ascertainable, down to 1870, it appears that there were at that date:—

215,000	youths receiving education in the	Bengal Presidency.
105,500	,, ,,	Madras ,,
167,904	,, ,,	Bombay ,,
211,000	,, ,,	N.W. Provinces.
77,798	,, ,,	Central ,,
150,000	,, ,,	Punjab.
12,000 (say)	,,	British Burmah.
40,680	,, ,,	Oude.
979,882		

In round numbers one million youths were receiving education in British India in 1870. The following years may probably have added a quarter of a million to the number.* To a Prussian or an American this may not be a startling proportion of a population of 241 millions; but when the condition of society in the East is examined, when it is considered that three-fifths of the people are too poor to spare time from their daily pursuits in the fields and the towns to attend schools; when it is borne in mind that we are in India in the rather unacceptable character of conquerors and foreign rulers, whose earliest achievements date from little more than a century back, it will be allowed that we have neither mispent our time nor been niggardly in the application of the revenues raised from the people to the people's substantial benefit.

The expense attending the establishment of schools, colleges, and universities has of course been enormous. Professors of History, Political Economy, Chemistry, and most of the other sicences which enter into a scheme of sound education have had to be sent from England, on large salaries and at a considerable charge for passage money and outfit. Many hundreds of the principal establishments have been maintained entirely by the government, others are "aided" by monthly or annual grants, because they are not yet self-sustaining. Young natives who aspire to the bar, medicine, and surgery, and the engineering colleges, are brought to England, receiving government scholarships for three years, and are then provided with passage back and equipment on a very liberal scale. The cost of all this effort to expand the minds of the people may be set down at neary 70 millions of rupees, or about 7 millions of pounds sterling. But it by no means represents the total outlay. Since the year 1858, no less a sum than three hundred thousand pounds has been spent on the patronage of useful publications, the establishment of museums and schools of art, the encouragement of newspapers in the vernacular languages; the study of Oriental languages generally; the translation of valuable and rare documents and books, archæological researches, meteorological observations, and the formation of public libraries. And much of this is continued annually to this hour. What more can be said? What more could have been done in the same space of time?

It has been maintained, in an admirable paper on "Popular Education in India," by Mr. William Taylor, read in this Hall two years ago, that little has been accomplished for the "moral" education of the people. His views were supported by the late lamented Sir Donald Macleod and other enlightened men. But it is yet a question how far we dare to venture upon moral instruction founded on our own notions as disciples of Christianity. Perhaps we had better be content at present with the intellectual culture of the people, leaving the higher object to follow as a matter of course.

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* The returns from every part of the empire for 1871-72 not having been received and published, I have been obliged to be satisfied with the results down to the end of the previous official year.

From a review of what has been accomplished for the intellectual advancement of the people we naturally turn to a consideration of material progress, and this brings us to a sketch of the history of Indian railways. The contrast between the pace at which the old stage-coaches used to travel in England, and the rate of speed maintained by the modern railway carriage, is a frequent and amusing subject of speculation among complacent men of the present generation. There are still a few of the *laudatores temporis acti*, who love to dwell upon the comparative security of the old forms of locomotion, and to disparage the appearance and power of the steam engine; the popular team of three chesnuts and a grey, the dapper coachman and his trusty associate, the custodian of the mail bags, are yet fresh in their memories, and they even recal, with unaccountable pleasure, the hasty suppers on the road and the unfinished breakfasts, from which they were summoned by the horn of the guard. But these remnants of a bygone time are in a miserable minority, and all sane men rejoice that we have exchanged ten miles an hour, cooped up for an entire night on a journey from London to Bath, for forty miles in the same space of time, in a first-class carriage, with plenty of light, warmth, and elbow-room.

Changing the *venue*, what infinite cause of rejoicing men whose lot is cast in India must recognise when they recal personally, or read of, the tedious methods of travel in use throughout that portion of the British empire, down to the commencement of the last fifteen years, and even to a later period. Two and three miles an hour in a palankeen, or twelve to fifteen miles a day on a march, were the limits of our locomotion.

It was during the railway mania in England of 1845-6 that the idea was conceived of supplementing the establishment of a regular intercourse with England *viâ* the Red Sea, by railways that should traverse India from Calcutta to the Upper Provinces, and from Bombay across the peninsula. Confidence in the feasibility of the enterprise led men to subscribe their capital, but they needed a guarantee that they should receive a certain fixed interest for their outlay, in consideration of their venturing upon an undertaking which was sure to yield rich fruit to the government and the people. The prospective "moral" advantages were to pay for the immediate "material" sacrifice. Five per cent. per annum was the interest guaranteed for 99 years, and it was stipulated that if in any one year the net receipts from traffic exceeded the guaranteed interest the surplus should be divided between the government and the shareholders, until the charge to the government for interest in the earliest years was repaid, after which time the extra receipts were to be distributed among the shareholders. This was a capital bargain for the shareholders.

The preliminaries to cutting the first sod occupied a considerable time. The land on the contemplated lines had to be surveyed; the value of the property invaded to be assessed. The cost of labour, indigenous and imported; the expense of the iron, which was to come from England; the price of the wood for sleepers, and sheds, and carriages; the quantity and quality of the fuel needed for the locomotives, were all matters of serious and anxious consideration. At length the work was commenced, but ten years passed away before 120 miles of line had been opened. That line extended from Calcutta to Raneegunge, a coal district.

From 1855 the establishment of railways proceeded as rapidly as inundations, the casualties among the work-people, and the fearful obstacle presented by the mutiny of 1857, would allow. The Great Indian Peninsula line was commenced soon after the East India, and in 1854 thirty-three miles had been opened. Branches were established to connect this railway with others, one of which has its starting point at Madras, and another formed part of the East India.

By the year 1865, 1,127 miles of the East India Railway were completed, and 811 miles of the Great Indian Peninsula. Emboldened by the success attending the incipient operations of the two great lines, others were opened by different companies on the same terms, while some were projected by the government on its own account, these latter being distinguished from the guaranteed concerns by the appellation of "State railways." Before 1865 railways were established between Madras and Bangalore, Bombay, Baroda, and Central India; Kurrachee and the Punjab; Delhi to Umritsur; Negapatam to Trichinopoly, while others ran from Calcutta to the eastern and south-eastern parts of Bengal.

While the introduction of the railway system into India was pending, very many persons expressed their doubts if the natives would ever be induced to adopt the line as a commendable mode of locomotion. It was expected that they would demur to the cost and the contact of opposing castes, and that it would take a long time to convince the producers and merchants that the acceleration of the speed in the transport of their goods from place to place would more than compensate them for the additional expense of carriage. The native of India is proverbially indifferent to the value of time, and could not endure to part with his money for any prospective advantage that appeared to be remote. It was further doubted that native functionaries at isolated stations could be depended on for watchfulness, courage, and integrity; while European agency, it was thought, would be too costly for its general entertainment.

All these scruples and apprehensions were rapidly dissipated. The natives adopted the railways with alacrity.

The number of passengers conveyed by the several lines, as far as they had been completed, was:—

In 1859	3,112,500
„ 1861	4,255,940
„ 1864-5 (three years later) the number had increased so much that the returns gave a total of	11,781,683

More than 94 per cent. of whom had travelled in the third-class carriages. Each succeeding year beheld an augmentation of one million passengers:—

In 1866	12,867,000
„ 1867	13,738,472

Equally progressive was the traffic in goods. All the staples which formerly found their way to the coasts through trackless lands were now conveyed by rail, and the commerce of the country increased prodigiously. Bombay and Kurrachee were the ports which derived the earliest benefit from accelerated inland traffic. The population of the former town, which in 1845 did not exceed 250,000 persons, is now only second to London in the number of its inhabitants; and Kurrachee, which was little else than a depôt for the meagre produce of the Punjab, sent lazily down the Indus in clumsy boats, is at this date a populous city, with all the features and appliances of a presidency town. Much of the latter result is due to the liberality and efforts of Sir Bartle Frere, who, while commissioner in Scinde, opened out 600 miles of roadway for facilities of commerce.

Next to Bombay and Kurrachee, the use of Jubbulpore as an *entrepôt* of merchandise is to be noted. Jubbulpore is the Alexandria of the east and west of India, being placed at the junction of the two railway systems of Hindustan. A large portion of the trade of the North-West Provinces passes through it. It is worthy of note, as indicative of what may be expected from the diversion of shipping from the Cape of Good Hope route to that of the Suez Canal, that in the first two months after the completion of the line 43,000 maunds of grain and 400 bales of cotton had been dispatched westward from the Nerbudda Valley, while 85,000 maunds of Bombay salt travelled to the towns of the Nerbudda and Jubbulpore country.

It is hardly necessary to pursue minutely the progress made in the establishment of Indian railways during the past four years. Let it suffice that down to July last (1872) according to Mr. Juland Danvers' latest report, 5,204 miles had been opened, and a further length of 2,438 miles is in course of construction, of which 1,503 miles are being executed under the direct orders of the government, without the intervention of guaranteed companies.* The capital outlay on all the railways has reached the enormous sum of £91,963,510, yielding a return of 3½ per cent. per annum. The number of passengers carried in the past year was 18,940,585, of whom 144,215 were first-class, 642,645 second, 523,740 intermediate, 14,113,436 third-class, and 3,516,549 fourth class. This sub-division of classes is, of course, a necessary consequence of the gradation of means and the prejudice of caste among the Hindus. The merchandise carried in the same period exceeded 2,500,479 tons, besides three-quarters of a million tons of coal and other minerals.

This rapid summary of the work of 27 years may be fitly closed with the following irrefragable observations of Mr. Danvers:—

"To say nothing of the moral and social improvements which, as civilising agents, they have conferred upon the country, there can be no doubt that railways have added to its security, have greatly advanced the material prosperity of the people, and have been the means of increasing the revenue, and of saving much expenditure both on account of the army and the post-office. They are still in their infancy, and their direct contributions to the revenue are capable of expansion."

The mention of the progress that has been made in the construction of railways naturally leads to the subject of the forests of India, to which, in the absence of coal, recourse is had for the supply of fuel. Under the government of the East India Company, forests were preserved merely to supply the wants of the trader and the ship builder, and as the transport of timber, in the absence of canals, roads, and suitable carriage, would have been extremely tedious and costly, the conservation was limited to the forests in the south and on the sea-board of India. Malabar and Canara were the districts which then chiefly claimed attention. But within the last 20 years new and pressing wants have arisen in connection with the railways, the canals, and other great public works. Moreover, the people, improved in their position, have taken to build houses of wood, where formerly they contented themselves with huts of mud, bamboo, and the broad leaves of the palm tree. Hence the demand for the best kinds of timber has increased to so great an extent that the care and culture of the forests has become an imperative obligation. Happily the acquisition of the Punjab and Pegu has placed a large amount of forest land at the command of the state, but it has required great watchfulness on the part of the government officers, and the application of the botanical and other sciences, to preserve and improve the flora of the country. The natives in some parts of India have a practice—and it has been for a long time in force—of burning the trees in order to clear the ground for their grain seed. This not only removes the dry leaves and grass which would otherwise form the vegetable mould, enrich the soil, and keep it moist and loose, but it destroys millions of seeds and seedlings, injures and often kills trees of all ages, and, scorching and burning the bark, exposes the wood to the air, whence the insidious attacks of dry rot, hollowing the tree, and rendering it useless for timber. To check this mischievous and improvident mode of grain culture, much tact and caution have been necessary, lest restrictions should be stigmatised as oppression. The largest trees in India do not reach the gigantic proportions of the wonderful monarch of the forest (the Wellingtonias,) found in California, but the Teak, invaluable for its strength and durability, has been known to reach a height of 150 feet, and the Sal, if it does not attain a very conspicuous altitude, is so strong, hard, and heavy, as to exceed in value some of the best products of Europe. Unfortunately, however, these extremely serviceable forest trees, to which may be added the Sissoo and the Deodar pine, do not grow with sufficient rapidity to keep pace with the annual destruction, not simply from the fires alluded to, but from the ravages of cattle and wild animals, vegetable creepers, insects, hurricanes, and the furtive application of the woodman's axe. The advantage to the revenues of the state from the conservancy, now at great expense, and with sound judgment established, must eventually be very considerable, but in the meanwhile we must be satisfied with a slight excess of receipt over expenditure. Fortunately, other sources of commercial wealth have been created in the forests independently of the timber supply. Exotic trees and plants, which owe their parentage to the soil of Australia, South America, Arabia, and China, have been introduced upon an extensive scale, and already yield rich fruits. To the chinchona of Peru we owe the bark whence quinine is extracted. The blessings conferred by the possession of that febrifuge, in a country whose population is scourged by fever, is beyond all price. Tea and coffee, but scantily grown in India forty years ago, now form very important articles of commerce. Indigo, caoutchouc, and the poppy, are greatly increased sources of revenue, and the mulberry and soom feed the worm which augments our supplies of silk.

An immense increase of the commerce of India, external and internal, has been the natural result of accelerated communication and enlarged cultivation. It would be tedious to go into all the causes of the rapid augmentation of material prosperity, or to trace its advance step by step since the empire was transferred from the management of the East India Company to the hands of the ministers of the crown. But we cannot blind ourselves to the fact that large accessions of territory, and the encouragement given by the government to the industry and enterprise of the people of the newly-acquired provinces, must have had an important influence on the increase of commerce and manufacture, while the improved circumstances of the people, inducing more luxurious habits of life, have opened the door widely to the consumption of foreign goods. I find, by the last-published report on trade and navigation, that the total value of the trade in 1871-2 amounted to £107,319,500, or nearly one million and three-quarters more than that of the highest preceding year since the close of the American war.

The gigantic strides which have been made in the cultivation of the land, and in the trade and manufactures of the people, have, of course, had their bearing on the revenues and expenditure of the state, and the ingenuity of the fiscal officers has been sorely taxed to balance the income with the apparently unavoidable public charges. Their anxiety to create a surplus has not always been attended with a success commensurate with their wishes and exertions, for circumstances have unexpectedly arisen, in the shape of floods, drought, disease, and military expeditions, to alter the figure in their calculations amazingly. It is, therefore, a highly gratifying proof of the success in a general way of their untiring efforts, that during the six months ending on 30th September last, the revenues and receipts amounted to £22,294,326, while the expenditure on every account amounted to £18,390,454, showing a surplus of £3,903,872. The results of the corresponding period in the previous year were not so satisfactory by £80,000. The absolute amount of the population of British India has been ascertained to exceed two hundred and forty millions, but of that number only 186½ pay revenue to the supreme government—the remainder are tributary to native princes, under English administration, or entirely independent nobles.

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* There are nine lines under guaranteed companies, and seven constructed or constructing by the State.

The main sources of revenue are primarily, of course, the land, and after that salt, opium, stamps, customs, and excise. The Post-office revenue is considerable, though fluctuating, sometimes exceeding and occasionally falling short of the cost of the establishment and carriage. And this brings us to the mention of one of the best tests of a people's progress.

"A nation [*] writes more letters only when the necessities for intercourse increase; and a steady augmentation in the Post-office returns tells the same tale for its intellectual advancement that a rise in the exports and imports does for its material prosperity. Now, as regards India this story has, during the past ten years, been a constantly brightening one. An inspection of the returns from 1862 to 1871 inclusive shows that the people resort to the Post-office more freely, and are willing to pay a larger total sum for the facilities which it affords. Thus in 1862 the number of letters received for delivery by the post-offices throughout British India amounted to 42⅓ millions; in 1867 it had crept up to 54 millions, and during the succeeding four years it rapidly advanced to over 77 millions. This is the return for 1871 for the whole empire. If we turn to the particular provinces, we find Bengal, as regards the rate of progress, at the head of the list. In 1862 the number of letters posted in Lower Bengal was 8⅓ millions, and in 1871 it had risen to seventeen millions and a-half, or more than double. The Punjab stands next, and shows an increase from under five millions in 1862 to over nine millions in 1871. British Burmah exhibits an equal progress, though on a much smaller scale. The North-West Provinces hold an honourable place half-way down, and show a rise from eleven to seventeen millions. Madras exhibits an increase from 7¾ to 11¾ millions, and Bombay from nearly ten to fifteen and a-half.

In each case the rise has been much more rapid during the last four years than in the preceding six. During the second period the Post-office augmented the weight which could be sent for half an anna; and this measure at once told upon the public. The returns in every part of the empire showed an immediate increase, and during the period which has since elapsed, the increase has been more than maintained by a permanent elasticity which even the most ardent promoters of the change did not venture to predict."

Is it too much to say, in the face of these startling returns, that the education given to the people has really penetrated into their daily acts, quickening their intelligence, stimulating their intercourse with their fellow men, and opening up those new thoughts, new ambitions, and new conceptions of life which belong to a higher civilisation? I humbly think the conclusion is inevitable.

There is still one subject, in connection with the condition and security of the people, on which a few words may be said—the administration of justice.

A very forward step appears to have been taken in the substitution of high courts of justice, presided over by judges well versed in the principles of British jurisprudence, for the courts which administered a compound and conflicting system, in which the acts and regulations of the government, and other local considerations, were imperfectly amalgamated with the statute and common law of Great Britain. Litigation has not been checked among the natives by the introduction of a new code and new forms of practice. On the contrary, it has essentially augmented, for the people in the Upper and Central Provinces, having more confidence in the integrity and learning of British practitioners than they possessed in the pleaders and judges of their own nation, have freely resorted to the new courts, in the assurance that their cases would receive equitable treatment, and that bribery and corruption were next to impossible. The expense of the new courts, in the erection of suitable buildings, the salaries of the judges, and the multiplication of law officers of the crown, &c., has been considerable, but it has been more than counterbalanced by the stamp duties on legal documents, which have added materially to the state revenue.

The administration of criminal justice has not tended much to the suppression of crime, but the detection of offenders has been rendered infinitely more facile. The people now cheerfully co-operate with the police in unravelling the webs woven by conspiracy, in fathoming the depths of offence, and apprehending the perpetrators of foul and vicious outrages upon the peace and safety of the public. There has been a very great diminution, if not a total extinction, of female infanticide; and human sacrifices, which once had the sanction of native society and the supposed support of religion, are abolished.

It would be easy to expand this paper. Much remains to be said upon the subject of the spread of medical science in India, superseding the empiricism of the east by the skill of the western practitioners, and largely contributing, with the establishment of hospitals and dispensaries, to the improvement of the health of the people and the reduction of the returns of mortality. Vaccination has done wonders in checking the ravages of a fearful disease. The extension of the electric telegraph system is particularly note-worthy, the enlargement of the canals in the north-west, and the roads everywhere, assisting traffic and contributing to the irrigation which partially counterpoises drought; the vast multiplication of other public works, the penetration of coal mines, the encouragement of topographical surveys, and the promotion of river traffic—especially on the Ganges—are likewise deserving of mention and of unqualified praise, but there are limits to human patience and to the faculty of listening to details *couleur de rose* (however they may merit the favourable hue), and therefore I bring the paper to a close. I think that it has been established, by the authoritative facts I have accumulated, that during the past 14 years England has done her duty to India in the way of education, railways, the encouragement of trade and manufacture, the arts, sciences, and literature, and the administration of justice. To this I might add that she has been throughout tolerant of religious usages, self-sacrificing in the establishment of adequate military protection, and faithful to her obligation to respect the vested rights of the people brought under her government.

DISCUSSION.

At the close of the Paper,

The Secretary read the following letter from Mr. Edwin Chadwick, C.B.:—

"Dear Mr. Foster,—I regret that I cannot avail myself of the invitation to be present at the India Conference, to hear the paper read by Mr. Stocqueler. I beg, however, to submit that any account of the progress of India will be wanting in an important element which omits to set forth the sanitary progress made as a guarantee and promise of future advances in the improvement of the physical and moral condition and the productive power of the population.

"If anyone conversant with the subject will read the report, just issued, on the measures adopted for sanitary improvements in India from June, 1871, to June, 1872, he will find abundant grounds for this statement.

"I would remind our good friends, the old Indians, that the death rates in the army were in their times 60 and more per 1,000 in places where they are now little more than one-third of that. This is chiefly due to the labours of the Indian Army Sanitary Commission—that is to say, to labours wisely and steadily directed by officers of special aptitudes and qualifications in sanitary science, and giving their undivided attention to the prosecution of the work. These labours, if they are duly supported by the council and government of India in this country, in the application of the best sanitary experience of the West through the local governments to our Indian civil populations, will effect, though probably not for some time, as large results as have been obtained in the army, but still considerable transformations of the physical and moral condition of those civil populations under our dominion in the East.

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[*] "Calcutta Englishman."

"It would be out of place to distinguish particular achievements in that branch of service, but we have one distinguished instance, just reported, which I would beg to mention as of the greatest promise in sustaining that dominion which, it is to be hoped and believed, will prove the most beneficent, the most liberal, and, with all its shortcomings, the best for the people of India—the dominion of the British empire.

"Old Indians, with little knowledge of sanitary science, have forebodings that the British people cannot settle in India. They refer to the fact that European children die out there. Now I have paid particular attention to this point, viz., the treatment of children in India and the tropics, and I have generally found that the sanitary treatment of children, which is deplorably bad here, is generally worse there. Have we not places in England, such as Manchester and Liverpool, where half of those born are in their graves soon after their fifth year? Have I not shown recently that in Berlin, half those born are in their graves before their third year? I could indeed point out insanitary urban conditions in the West, where generations die out rapidly, where no lineage can be counted, and where the population is only sustained by immigration. In contrast to such excessive infantile mortality here, have we not examples that in well-managed orphan asylums, the so-called children's diseases have been in great measure banished, and their death-rates reduced below one-third of the rates generally prevalent even among middle-class populations? I contend that the like sanitary precautions would be efficacious in withstanding the greater disadvantages of the general climate in the uncleared and ill-cultivated districts of India.

"I have had stated to me numerous instances of indigo planters and others, whose families have attained even to a third generation, apparently with good promise of succession; but in the recent sanitary report from India to which I have referred, there is a conclusive corroborative example, arising from the application of sanitary science to the care of children in an orphan asylum in Calcutta.

"Dr. Fayre reports as follows:—'The very small mortality, as well as the small amount of sickness, proves that the European child, under proper hygienic conditions and careful physical training, may live and thrive in the plains of Bengal almost as well as in its native country. It is not merely in the absence of any serious disease and the low death-rate that this is manifested, but in the vigorous healthy appearance of the children generally. During the period of six years there had not been a single case of cholera, and the only death from dysentery, which is the disease peculiarly to be dreaded in Calcutta, was that of a girl, aged five, in 1863, and this was rather a case of dysenteric diarrhœa in a naturally delicate child. Two cases only of modified small-pox are recorded, and there has never been any tendency in the disease to spread. The children have all been protected by vaccination. A few cases of genuine typhoid or enteric fever had occurred, and one death; the other forms of fever had been of the simple continued form, or mild manifestations of the influence of malaria. Whooping cough had been altogether absent. There were a few cases of simple skin disease of a tractable kind. Of acute inflammatory disease, whether of the head, chest, or abdomen, there has been almost none. Diseases of the liver and spleen, whether from malaria or other causes, have been also singularly few, if not altogether absent. Pulmonary and bronchial complaints have been very few and slight.'

"Much as has been done here, sanitary science may yet do even more than this for the protection of infant life in India. But compare this with the fact of a recent report lamenting sincerely a death-rate nearly ten times greater of soldiers' children, as inevitable for European children there!

"I may refer, as respects adults, to the account which I append of what has been done for the protection of adults by Lord Mark Kerr, in the abolition of the Delhi sore among soldiers, as a proof of what may be accomplished for civil populations, and what in truth must be accomplished, for it is not enough to improve the sanitary condition of barracks alone in order to protect soldiers completely; the protection must be extended to the camps and cantonments, and also to the sites and houses occupied by adjacent civil populations.

"Hence the seats of the British army may be made the seats of security for the population against worse foes than predatory human enemies. The question arises, after such examples of sanitary successes, whether the like distinctions that are given for achievements in destroying life shall not be required to be conferred for achievements in the art of preserving life. Compare an achievement in military service, in the repulse of an incursion of marauders, with an achievement such as that above recited, in the preservation of the lives of children and of a race, or of one such as that described in the letter given in the report from Lord Mark Kerr, of the rescue of an adult—civil as well as military—population for ever from a perpetual painful plague of boils!—I am, &c.,

"Edwin Chadwick."

The following is the letter aboue referred to, from Lord Mark Kerr, on the Delhi sore:—"Before my arrival in India I had heard of the existence of certain boils and sores in many Eastern cities, which, having once been places with enormous populations and all the requirements of wealth and luxury—well-drained, well-watered, and adorned with numerous trees and gardens—had in the process of centuries become, for the most part, desert wastes—their canals and watercourses choked up, and their only vegetation unwholesome weeds. I knew such to be the case at Bagdad, Aleppo, and other places. When I arrived at Delhi I found the inhabitants—and those with whom I, as a brigadier-general, was most concerned, the garrison—both European and native, to a great extent suffering from boils, sores, and unsightly, fungus-looking growths on their hands and limbs; and I found Delhi, within the walls, a surface of barrenness, covered here and there, for the space of two miles in length and 500 yards in breadth, by foul weeds or heaps of demolished buildings, with wells and water-ducts choked up. I informed the viceroy and the commander-in-chief of the state of things, and of my intention to plant trees and grass, so as to remove the cause of evil. I had previously obtained the lieutenant-governor's sanction and funds sufficient for the purpose. One circumstance confirmed me as to my opinion of the cause of evil, and induced me to make a trial, which still further strengthed this opinion. The men of the cavalry regiment stationed near the Cabool-gate, amongst trees and grass, were entirely free from any sore; and I sent out those of the rest of the garrison of the 82nd regiment and the 12th native infantry (unfit for duty from the sore) under canvas amongst the trees and verdure of the old cantonments, with the most satisfactory results, the worst sores becoming, after the first week, greatly ameliorated, and the slightest cases returning to duty day by day at the same time. I continued planting as the ground became cleared, and I restored an aqueduct, which still takes water to gardens in Durriangunge from the further side of the Chandnee choke. I left India in January, 1864. I informed his Royal Highness the Duke of Cambridge, on my arrival in London, of what I had done, and of my sanguine hopes of success. Since then I have from time to time heard such satisfactory accounts of the growth of the trees and gardens in Delhi, and the gradual diminution of the cases of sore, that I resolved, on hearing that the commander-in-chief was to hold a camp of exercise at Delhi, to come out and see for myself. I am most truly rejoiced to find the disorder has at the end of these eight years almost disappeared from Delhi. I am aware that other reasons are now urged to account for the cure of the sore, but not even the plea of the stamping out of the contagion can account for the non-appearance of fresh cases amongst either the native or European population. Without wishing to claim credit for myself in the matter, I am very anxious that the experience of this city of Delhi should be made known for the benefit of other regions in India, where the like pure irrigation and draining, with judicious planting and gardening, would, I firmly believe, remove not only sores and such like evils, but prevent the approach of more serious and even fatal scourges.

"Mark Kerr, Major-General.

"Delhi, Head-Quarters Camp, January 18th, 1872."

General Vaughan, C.B., asked where the statistics referred to by Mr. Chadwick were gathered from, for he had listened to his remarks with some astonishment, as they were certainly opposed to his experience in India, which was that, however careful one might be with children, and whatever scientific appliances were brought into use, it was impossible to render the climate absolutely innoxious to infant life.

The Chairman said, as far as his experience and information went, Mr. Chadwick's statistics were hardly borne out by the facts. He thought the instances named must be exceptional. The evils which we had to contend with in India were the climate, the heat, and other deleterious influences, which could not be provided against by any amount of precaution. The great objects which had been kept in view in the sanitary measures that had been extensively introduced of late, had been, first, to promote drainage; and, secondly, to provide sanitaria; and there was no doubt that the mortality amongst the European forces, adult as well as children, had been much diminished. One cause of this improvement was that the troops were removed at times to the hills, and this had produced a wonderful improvement in the hygiene of the army. Where, however, the troops had been obliged to remain in an unhealthy climate, as at Peshawur, the mortality was as great as it ever had been.

The Secretary said the quotation given by Mr. Chadwick was from Dr. Fayre, who represented the mortality in orphan asylums as almost as small as in England.

General Vaughan said he must dissent from the conclusions arrived at.

Mr. A. Cassels was of opinion that, whatever care was taken, it was impossible to overcome the evil effects of the climate of India. The data given might be taken from an orphan asylum amongst the hills, and he certainly thought it an impossibility to make infant life as secure in the plains of Bengal as in the climate of England. Mr. Stocqueler stated the amount of exports and imports at upwards of 107 millions sterling; but he remembered only fourteen years ago they amounted to something less than 60 millions. At that time the revenue of India was somewhere about 33 millions, whereas it was now 52 millions, and the population, which was now 240 millions, was then generally supposed to be about 180 millions. Going back rather further than the period referred to in the paper, viz., about thirty years ago, the change was absolutely startling. At that time India was a scene of strife, discord, and oppression, whereas now peace and tranquillity reigned throughout the land.

Mr. Stocqueler said he had not paid much attention to the changes which had taken place in the sanitary condition of India during the last thirty or forty years, but they did not appear to differ in a general way from those with which he was familiar when in that country. One thing had struck him very forcibly, and that was the immense importance of good drainage. It was some twelve years since Col. Ochterlony, who was stationed on the Neilgherry hills, recommended that English regiments, on their first arrival in India, should be sent up there to make roads, and one of the Highland regiments was accordingly sent there. The men were engaged in hard work, making the roads, exposed to the full heat of the sun, and not one man was in hospital during that period. Only the other day, however, in the *Times of India*, he read a letter from a correspondent in the Neilgherry hills, who stated that the condition of that district had been wonderfully altered since soldiers had been removed from there, owing to the absence of good drainage; in fact, the climate was now so bad that no man could live in it for a week without being subjected to disease.

Mr. John Cheetham said he had no Indian experience personally, but for some 15 years he had been brought much into contact with those who had, and with whom he acted in the investigation of our government of India. He thought the lecturer had not sufficiently attended to the cause of the progress. In 1857 the constant fluctuation in the production of cotton in the United States led several gentlemen in Lancashire to consider if any steps could be taken to lessen our dependence on that country, and hence the establishment of the Cotton Supply Association, which had lately, much to the dissatisfaction of many persons in India, terminated its existence. Now there was one principle which, more than any other, he believed, had led to the results the lecturer described of our Indian government, viz., the bringing of the public opinion of England to bear upon it. In 1857 he remembered the interview he had with the governors of India, the President of the Board of Control, and the East Indian directors, when he found old-fashioned notions governing all their actions. He was then told that the reforms which were submitted for their careful investigation would, if carried out, deprive England of that great country; but his answer was, without hesitation, we had better lose India than misgovern it. After fifteen years' experience, he was happy to say that nearly every one of those recommendations, which were then stigmatised as impracticable, had been carried out. After a careful investigation of every country in the world which produced cotton, it was found that there was one great obstacle to its increase everywhere except in India, that obstacle being the want of population. India was the only country where there was an abundance of labour, which, if it could be stimulated, was capable of producing vastly increased and improved results. What was wanted, therefore, was to introduce Englishmen and western civilisation into India, but this was in direct opposition to the policy which had long governed Indian affairs, so much so that no Englishman not connected with the Civil Service was welcomed in the country. In fact, in 1857 it was the law, and he believed it was still the same, that the government of Bombay could deport, on twenty-four hours' notice, any Englishman not in their own service.

General Vaughan said that law had long since been abrogated.

Mr. Cheetham—It thus happened that the very men, and the only men who could do the work required were tabooed and kept out of the country for fear of ruining it. Another objection which met their ears was this:—"Oh, the ryots in India have been growing cotton for more than 2,000 years—what can you teach them?" But what cotton did they grow? It scarcely deserved the name, showing the want of improved systems of cultivation and better seed. Another difficulty was the want of tenant-right. The natives of Bombay, who were large cultivators, had no settled tenure of their holdings at all, but every year an officer came and settled what rent they were to pay. No country on earth could grow anything under such circumstances. The Cotton Supply Association, therefore, had to become politicians, and to insist on some kind of tenant-right being given, and now a most satisfactory system of thirty years' leases had been introduced. Madras, however, was still going on in the old way, and the result was that, with regard to industrial occupation, it remained the lowest presidency in India. It would even have been better to adopt the Bengal settled tenure, than to have no tenant-right at all; for although it was said there that, though the land had increased in value from four millions to nine, this balance had become merely the benefit and the property of the zemindars, still the land was improved, and it was better than leaving things in the wretched state in which they were before. In consequence of the civil war in the United States for four years, England sent 105 millions sterling to India in payment for cotton. This gave an immense stimulus to cultivation, and the system of entire dependence on native bankers was broken off, the condition of the ryots was greatly improved; and this of course was the first step towards a peaceable and prosperous condition of affairs. These improvements had been greatly owing to the increased attention which English people had paid to Indian affairs, and he only wished they would do so still more, because in a country of that kind there were always officers and residents who wanted to go on in the old-fashioned way, and thought nobody knew anything who had not been there. He remembered that when he first approached the question he talked to old residents with the greatest possible reverence, but when he came to know them a little better, he found that one perhaps had lived all his days in Calcutta, another at Bombay, had never been fifty miles away from either place, and did not really know so much as he did himself by careful reading. The progress of education had been mentioned, and it was exceedingly satisfactory, and the same had been said of the railway system. But no mention was made of the bungling way in which the lines were laid out. This arose from the inspecting genius being a military one; one part of the army being stationed at one spot and one at another, a railway was made to connect them, without any regard to the requirements of the civil population, and thus in Madras there were large populous towns lying six or eight miles from the railway; supplemental lines were therefore required to give these centres of population the advantages of railway accommodation. Irrigation, again, was a matter to which Government had not paid sufficient attention, and in fact, seeing that it had spent 100 millions on the railways, he thought it was time they should turn their attention a little more to the systems of water carriage and irrigation. Large portions of India were very much like Egypt, which it would be in vain to attempt to cultivate without irrigation. The improvement in the cotton production would have taken place long ago if this matter had been taken up. But how had Sir Arthur Cotton been met in his endeavours, after devoting nearly the whole of his life to the subject? He had shown, in the most positive manner, the immense benefit following from irrigation, and when it was carried out the results could not be questioned; but still his efforts were stopped because the money had all gone on the railways, and it was said that no more could be spared for this class of public works. He thought it would be better to stop further outlay on railways, for the present, and devote more to the water system. He was happy to say that, though the Cotton Supply Association had come to an end, the Manchester Chamber of Commerce had, to some extent, taken up its ground with regard to India, and he hoped still more would be done. The lecturer, in alluding to schools, had not referred to those under missionary control, which, he believed, were very extensive, and were devoted rather more to moral and religious subjects than the government ones. In conclusion, he hoped that the more enlightened principles on which India was now being governed would continue to produce a rapid and progressive extension of the benefits which had been described.

Mr. Hyde Clarke could not quite concur either with Mr. Cheetham or with Mr. Stocqueler with regard to the want of interest shown by this country in India. Mr. Cheetham had given one of the best proofs of interest felt by this country in the rapid development which had taken place in India. He rather thought all who had been connected with India demanded for that country a greater degree of attention than it was possible for anyone in England to give; for there were so many claims on the people's attention at home that it was totally impossible to answer to the call sometimes put forward, and give undivided attention to India. The friends of India must, therefore, be contented with going on creating an enlightened public opinion with regard to it, and still more in creating in India itself an opinion in response and in accord with the public opinion at home, so that all may work together for the object which all had in view—the advancement and welfare of that immense population. Considering the difficulties to be encountered in all such exertions from the prejudice of the populations, and those affecting the governing classes, everyone ought to feel gratified with the result which had been laid before them. All those familiar with such countries knew that the people were prejudiced against schools and schooling; and it was impossible for a man to live long in such countries without, to a great degree, participating in the prejudicies and feelings of the society by which he was encompassed. Making allowance for these things, he thought hopeful views ought to prevail, though, at the same time, he looked almost with dismay at the figures which had been put forward, showing that only one in 240 of the population was receiving education. That certainly was a proportion enough to appal any friend of education, and must be vastly altered before it was possible to relax educational efforts. Again, when it was said the State had expended about 90 millions on railways, so far from agreeing with Mr. Cheetham that their hand ought now to be stayed, he could not help calculating the proportion which this amount bore on population, and he found it represented on an average an investment of about 8s. a head; in fact, it was less than the return for one year's export of cotton. So far, therefore, from stopping railways in order to promote irrigation, he thought there was the greatest reason for pushing on both, for railways would enable irrigation to be better carried out, whilst on the other hand irrigation would help to feed the traffic of the railways. He regretted that on such an occasion he could not abstain from repeating what he had said before, and calling attention, particularly from Indians, to the example of the United States. If the circumstances were not the same in many respects, they were the same as to the necessity for means of locomotion; and to limit the expenditure on this account to the small amount or 8s. or four rupees a head, was absolutely out of the question. Indeed, if the result of English government depended simply upon what some seemed to think—a large expenditure on railways—discouragement, rather than exultation, ought to be the predominant feeling. But there were various other acts which showed that immense benefit had been conferred upon the population. One of the most apparent and important was the great increase in the price of labour, which was now four and five fold in many parts what it was a few years ago. He would not refer to the large sums which had been paid to India for the purchase of cotton and other products, but when the whole population was influenced to such a degree that the nominal price of labour was raised in the way he had stated, a vast benefit was conferred upon them. There were some who would say that, inasmuch as the price of provisions and other articles of consumption had also been raised, the population had not obtained an equivalent; but in order to obtain a surplus by which the population might be raised from the condition of serfdom, receiving bare food in return for their labour, it was necessary that there should be such a system of prices in relation to those prevalent in other parts of the world, as would enable them to participate in the productions of other countries, receiving from them, on a fair basis, a reasonable equivalent. That was an economical point of great importance, which showed how deeply industrial progress had penetrated amongst the masses, and was a good indication of what must occur in those systems of improvement which had been already commenced, and were now being developed with such advantage. He was very glad to hear the chairman refer to the hill occupation of the troops, because he looked at this from another point of view, as an element in the advance of India. In many parts the hills, which were formerly considered barren and worthless, now produced those products to which Mr. Stocqueler referred—tea and cinchona—so that desert and barren regions now under the auspices of the government had become productive to the revenue, and at the same time beneficial to the whole country. There was no doubt that in every instance where good principles of government were applied, there would not only be a direct result, but collateral advantages far greater than could be at first estimated would follow.

The **Chairman** said it was so common to hear ill informed and ignorant criticisms on the acts of the government of India, that it was quite refreshing to hear a well-informed and thoroughly impartial review of the Indian administration for a long series of years. He did not contend, and he did not know that any officer contended that the government of India was perfect, or that its measures had always been successful. Every government had its shortcomings, and there was no suit of armour in which a weak place could not be found; but he did contend that the policy of the government had been honest, that it had really aimed not only at developing the material prosperity of the country, but also the improvement of the moral and intellectual condition of the population. They had striven to make the people happy and contented, and he believed they had been more successful than any of their predecessors. Mr. Cheetham had drawn attention to some very important matters, matters of great interest, but he had hardly given as much credit as he might have done to the government. In the firstplace, with regard to irrigation, the government had had it as much at heart as railways, and for the last thirty years they had been engaged in a series of irrigation works. For instance, the famous Ganges Canal; then there were the Madras Irrigation Works, conducted by private enterprise, and the Orissa, which government had taken in hand because they were flagging under private enterprise. There were also three or four large systems which were now either in actual progress or in contemplation, on the Upper Ganges and the Jumna, as well as in the Punjaub and in Scinde. In fact, it was a matter which the government had very much at heart, not merely with a view to remunerative return, but with the object of increasing the welfare of the people, and especially of providing against those periodical famines which were the sad curse of India. If the Orissa system of irrigation had been completed some few years ago, there would not have been that horrible mortality which so astonished Europeans. The same curse had often previously been threatened in the Doab district, between the Ganges and the Jumna. With regard to the cotton question, it was almost interminable. He thought the government had done all they could to aid it; they supplied the best seed, and skilled instructors, who travelled throughout the country; they had appointed cotton commissioners, and above all, they had furnished roads, which were the great and crying want of the country. He must also remind Mr. Cheetham, who, as a free trader, would, no doubt, agree with him, that the government could not compel the Indians to grow cotton. If this crop did not pay them the best, they would not grow it. However, he believed, it had been Mr. Stocqueler's object not to enter upon the discussion of such matters as the land settlement, or system of taxation, or military expenditure, or the practical relations between the government and the governed—all of which were of great importance—but rather to speak of the actual results which had been attained. For his own part he should be very glad to hear these subjects treated with the same freedom of discussion, and, no doubt, great benefit might be derived from the same publicity being given to all the operations of government as to their results. He trusted, therefore, both with reference to these subjects and also to the sanitary question, which had not been sufficiently ventilated, that Mr. Stocqueler might be prevailed upon to give a supplemental address, and with that view he had been authorised to announce that the discussion would be resumed on that day fortnight. He concluded by proposing a vote of thanks to Mr. Stocqueler.

Mr. Stocqueler said he should be very happy to attend at the adjourned meeting, when he would reply to some of the observations which had been made.

Mr. Hyde Clarke proposed a vote of thanks to the Chairman, and the meeting separated.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

At the fifth meeting of the Committee for Cooking, held on Saturday, at Gore-lodge, the following gentlemen were present:—Mr. F. B. Alston, Mr. James Bateman, F.R.S., Mr. Birdwood, Mr. de Rivaz, and Major Du Cane, R.E. The Committee were informed that Her Majesty's Commissioners considered that arrangements should be made to admit to the School of Cooking a large number of visitors daily, during the hours of the exhibition. Four Sub-committees were appointed; 1st, to carry out the arrangements for the School of Cooking; 2nd, for the exhibition of apparatus; 3rd, for the science of food, &c.; and, 4th, to consider modes of cooking in this country.

The first meeting of the Committee for the representation of Fish as an article of Food, was held on Tuesday, at Gore-lodge. The following were present: — Lord Saltoun, in the chair, Lord Abinger, Mr. Spencer Walpole, Dr. Hood, Mr. Frank Buckland, and Mr. Thomas Sacks. Resolutions were passed recommending Her Majesty's Commissioners to take steps to secure various representations of fish, as in small aquaria, in coloured casts, arranged according to species, and in a preserved condition, and what nets and fishing implements of all kinds should be exhibited.

The fifth meeting of the Committee for Silk and Velvet was held at Gore-lodge on Tuesday. There were present Sir D. Cooper, Bart., in the chair, Mr. Brocklehurst, Mr. Cobb, Mr. Dickins, Mr. Lewis, Mr. Lintilhac, Dr. Mann, and Mr. Tucker. The committee considered applications received from Brusia, Créfeld, France and Italy, and from Coventry, Derby, Dublin, and other towns in Great Britain. The Committee decided to demonstrate the marvellous effects of dyeing on the weight of silks.

The second meeting of the Committee for French Art and Industry was held on Saturday, M. Paul Dutreil, Second Secretary to the French Embassy, in the chair. There were also present Messieurs Casella, Corbière, Gaudet, and Lintilhac. The committee approved of the address to French producers, and considered the applications received from French exhibitors since the last meeting, for carriages, silk, and food. They adjourned to 15th February.

The fourth meeting of the Committee for Carriages was held on Wednesday, the 5th February. There were present Lord Francis Gordon Lennox in the chair, Viscount Valentia, Lord Arthur Somerset, Mr. Holmes, Mr. Hooper, Mr. Peters, Mr. Thorn, Mr. Thrupp, and Mr. Woodall. Applications to exhibit 276 carriages were laid before the committee, who decided that not more than 200 could be shown in the space available.

The representation of paintings, British and Foreign, in the Exhibition of 1873 will consist of the undermentioned classes of paintings:—1. Paintings in oil and water colours which have been executed since 1863 and have been exhibited at the Royal Academy, the Water Colour Society, and similar established societies, contributed direct by the artists or by proprietors. 2. New works submitted for the first time for exhibition. 3. A representation of the works of John Phillip, R.A., who died in 1867, and of Thomas Creswick, R.A., who died in 1869. 4. A collection of paintings in water colours by artists who have died since 1863. For divisions (3) and (4) a special part of the Exhibition will be assigned, if found to be desirable.

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. The following meetings have been arranged:—

FEBRUARY 12.—Discussion on Lieut.-Colonel A. STRANGE's paper, "On Ships for the Channel Passage," adjourned from Friday, the 5th. On this evening Vice-Admiral Erasmus Ommanney, C.B., F.R.S., will preside.

FEBRUARY 19.—"On the Virginias; their Agricultural, Mineral, and Commercial Resources." By Major HOTCHKISS, late C.S.A., engineer in charge of the survey of Virginia by the Washington and Lee University. On this evening Sir Antonio Brady will preside.

FEBRUARY 26.—"On the Edible Starches of Commerce, their Production and Consumption." By P. L. SIMMONDS, Esq.

MARCH 5.—"On Gas-lighting by Electricity, and Means for Lighting and Extinguishing Street and other Lamps." By W. LLOYD WISE, Esq.

MARCH 12.

MARCH 19.—"On Certain Improvements in the Manufacture of Printing Types." By J. R. JOHNSON, Esq.

INDIA COMMITTEE.

The conference on "The progress of India during the last fourteen years," was adjourned on Friday, 30th ultimo, until Friday, 14th instant, when the subject will be resumed, and Mr. J. H. Stocqueler will open the discussion with a further paper supplementing the previous one.

On Friday, 28th instant, a paper will be read by P. Roger Smith, Esq., architect, on "Architectural Art in India."

CANTOR LECTURES.

The second course of these lectures is "On the Energies of the Imponderables, with especial reference to the Measurement and Utilisation of them," by the Rev. ARTHUR RIGG, M.A. The remaining lectures will be delivered on the following evenings, at eight o'clock:—

LECTURE II.—MONDAY, FEBRUARY 10TH, 1873.

On the Energy of Gravity, with especial reference to the Measurement and Utilisation of it.

LECTURE III.—MONDAY, FEBRUARY 17TH, 1873.

On the Energy of Vitality, with especial reference to the Measurement and Utilisation of it.

LECTURE IV.—MONDAY, FEBRUARY 24TH, 1873.

On the Energy of Affinity, with especial reference to Suggestions for Estimating and Utilising it.

LECTURE V.—MONDAY, MARCH 3RD, 1873.

On the Energy of Electricity, with especial reference to the Measurement and Utilisation of it.

LECTURE VI.—MONDAY, MARCH 10TH, 1873.

On the Energy of Light, with especial reference to the Measurement and Utilisation of it.

LECTURE VII.—MONDAY, MARCH 17TH, 1873.

On the Energy of Heat, with especial reference to the Measurement and Utilisation of it.

MEETINGS FOR THE ENSUING WEEK.

MON. ...**SOCIETY OF ARTS, 8.** Cantor Lecture. Rev. A. Rigg, "On the Energies of the Imponderables."
Social Science Association, 8. Mr. Alsager H. Hill, "On Impediments to the Circulation of Labour, and Suggestions for their Removal."
Institute of Surveyors, 8. Mr. E. J. Castle, "The Origin of Parochial Relief."
London Institution, 4. Professor Duncan, "Physical Geography."
Royal Geographical, 8½. Mr. Clements R. Markham, "On Discoveries East of Spitzbergen, and approaches towards the North Pole on the Spitzbergen Meridians."
Medical, 8.

TUES.…Civil Engineers, 8. Discussion on Mr. W. T. Thornton's Paper on "The Relative Advantages of the Standard Gauge, and of the Mètre Gauge, for the State Railways of India."
Photographic, 8. Annual Meeting.
Royal Institution, 3. Prof. Rutherford, "Forces and Motions of the Body."

WED. ...**SOCIETY OF ARTS, 8.** Discussion on Lieut.-Col. A. Strange's Paper, "On Ships for the Channel Passage."
Graphic, 8.
Royal Literary Fund, 3.
Archæological Association, 8.
London Institution, 7. Prof. Barff, "On Fresco and Siliceous Painting."

THURS...Royal, 8½.
Antiquaries, 8½.
Royal Society Club, 6.
Mathematical, 8.
Royal Institution, 3. Dr. Armstrong, "Formation of Organic Substances."

FRI ......**SOCIETY OF ARTS, 8.** India Conference. Adjourned discussion on Mr. J. H. Stocqueler's Paper, "On the Progress of India during the last Fourteen Years."
Astronomical, 3. Annual Meeting.
Royal Institution, 9. Mr. R. H. Scott, "Progress in Weather Knowledge."
Quekett Club, 8.
Royal United Service Institution, 3. Major C. J. East, "The Lushaie Expedition."

SAT ......Royal Institution, 3. Dr. Freeman, "Comparative Politics."

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FRIDAY, FEBRUARY 14, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

TECHNOLOGICAL EXAMINATIONS.

The Programme of Examinations in the Technology of the Arts and Manufactures of the country, in reference to which notices have already appeared in the *Journal*, is now ready for issue, and may be had on application to the Secretary. These examinations will be held annually, in conjunction with the examinations of the Science and Art Department, and due notice will be given of the particular subjects selected each year.

In 1873, Examinations will be held in the technology of Cotton, Paper, Silk, Steel, and Carriage-building. Candidates, in order to obtain certificates in any of these subjects, must pass the examinations of the Science and Art Department in certain sciences, which are specified in the programme as bearing upon the particular art or manufacture. In addition to these, special papers will be set in the technology of each manufacture by examiners appointed by the Society of Arts, and certificates of three grades will be awarded:—"Honours," "Advanced," and "Elementary."

The examinations of the Science and Art Department will be held during the first three weeks of May, the technological paper being worked on the evening of the 17th May. The dates of the Science subjects are given in the Science Directory, published by the Science and Art Department.

The following Prizes are offered by the Society of Arts in each of the five subjects mentioned above:—

To the best candidate in Honours, £10.

To the best candidate in the Advanced Grade, £7.

To the best candidate in the Elementary Grade, £5.

The following additional Prizes are offered by Wyndham S. Portal, Esq.:—To the Second and Third best Candidates in the Elementary Grade, Paper Manufacture:—

A Prize of	£3
A Prize of	£2

In order that these Examinations may really be successful in promoting technical education in this country, it is desirable that encouragement should be given to candidates by the offer of additional prizes and scholarships. With this object the Council appeal to the Companies of the City of London, to merchants and manufacturers, and to members of the Society generally, to aid them by contributing to the Prize Fund.

The Council have the pleasure to announce the following contributions to the Prize Fund:—

	£	s.	d.
The Worshipful Company of Vintners..	£10	10	0
Dr. Crace Calvert, F.R.S. (annual)	5	5	0
Daniel Cooper, Esq..................	5	0	0

The Council invite the aid of masters and managers in promoting these examinations by encouraging their workmen to take advantage of them. An explanatory handbill, suitable for being suspended in factories and workshops, may be had on application to the Secretary of the Society of Arts, Adelphi, London, W.C.

PRIZE FOR STEEL.

1. The Council have resolved to award the Gold Medal of the Society to the manufacturer who shall produce and send to the London International Exhibition of 1873 the best collection of specimens of steel suitable for general engineering purposes.

2. The specimens exhibited must include a complete illustration of the applications of the varieties of steel submitted.

3. Each manufacturer should send with his specimens a statement of the nature of the tests he has applied to each kind of steel submitted, and give the results of such tests.

4. The samples tested are to be exhibited together with duplicate samples, or portions of the same samples; these will be submitted to tests should the Council consider it desirable.

5. All persons using steel for general engineering purposes, who are not manufacturers of such steel, are also invited to exhibit specimens on the above terms and conditions.

6. The Council reserve to themselves the right of withholding the premium, in the event of the specimens exhibited not being sufficiently meritorious.

THE DUKE OF EDINBURGH ON TECHNICAL EDUCATION.

On Friday last the Duke of Edinburgh was presented with the freedom of the Coachmakers and Coach-harness-makers' Company. In acknowledging the presentation, His ROYAL HIGHNESS made the following remarks:—

He said he begged to acknowledge most sincerely the honour which that ancient guild had conferred upon him, and it was with much pleasure that he found himself enrolled as a member of a corporation whose loyalty and attachment to her Majesty the Queen were so well known. The power that such a body possessed in aiding and stimulating the efforts of those who sought to encourage technical education among our artisans could not be overrated, and he was glad to think that the influence of the Coachmakers' Company had been thus exercised. There were some among them who might remember a Conference held at the Society of Arts last year, under the presidency of his brother, Prince Arthur, when a scheme was suggested, showing how the resources of the great City companies might be most beneficially applied in that direction. He trusted that the labours of that Conference might have the success they deserved. He accepted with much pleasure the beautiful medal which had been presented to him, and he thanked the Master for the kind expressions of which he had made use. He hoped that in some manner he might be fortunate enough to serve the company to which he had that day been admitted.

PROCEEDINGS OF THE SOCIETY.

TENTH ORDINARY MEETING.

Wednesday, February 12th, 1873, Vice-Admiral Erasmus Ommanney, C.B., F.R.S., Member of Council, in the chair.

The following Candidates were proposed for election as Members of the Society:—

Baker, John Marcombe Bromley, Hortensia-villa, Southsea.
Parr, Henry, Beoley, near Redditch.
Roberts, Benjamin, Cornwall-lodge, Anerley, S.E.

The following Candidates were balloted for and duly elected Members of the Society:—

Davies, William Henry, 51, Tregunter-road, South Kensington, S.W.
May, Herbert, 210, High Holborn, W.C.
Price, Rev. Newton, Watford.
Quick, Joseph, 29, Great George-street, S.W.
Quick, Joseph, jun., 29, Great George-street, S.W.
Schanschieff, Alexander, 39, Clifton-gardens, Maida-vale, W., and St. Petersburgh.

The discussion upon Lieut.-Col. A. Strange's paper, "On Ships for the Channel Passage," adjourned from the 5th inst., was resumed by

Capt. Dicey, who said Colonel Strange had so fully explained the outline of his scheme that he had left him but little to add. The defects in Channel transit were principally owing to the railways, who have a monopoly of the transit, and are not easily moved, unless by Act of Parliament. There was no doubt the shallowness of the French harbours had been the great obstacle to improvement, and from the time he (Capt. Dicey) took this matter up, now some years since, he saw that nothing but flat-bottomed vessels would meet all the requirements of the case, as only flat-bottomed vessels could be constructed of sufficiently light draft of water to enter the ports at all times of tide. It was well known that quite flat-bottomed vessels were the most uncomfortable of all vessels in a sea-way, they rolled and jerked so suddenly. Some years ago three or four flat-bottomed vessels were sent out to the Government of India for service on the coast. Each of these vessels was about 170 or 180 feet long, with 32 feet beam, and they rolled in a most uncomfortable way. Those who have not been to sea could hardly understand how it was possible that one vessel should roll easily and another very uncomfortably; the one rolls slowly and gracefully, the other suddenly and with a jerk, so much so that sailors who have been accustomed to an ordinary vessel, when they go on board a flat-bottomed vessel will get as sea-sick as those not used to the sea. These facts suggested the necessity of adopting something similar to the outrigger of the Indian vessels described by Colonel Strange. Some of these outrigger vessels are between 200 and 300 tons, and when at anchor in the open roadsteads of India, while ordinary vessels of 2,000 or 3,000 tons are rolling so heavily that it is impossible to stand on deck without holding on, these small vessels are as steady as possible. The vessel now proposed will be about 200 feet long, 26 feet between the two hulls, and each hull having 16 feet beam. Although this is reducing the size originally proposed, it will not curtail the cabin accommodation, as the cabin is to be carried from side to side, doing away with the passage you see at the side. This will accommodate under cover about 400 passengers. Colonel Strange mentioned that Mr. Reed was of opinion that a vessel could not be constructed on this principle sufficiently strong without greatly increasing the draft of water. He (Capt. Dicey) believed that the strength required was greatly over-estimated. The vessels were mere shells, with light frame-work and plating, drawing only six feet of water, offering but little resistance to the sea. The strength and weights had all been carefully calculated, and it had been found that a vessel built as proposed will bear such a strain, that if one vessel were placed on the pier at Dover, she would bear the other up in mid-air; and if turned over on the deck she would still bear the weight of the other. Now, it was not at all likely that the vessel would be called on to bear such a strain as this. There would be nine feet in the web of the girder in the narrowest or weakest part, while the whole of the accommodation would form a double box girder throughout, the forepart of the cabins forming a girder of a horse-shoe shape, the ends stretching the whole length of the accommodation, and the iron girders extending from the outside of one vessel to the outside of the other, the plating of the inner sides being carried round to form the arch. Some doubt had been raised as to whether the sea would not strike under this arch, and, if it did not injure it, cause a gerat thumping. Now it should be recollected that the seas in this part of the English Channel are short chopping seas, and never likely to rise so high between the two vessels as to touch the archway. Many years ago he was an officer in the *Enterprise*, the first steamer that went to India round the Cape of Good Hope; she was employed as a transport for troops, and all the cabin accommodation being occupied, the ship's officers' cabins were placed before and abaft the paddle-boxes, so that their cabins, as it were, overhung the sea. They extended about 12 feet out from the ship's side, and when she went to sea full of coal and troops, they were not more than 5 feet above the water. She was frequently in heavy gales of wind, and consequently high seas, yet no instance occurred of the paddle-box cabins suffering damage. The archway of this tunnel would be much more protected and double the height above the water, therefore there need be no fear of inconvenience from the sea striking up under the tunnel. Doubts had also been raised as to whether a vessel of this description would steer as well as the ordinary vessel; it is supposed the wash of the paddles impinging on the side would prevent her turning as readily as an ordinary vessel. This had not been found to be the case in the model that had been tried in the river; she answered her helm as readily and came round as quickly as any other vessel; and perhaps the best proof of this was, that a vessel built in Calcutta by the government, on the twin principle, some years ago, as a ferry boat on the Ganges, was a perfect success. Again, it was said they would never get good speed out of the vessel, the argument being that the paddles working between the two vessels would force the water backwards faster than it would come in before the paddles; and, again, that the skin friction on the four sides, instead of on two sides only, as in ordinary vessels, would be very great. This last objection had some weight in it, but not so much as supposed; besides, the ship did not profess to go at a very high speed. It would cross in about the same time as the present vessels; there would be no difficulty in obtaining greater speed, but to increase the speed four or five knots would involve greater engine power, and this would be at the sacrifice of draught of water and at great additional cost. If the motion were reduced to a minimum, and every comfort in the shape of accommodation given to the passengers, they would not complain if the passage was performed in the same time as by the present vessels. He showed a sketch of the vessel which was built for the Ganges ferry; her dimensions were 90 feet long, 8 feet each hull, and 8 feet between the two vessels. Her speed, with engines of only 24 horse-power (a very old style of engine, not working up much above their nominal power), was eight knots, and she had to steam against currents and river freshes of great strength; this showed there is not much skin friction due to the twin form, for if she had been a single vessel, engines of that power would not have propelled her any faster. It had been said that a vessel of this form would be circumstanced very unfavourably for high speed, because of the interference with each other of the waves of displacement in retreating from the inner bows. This may appear so in theory, but is it so in practice? For instance, it was not unusual to see two paddle-wheel steamers going in the same direction at great speed abreast of each other, and only a few yards separated, say paddle-box and paddle-box nearly touching each other—did these vessels lose their speed because they came near to each other? He had never observed it, and he had frequently seen vessels in this position; or could it be supposed that the mere connecting of these two vessels together would retard their progress? It has been stated that the twin form of vessel has been tried in this country, the *Gemini* on the Thames, and another vessel on the Clyde, and that these vessels would not steer well, and that they could not get the speed out of them that was expected. He showed the deck plan of one of them; she was fifty feet longer than the vessel built for the Ganges ferry, and the two vessels were only eight feet apart, and any practical man would say that with such proportions it would be impossible to realise any ordinary speed out of a vessel so constructed. His argument always had been that the further apart you can keep the two hulls, the better result you will have, and the less strain upon the girders. All seamen know that two boats lashed together (at but a short distance apart), with two spars across them, require a strong lashing to keep them secure, while, if kept at a considerable distance apart, a much slighter lashing will suffice; so he believed the farther apart the hulls of the twin vessel were, the less strain there would be on the girders.

The Chairman said that since the last meeting another model had been put upon the table, which differed considerably from the first, and perhaps Captain Dicey would just explain the difference.

Captain Dicey said the first model was 400 feet long, and it was then proposed to have a cabin with a passage all round, but it was afterwards thought better to reduce the size of the ship. A new model had therefore been prepared, in which, instead of having the passage round, the cabin was extended to the edge of the vessel, so that, although she was smaller, the same accommodation was provided. The proportion of length and breadth remained the same, and also the draft of water, but the length was reduced to 280 feet She would require much less engine power, and would cost less to build. The paddles being between two hulls, there was no obstruction which would come in the way whilst approaching piers or moorings.

Mr. A. J. Sedley then drew attention to a diagram on the wall, illustrating his own plan, which was similar to Captain Dicey's, and he had also a model on the table. The bottom of his vessel was divided into seven watertight compartments, the bulk-heads fore and aft being empty, the next two containing two saloons 70 feet in length, and the intermediate one being occupied by the engines and boilers. There was an engine of 300 horse power in each hull, and the length of the boat, which he designed in 1866, was 400 feet, each hull being 20 feet wide and 20 feet high. Above them was placed another vessel, shown in cross-section, resting bodily upon two hulls or pontoons. This upper vessel was designed for the accommodation of the public, beyond the saloons already mentioned, and included two large saloons, 140 feet by 40, and fourteen private saloons on each side. He calculated that a vessel like that, and with a power of about 600 horse-power nominal, working up to 3,000, would reach a speed of something like 20 miles an hour. The diagram also showed a small vessel, which was now being tried, 50 feet long, each hull being 2 feet 6 in. beam, and the high-water line of each hull being about 3 feet wide. Between them were placed a couple of paddle-wheels 5 feet in diameter, 2 feet 4 in. wide, and with 6 or 7 in. floats. A small engine placed in her was hoped to have been 20 horse power, but unfortunately it was not more than 6 or 8, and consequently the speed anticipated could not be obtained; but a new engine was now obtained, and she was doing remarkably well. Capt. Dicey, who had had great experience in these matters, had got as much as seven miles an hour mean speed in still water, and they hoped to do better still. There was also a drawing showing the position of the vessel at every state of the tide during the last year and a-half, and this proved quite clearly that she did not strain, as had been suggested she would. She had also been tried with one hull full of water, the other being empty, but even in that position she had been perfectly safe. With regard to the connection between the two, Mr. Merrifield had stated, some time ago, that there would be great difficulty in making this connection perfectly rigid without immense weight. The weight of these two hulls together was two and a-half tons, and the whole weight of the connections, which were perfectly rigid, and had not stirred an inch since they had been put in, was only five cwt. In the terrible gale which had occurred a short time ago, this little boat was moored in such a position as to be exposed to the full force of the storm, the waves having a reach of a mile and a-half, and breaking full upon her side; nevertheless she rode it out, though every other boat in the vicinity went down. This showed, at any rate, that such a system of construction was not incompatible with a resistance to the break of a powerful wave. There had also been a notion expressed that sufficient water could not be got in between the hulls for the use of the paddle wheels, and that it would be drawn in at the side under the hulls. Nothing of this sort had, however, been observed in the trials which had been made, though careful attention had been paid to the point. In fact, there had been no trace at all of the water having been drawn in at the side of the vessel. He thought, with Capt. Dicey's arrangement for increasing the width between the two hulls, there would be quite space enough for the paddles to work well, and in this respect it was superior to his own, as also in having the paddles inside. His own model was originally constructed in order to compete for the prizes offered by Mr. John Fowler for vessels for the Channel traffic, the conditions of which competition seemed to necessitate an enormous tonnage, something like 12,000 tons, and this led him to the idea of getting rid of a great deal of the superincumbent weight by adopting the two hulls. The figures had been worked out for him by a naval architect, and by them it appeared that a vessel 400 ft. long, built as he had described, would not weigh more than 1,400 to 1,600 tons, including 500 passengers on board, and that the draft would not be more than five or six feet, whilst by a proper amount of boiler and engine power there would be no difficulty in getting almost any speed. No doubt there would be a little more skin friction in a twin boat than with a single boat, but, from what he had seen and the experiments he had made, he fancied it would be a mere trifle. The boat steered wonderfully well, was very easily worked, and could be readily brought up to a most awkward corner, where she usually lay. In conclusion, he had only to say that Captain Dicey and himself were working harmoniously together, seeking only the public benefit, and he had no doubt that if they were successful their endeavours would be appreciated.

The Chairman having invited a general discussion on the whole of the matters which had been brought forward,

Mr. John Grantham, C.E., after quoting a passage from Capt. Tyler's report to the Board of Trade some years ago, in which he mentioned a scheme which he (Mr. Grantham) had proposed to the South Eastern Railway, as his warrant for speaking on this subject, said that when those plans were prepared, some six years ago, plans which up to this time he believed were not wholly unacceptable to the South Eastern Company, it was generally conceded that the vessel required must be a very long one, that she should go very fast, steer at both ends, draw very little water, and have great power. The reason why those plans were rejected by the railway company, and reported against by Captain Tyler, was because of the length, the draught of water, and the steering, and it was consoling to him to find that every plan since proposed had adopted those very points, and that they were now universally accepted by practical men in dealing with this matter. Some began with a length of 500 feet, and some went down to 350, whilst the length he had proposed was 400 feet. Referring now to the schemes which had been put forward, he would first allude to Captain Dicey's and Mr. Sedley's, on which he had felt some delicacy in speaking before, because he had been professionally consulted by financial men with regard to them, and his opinion had been very unfavourable. He, therefore, refrained from expressing it publicly. Both Capt. Dicey and Mr. Bessemer had been most liberal and kind in showing him their plans, and, therefore, he was reluctant to say a word unfavourable to them, but at the same time he thought a public duty was imposed on every one to speak out openly on the subject, for if people were willing to risk their money to the extent of £60,000 or £80,000 in building a vessel suitable for the Channel service, it was of the greatest importance to the public that the first attempt should not be unsuccessful. In fact, he believed one of the excuses put forward by the railway companies for not building proper vessels was, that there was such a variety of opinions upon the subject that no one could tell what was best to be done. For that reason he thought they should keep to acknowledged principles, and not try experiments until it was conclusively proved that a vessel built upon those acknowledged principles would not answer the purpose required. With regard to double ships he had had some practical experience, for it so happened that the first vessel which as a boy he put his foot upon was a twin vessel, one built by his father for the Irish lakes. He had sailed in her many times, and watched the principle, and from that time downwards he had never lost sight of the question, whether a twin vessel, in any form, would meet the requirements of the case. His father's vessel was no criterion to go by; but at the same time the properties she developed gave him the idea that those properties, though they might be greatly ameliorated, were inseparable from that construction; and two of them, which were inherent in the system, were these:—Of all the vessels he had trodden, she was the most uncomfortable, rolling more than anything he ever tried; and in the next place, no speed could be obtained from her compared with ordinary vessels. He quite agreed with Captain Dicey that she steered admirably, for the force of the water coming from the paddle-wheels direct on to the rudder made her answer her helm remarkably well. She was also quite rigid, and would bear any amount of canvas. On these points twin vessels no doubt possessed advantages. Since then he had seen some vessels built for the Forth and Clyde Canal, by Sir William Fairbairn; they had straight sides, and he believed two or three different forms were tried to test the principle whether speed could be obtained. They were extremely light, being built on very elegant lines, and great power was applied, but they utterly failed in speed. As far as he knew, they were never tried in rough water. A vessel was afterwards built in the Clyde, by a company got up for the purpose, but she was also abandoned on account of her slow speed. With regard to Mr. Bessemer's plan, he feared that it would not bear close examination. There was a plan of the vessel on the wall, showing that she was to have fifty feet at each end cut away, and very little freeboard, the effect of which, he believed, would be that she would go level and cut through the waves, but this would result in the waves breaking with great violence on the deck and striking the fore part of the cabin with such power that the shock of the sea upon her would be much greater than with a vessel of the ordinary construction. In the next place, the cutting away at each end had the effect of reducing the length from 350 to 250 feet, and as the deck would be cut up by the engines and the hatches, and the middle entirely occupied by the moving saloon, the deck, except as regarded passengers, would be entirely destroyed. Now, it appeared to him that one of the great features in a Channel vessel must be that she should not only be able to accommodate her passengers comfortably, but also to take on deck all the luggage, which should be lowered by cranes, and would require a considerable area. Unless that were provided for, one of the principal requirements in these large vessels would be lost sight of, because rapid transit from the train to the ship, and from the ship to the train, was one of the main elements of the question. He believed, therefore, that commercially this plan would be a mistake, as the vessel would not carry what was required. Then again, would the swing cabin obviate sea-sickness? His opinion was it would not. It did meet one of the motions very painful at sea—the rolling motion—but he believed the plan to prevent pitching could not be carried out, and in that respect she would be like any other vessel. Then, would the cabin itself be a remedy for sea-sickness? He thought the motion of translation, which had been described by Colonel Strange, was one which could not be got over, and it was the most sickening of all motions, and not only so, but it would be felt more painfully in a large saloon than a small one. Only imagine a saloon, 60 feet long and 30 feet wide, suddenly sinking below one's feet and rising again from six inches up to six feet, as Mr. Merrifield thought possible. There was not a head in the room which could stand such a motion without being giddy. Then there was this great defect, that the cabin was so circumscribed that the passengers could not do what every one who was sick longed to do—lie down. This required a space of at least six feet for each passenger, and the dimentions of the cabin described would not give this kind of accommodation for more than about 60, leaving the other 340 unprovided for. For these reasons he believed that commercially this scheme would be a failure. In his judgment there was no necessity for any of these new schemes, for a vessel of 300 to 400 feet long, built on acknowledged and recognised principles, would answer every purpose. He was not speaking at random, but from examples which any one might learn from, namely, the American steamers, many of which were traversing rivers and seas quite as rough as the Channel, and yet it was a well known fact that there was constantly a band playing and ladies dancing and amusing themselves the whole way. In conclusion, he hoped that an appeal would go forth from that meeting most earnestly to the railway companies to provide the public with something better than the miserable accommodation they at present possessed; he was sure there was nothing to prevent their doing so, and at the same time it would greatly conduce to their own interests.

Mr. C. W. Merrifield, F.R.S., stated, in response to a query put forth on the former occasion by Colonel Strange, the grounds on which he believed that in rough weather a vertical motion of 5 or 6 feet might be expected in any vessel, totally irrespective of any rolling or pitching motion. The result of his calculations, at first only rough, but afterwards repeated more accurately, tended to show that, taking the theory of the oscillating sea wave known to mathematicians as the trochoidal sea wave, and taking a wave 95 feet long and 10 feet high on the surface, a particle on the surface would have a vertical oscillation of 10 feet. If that particle were at the mean depth of 6 feet 8 in. below the surface, the vertical oscillation would be, on as exact a calculation as he could reasonably make, 7 feet 11 in., say 8 feet. That was in the free ocean, and there was no doubt that when the influence of the bottom was felt, the oscillation would be somewhat less, but in such a case as was supposed he did not think it would be less than 6 feet. He had not assumed any extravagant wave, 95 feet being about one-third the length he had actually observed from the Chain Pier at Brighton. The particle he had supposed would be under the bottom of the ship, and the wave acting upon the ship would be intermediate between that and the one on the surface. It was true that a ship of considerable breadth would not be exactly in the position of a cork poised upon the wave, but even on such a ship a vertical oscillation of 5 or 6 feet was what might quite reasonably be expected in rough weather. Between Calais and Ramsgate the waves would generally be less, because the sandbanks of the North Sea broke up the sea very much, but when you came to Boulogne and Dover, on the other journey, it was a very different affair, for practically all you had to break the sea was the narrow part of the channel between Cherbourg and Portland, expanding into a broader bay within, which caused the waves to expand themselves over a larger surface, making to a certain extent a very imperfect harbour. In addition, when a vessel was rising and falling from any cause, it had a certain amount of inertia of its own, and oscillation would not be always confined to what was due to the wave; it was liable to a certain kind of accumulation, and what that would amount to when the oscillations happened to agree it was difficult to say. If two unrestricted oscillations happened to agree in time, the thing instead of oscillating to and fro might go round and round. This he illustrated by the facility with which an umbrella swung between the fingers by the handle might be caused to describe a complete circle, merely by a very slight motion of the hand synchronising with each momentary oscillation. With regard to Captain Dicey's ship he must remark that it differed altogether from the outrigger canoe used in the South Seas, which was not a double vessel at all, but simply a form of carrying ballast to windward, the wind in that region being always one way. The log, by its weight, resisted being lifted out of the water, but if a flaw of wind were to take the canoe aback, having very little flotation it would sink at once, and the canoe would go over. Accordingly in the Fiji Islands, where the winds were not quite so certain as in the trades and the monsoons off Point de Galle, the log of wood became converted into a second small boat, beside the other, but even there it was not a double canoe. He agreed with much that had been said by Mr. Grantham on the subject of twin vessels, for though he had, in the first place, been rather impressed in favour of this mode of construction, all his subsequent knowledge and experience had led him to the contrary opinion. His more recent experience of this class of vessel was in connection with Mr. Sterling's yacht. He always found her very steady, whether under sail or not; but still Mr. Grantham's testimony to the contrary ought to have great weight; and not only did Mr. Grantham's experience go to that effect, but several French engineers, with whom he had conferred, expressed an opinion directly adverse to any increase of steadiness from such a mode of construction. There was no doubt about the steering. He had never said they would not steer well in calm water, but that they answered the helm sluggishly, in consequence of the enormous side that had to be turned round, and that would be especially the case in a head sea. There were two bows for the sea to strike against instead of one, and not only that, but in many cases the sea would glance off from one inner side and strike the other. Captain Dicey, he thought, rather showed a disposition to set up giants of his own for the purpose of knocking them down. He (Mr. Merrifield) had never said the two hulls could not be joined together rigidly, but that it must be done at the expense of weight, which was something serious. The remark with regard to the lashing of two boats had not much force, because with a long spar you might have less strain on the lashing, but much more on the spar than if a shorter one were used. Captain Dicey and Mr. Sedley seemed somewhat at issue on the question of speed, the latter contending for a twenty mile speed, while the former spoke of 15 knots, which he did not consider a great speed. It was not a great speed considering the requirements of the Channel passage, but a low speed; but, when considered as a speed at which you were to make considerable sacrifices—surface friction and double wave displacement—it was a very serious speed. It was, in fact, double the speed at which the screw colliers ordinarily worked; and it took eight times the amount of coal per hour to go 15 knots that it did to go 7½. Therefore he considered 15 knots a good speed, considering the advantages to be thrown away, but not as compared with what it was desired to realise. He had only one more remark to make, and that was, that he could not follow Mr. Mackie in his little geometrical measurement. He did not see how the wave off the bow could come through a canal with the water already going through it from the front. With regard to the effect of putting in two paddles on a side, all those who had any real knowledge of the subject admit it to be a defect—a defect deliberately incurred for certain structural reasons. It was generally admitted that one paddle working in the wake of another was a defect, but that defect was very much enhanced by the way that Mr. Mackie proposed in a confined channel. As to the low bow proposed in Mr. Reed's design for the Bessemer saloon ship, he would himself not use that. He would rather prefer to have it continued to the full height.

Capt. J. E. Davis, R.N., said he would not have ventured to speak on the subject had he not consulted others who were better able to judge of the matter, and finding they agreed with him, he would give his opinion. It would be presumption in him, in the presence of so many engineers and shipbuilders, to speak one way or the other as regards the engineering part of the question. He spoke simply as a seaman; he thought seamen ought to have a voice in it as well as others. Not only was he a seaman, but he was a pilot for that portion of the Channel which these vessels were intended to cross, and therefore he knew something of the place these ships would have to go to, and the work they would have to do. He had no interest in any of them; he did not hold any shares, neither did he intend to, and therefore he could speak without bias. He was a seaman, and a sea-sick one, and so his sympathies, as far as that went, would be with Mr. Bessemer's plan. But he thought Mr. Mackie's was the best plan before them. He did not put much faith in speed; sailors knew too well what that meant. Steam was got up at a certain time, with picked coal, picked engineers, and picked men at a measured mile. He candidly said he did not think that the double vessel would answer. Captain Dicey said the sea would not strike the cabin underneath. He said it would. With regard to the Bessemer cabin they all knew the dimensions of it. That would not cure sickness, he was sure. In Mr. Bessemer's plan they had a cabin of a certain length, and so on, and they all knew it was only intended for those who could pay well, but he would ask what were those to do who could not afford to pay to go into that cabin? Every sailor he had asked looked upon Mr. Bessemer's cabin as a sort of hobby, and a rather expensive one. They did not believe in it. One or two points had struck him as a practical man. If you took a compass and measured an arc of 14 degrees from the point to the outer edge of the cabin it would strike the bottom. If you measured the arc from the top of the deck to the top of the skylight it was 16 degrees, and if the ship rolled more than that it would take the top of the skylight off. Then, again, the steersman was down below. Now in ordinary steering the man at the helm watched the waves, and anticipating each wave he moved the helm accordingly, but the steersman below, or leveller, or governor, or whatever he was called, could not see the waves, and if he were to attempt to act according to the movement of the cabin, he might give his rudder a little turn the wrong way, and the wave might be coming the other, and so upset all his calculations. Then another point was as regards the harbour. It was a very difficult thing indeed for the ordinary boats to get into Boulogne Harbour in bad weather. If one-third of the vessel got in and then a heavy sea struck her, what was to prevent her being dashed against the pier and knocked to pieces? For ships such as these considerably more space would be wanted. He said Mr. Mackie's cabin was too high. Its breadth over Mr. Bessemer's amounted to 14 per cent. That was a matter of great importance as to safety and as to maintaining equilibrium. As to which of the models was best for the Channel passage it would be impossible for them to decide. There were great merits in each. It would not be decided at the Stock Exchange; the almighty dollar would not decide it; no opinion of theirs would decide it. It would depend wholly upon the public to say which was best, and they would have the best, though he thought that, as practical men, nine sailors out of ten would say that for the future passage-boat across the Channel, of these three now before them, the Mackie boat was best.

Mr. J. Oldfield Chadwick was surprised to find that Colonel Strange had neglected to mention Mr. Fowler's scheme of the Channel passage, which had been called Noah's Ark. They had had the opinions of scientific men and he would venture to speak simply as a layman and a landsman. The matter could only be decided by practical experience. With regard to Mr. Bessemer's saloon, a good deal would depend upon actual experience; as to Mr. Mackie's, he thought he was engaged in a vain attempt to manufacture power. It was said that the water would act in propelling the boat as a rocket. All the force would be due to the engines; the picking up of water at the bow and discharging it at the stern was not the most profitable work of the engines. The four frictional surfaces instead of two must inevitably cause a great diminution of speed. Now, the two requisites for the Channel passage were steadiness and speed. Whatever was done, the passage must, to the majority of persons, be a very disagreeable and painful affair. If, therefore, the journey could be diminished by even a few minutes it was an enormous advantage. As to Capt. Dicey's ship, in the event of any accident, the fact of each hull being only half a hull instead of a whole would only add to the disaster. With regard to Mr. Bessemer's saloon, that in all its lines and arrangements was designed with the view to the greatest steadiness. Even if it should not prove to be all that was expected for it, the ship would be an enormous advantage. If he succeeded in keeping the ship steady and horizontal, within perhaps one degree, it would be an immense gain.

Mr. Coryton remarked that Mr. Grantham and others had said that there should be nothing but well-established principles, which meant simply old ships under new forms. He would venture to lay before them what might be called a monstrous form, but one which he was sure would accomplish better than the other plans the end in view.

The Chairman said that it could not be allowed for any further models to be introduced, as there would be no end to the discussion.

Mr. Coryton said then he would just state his objections to these plans. It was a great objection to attempt to steer at both ends, for the means of propelling the ship and steering the ship were in the engine-room. Why do ships roll? As long as the sea was troubled ships would roll, and the great point was to prevent the accumulation of rolling. Ships rolled because they were built symmetrically — they were built like pendulums. The ship rolls and a sea strikes her, and every sailor knew that if the wave struck her at the same period of oscillation, that ship was doomed. It was to obviate that that he would have proposed a plan that would not only have increased the speed, but prevented the accumulation of rolling motion. If any gentleman wished to see his model they could do so by visiting the patent museum, where he had deposited it. This accumulation of rolling had been proposed to be got over in two ways. Mr. Bessemer's scheme was to have a man at a wheel, to balance us all over to France and back again. Another way was by double boats, which, as far as experience had determined, had been shown to be a mistake. He had been out sailing in the south-west monsoon from Galle Harbour with a Portuguese pilot, who told him that he did not dare to leave the ship for 36 hours at a stretch without being able to overhaul her.

Mr. Robert Rawlinson, C.B., considered there was one very important aspect quite apart from the structure of the ship, and that was the sanitary arrangements. The cabin, with its 62 feet width, would be the most unsatisfactory place to put anyone in. It was the sight of sickness about them that often made people sick. He thought if ever those vessels put to sea, the passengers would wish they were in the old boats again. It was said that these models were very strong, because they had been tested. Experiments of that kind proved nothing. The strength of the material of which these vessels were constructed was not increased by the size, but the strain on them was fearfully increased. A model worked on the Thames might apparently bear any strain, but when you came to put hundreds of tons upon her, you must either have a very enormously increased arrangement of beams or your vessel would come to grief. Then, with regard to the steering, every captain and pilot knew when he had a vessel going through heavy waves, he could not leave the tiller or take his eye off the waves, as the ship was always inclined to go out of her track. He thought the double skin friction would be a very retarding power. Those who wanted to know what friction is, if they had seen the boats that were put upon the canals, with a length of 83 feet and six feet beam, and 18 inches draft, would have seen that on being suddenly stopped they would hardly go three times their length. However, if you choose to pay for the coal you may overcome that. He was quite satisfied that the thing required was not large-cabined vessels, but vessels that should cross safely, evenly, and steadily, allowing the passengers plenty of good deck accommodation and a number of small cabins.

Captain Charles Chapman said, as far as the appearance of the boats went, the whole matter was strange to him, but, like Capt. Davis, he was a seaman, having been at sea more or less all his life. He could therefore speak with some accuracy as to what the waves would do. No theory in creation could tell you what they would do under certain circumstances. They sometimes did what they liked and you could not hinder them. The great object was to keep a vessel always above the water, so that she should go over the water as comfortably as she could, and to keep her dry. There was only one way to prevent sea-sickness effectually, he was confident, and that was to stop ashore. It might be modified, no doubt, and boats could be so constructed as to cause less. Every sailor in the world knew what a good sea-boat meant. If you built a boat that would not rise to the wave, the wave would most surely go over her. It would do one or the other. The water must either go over or under a boat, and if she does not rise to it she is a bad sea-boat. He had been ten times round the world, and seen nearly every nook and corner in it, and he therefore considered himself justified in saying that he knew something as to what the sea would do. He had commanded every kind of vessel, from a sloop to an ironclad, and the result of his experience was that a vessel must either let the sea go over her or under her, and all the known ingenuity of man would not alter the fact. He had no doubt that these vessels on the whole were good. He should like to see all the various plans tried at sea. It was a noble thing for these gentlemen to come forward and propoundtheories of this kind for experiment, and it was most unfair for anybody to say that they ought not to be tested. If Englishmen had not the pluck to go and try something they had never tried before they ought to be ashamed of themselves. He thought sailors ought to have a voice in the matter. He had crossed the Channel dozens of times, and it was impossible for the ingenuity of man to contrive anything more miserable than the Channel boats. They were as miserable as they could be, and a disgrace to the country. The ladies at least ought to be taken care of. He was not liable to sickness, because he had too much of the sea, but it almost made him sick to be in one of the Channel boats. He would sooner go down into the forecastle of a collier brig than into the cabin of one of these Channel boats. The public ought to put their hands in their pockets, so that these ships might be tried. What was the use of going on with a whole lot of nasty, dirty, miserable little craft, on which you had not room to sling a cat, or even to be sick? Therefore, he thought there was great honour due to those gentlemen who had brought the matter forward. He could not say which was the best, but they ought all to be supported, and anyone who tried to put a stumbling-block in the way of improvement was too conservative for this day. A double boat would do as well as any other boat at sea, inasmuch as it could now be made of any strength. Any amount of strength can be put, so as to bear any amount of strain; but he did not think that anybody in the world would ever bring forth a ship that would not have some motion. If any plan would do it, Mr. Bessemer's would. He had often slept in a cot or hammock, and even though the cot was still and the ship was rolling about, there was always some motion.

Mr. Edson asked if there was any possible means by which a ship could be kept steady, and alluded to the various experiments which had been made in America, and to Winan's cigar ship.

Captain Hoseason, R.N., said that the first condition of steadiness was size, which was obtained by length, and breadth, and depth of hold. Another means was the motive power. Steadiness could be obtained in ships to the greatest possible nicety by accelerating the velocity in certain seas. For example, he came up 5,000 miles from New Zealand in perfect steadiness and without sickness, because in that sea he could maintain a speed of eight miles. If he had reduced it to five he would have had more sickness. It was due to that particular sea. Now, one object was to provide a very large ship. It was also sought to give a very high power, which would give great velocity, and that in certain seas would give great stability. That was the real or main feature. Without professing to go into any of these plans particularly, he believed Mr. Bessemer was doing a great service to the country, whether his plan was right or wrong, or whether Mr. Mackie's was. They most likely would initiate a new ship. Indirectly they had already been the means of an important movement by the railway companies, who had laid a Bill before Parliament with the object of improving the Channel communication. This in his opinion, would, but for Mr. Bessemer, never have taken place. The lecturer had given them eight causes of sickness in his paper, but he had omitted one. He had been 25 years at sea, and his last voyage was one of 75,000 miles, and he had never been sick; but when he crossed the Channel on the 3rd of October last, he really thought there was a combined effort for the purpose of making him sick. Whether he stayed on deck or went below, whether he went here or there, he saw nothing but sea-sickness. It was not always caused by motion; people suffered from it through bad smells. The passage across the Channel from Dublin to Holyhead was pleasant enough, and for this simple reason, the boats were larger, the draught of water was greater, and the passage was longer. Mr. Reed had published a letter in the *Times* admitting the fact most impartially that one evil of the Channel boats was their smallness. They were well-constructed, but were too little. These boats before them would have that power of size which would give them steadiness in the water, and they would also have the power of speed, which would give them still greater steadiness. But there was a dangerous element in aiming at two high a speed. These vessels were 400 feet long, and 20 knots an hour meant a voyage at three minutes to the mile—15 miles an hour meant four minutes to the mile, and in the Channel that meant great risk of collision. And the question was whether you want such great speed so long as you get the regularity. The boats crossing the Channel are said to go 15 miles an hour. He had never known that. These vessels, having increased momentum, would be able to cross the Channel at more uniform speed. He had in his possession a letter from the captain of one of the packets running between Dublin and Holyhead; they have an average of 13 knots an hour in summer, but the smaller boats never will. Once he was off the coast of New Zealand, and he found it needful to increase the rate of speed. Before doing so he asked a lady who was in the ship if she would come and dine, and she said she could not, as she was too sick. He said he would speak to the clerk of the weather and make it smoother for her. He was then under two boilers instead of four, and he ordered the others to be lit. By-and-bye she came to dinner, and asked him what it was that had made it so calm. He had simply increased the velocity. He would not say that that would meet all the conditions of steadiness, but it would give one great element of it, namely, momentum. In the Dover channel they must not forget the draught of water was only 32 fathoms, and the distance only 21 miles.

Lord Alfred Churchill remarked that last summer he went from London to Boulogne in the old *Moselle*, a vessel of 400 tons, built for the Hamburgh trade, and the captain of the vessel assured him she was almost too large for the harbour of Boulogne. The entrance was extremely narrow, and entering at low water with a wind blowing, a vessel would steer wild. The expression he made use of was, "she smells the ground." He thought there was a great deal in that. If they came to have vessels of such enormous length there, very great danger would result in their entering the harbour. There was a very nasty shoal outside the harbour, and if a vessel of this kind were thrown upon that with a heavy sea, very serious damage might accrue. The Holyhead boats were too large. They were decked and covered forward, so that they went right through the sea, and then there was a passage of 60 miles. The great inconvenience of the Channel passage arose from the crowding of too many passengers. As a preliminary matter, what ought to be done was, instead of having one boat for each train, there ought to be two or three, to go over in comfort. They ought, however, to try these vessels, and he sincerely hoped they would succeed. The scheme which most took his fancy was Mr. Mackie's, but, as he said before, the first thing was to get the railway companies to put on more boats.

On the motion of **Mr. Webster, Q.C.**, the meeting was then adjourned to Wednesday week, the 26th February.

Mr. G. Peacock (Regent-house, Starcross) wished to send a model of his invention, but the offer came, unfortunately, too late. He thus describes his vessel:—"It is a very novel idea, founded on the Peruvian balsa, which vessel is composed of a series of logs of light wood with a platform above them, on which they carry their perishable cargo along the coast perfectly safe and dry, the tippling waves passing under the platform. I have passed them in a large steamer I commanded in the Pacific, going along steadily—no rolling, no pitching motion—whilst my steamer has been rolling her paddles under. I sent in a letter to the *Shipping and Mercantile Gazette* some months ago on the subject, and Mr. Reed wrote me to say my paper was very valuable."

Mr. Edmund Hunt (of Glasgow) sends the following:—"Colonel Strange, when describing Mr. Bessemer's proposed suspended saloon, and referring to a box chronometer, very clearly points out how the latter is liable to 'secondary oscillations,' which are to be overcome in the case of the saloon by hydraulic controlling apparatus. But this controlling apparatus is to be made to operate by a 'steersman,' who is to regulate his action by observing a spirit level. The whole thing, therefore, seems to depend on this 'spirit level,' and I have been surprised that no speaker nor writer on the subject has as yet, so far as I am aware, given this essential part of the apparatus any consideration. The liquid in the level tube must be subject to 'secondary oscillations' of the same kind as those affecting the chronometer or the saloon. It is, perhaps, possible that the spirit level may not experience such large oscillations as to seriously affect its intended use; but it is clear that the oscillations will increase just as the irregular movements of the ship become greater and more violent, when increased controlling action requires to be exerted, and when there is the more need of a really steady guide. So far as I have been able to make out from the published descriptions, Mr. Bessemer's experiment at Denmark-hill was not such as to test the action of the spirit-level in circumstances in which it would be acted on by movements tending to produce secondary oscillations."

We hear that an improved cab has just been tried in Leeds. It is arranged to carry four persons in the same space as an ordinary hansom, has clean and safe entrance and exit, plenty of windows warranted not to chatter, and is from 1 cwt. to 2 cwt. lighter than the ordinary Hansom.

The following is the progress of the Hoosac Tunnel to January 1, 1873:—Opened from east-end, westward, 13,196 ft.; and from west-end, eastward, 8,706 ft; making the total length opened 21,902 ft. There is 3,129 ft. remaining to be opened, being 319 ft. less than two-thirds of one mile.

Recent researches, by Mr. W. Galloway, show that a sound wave may cause the flame inside a safety lamp to be transmitted to the external explosive atmosphere. This shows a new and unsuspected source of explosive danger.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

A committee has been formed of the representatives of some of the colonies, for the purpose of considering the erection of a General Colonial Annexe, in connection with the current series of Annual International Exhibitions. It held a meeting on Friday afternoon, in Gore-lodge, at which the Right Hon. Hugh C. E. Childers, M.P., took the chair.

The Committee for the School of Cookery met on Saturday, and resolved to have a hundred recipes prepared for cooking, in the best way, one hundred dishes particularly suited to all classes with incomes not exceeding £500 a year, such dishes to be the subject of demonstration in the school.

On Monday a meeting of noblemen and gentlemen at Marlborough House was presided over by H.R.H. the Prince of Wales. The following gentlemen were present:—The Marquis of Westminster, Viscount Powerscourt, Lord Ronald Leveson Gower, Mr. S. Addington, Capt. W. Baldwin, Mr. A. H. Brown, M.P., Mr. E. L. S. Benzon, Mr. E. J. Coleman, Mr. F. W. Cosens, Mr. P. Dobree, Mr. H. W. Eaton, M.P., Mr. J. Fielden, M.P., Mr. J. Johnson, Mr. J. Kelk, Mr. C. Lucas, Mr. A. Morrison, Mr. C. P. Matthews, Mr. J. N. Mappin, Dr. Lyon Playfair, M.P., Mr. Quilter, R.A., Mr. S. Redgrave, Mr. Snowdon Henry, M.P., Mr. W. Smith, F.S.A., Mr. W. Waring, and Mr. H. Waring. The object of the meeting was to create a permanent organisation for promoting the exhibition of the best modern British pictures, upon a system somewhat similar to that successfully pursued for more than half a century by the British Institution. General Scott read the following memorandum:—

1. The British Institution was established in Pall-mall, for the exhibition of pictures, in 1805, and continued in existence until the year 1867.

2. Two exhibitions were generally held during the year, one of ancient masters, and the second of modern paintings. The works by ancient masters consisted wholly of loans made by patrons of art, who also contributed largely to the exhibition of modern works.

3. With the modifications necessitated by the change of circumstances, it is proposed to revive the system of the British Institution in the Annual International Exhibitions. The Royal Academy has recommenced an exhibition of works by the old masters. It is proposed in the International Exhibitions to collect only the works of contemporary painters in oil and water colours. This is a field of action which is not covered by any existing institution.

4. There is no doubt that the systematic exhibition of the best contemporary works will be highly important to the progress of art, will be instructive to the public, and it is hoped will be even useful to the patrons of modern art.

General Scott then explained of what classes of paintings the exhibition of 1873 would consist.

The Marquis of Westminster expressed his willingness to act on the committee and to lend pictures, and several gentlemen spoke in the same sense. A general feeling was expressed that the proposed limitation of ten years was too short, and that it ought to be extended to at least twenty-five. The noblemen and gentlemen then agreed to form themselves into a committee, which should meet shortly to discuss further details.

The Society's Committee for advising her Majesty's Commissioners in reference to the display of substances used as food (section, Grocery and Drysaltery) met at the Society's Rooms on Friday, the 7th February. There were present Sir Antonio Brady, in the chair, Lord Alfred Churchill, and Messrs. R. M. Curtis, James Duncan, W. Hall, Reginald Hanson, T. Hicks, F. Machin, J. J. Manley, P. L. Simmonds, Seymour Teulon, G. W. Yapp, A. Steains, S. Palmer, T. F. Blackwell, F. W. Rowsell, and Sedgwick S. Cooper; attended by Mr. E. J. Craigie, Deputy Commissioner, and Mr. P. Le Neve Foster, Secretary. The Committee, acting as a Committee of Selection, took into consideration the applications from intending exhibitors received since the last meeting.

EXHIBITIONS.

VIENNA UNIVERSAL EXHIBITION OF 1873.

Notice to British Exhibitors.—Protection of Industrial Designs and Inventions.

The following are the special regulations, issued by the Imperial Austrian Minister of Commerce on the 15th November, 1872, for the execution of the law of November 13th, 1872, concerning the provisional protection of the objects exhibited at the Universal Exhibition in Vienna, 1873:—

Article I.

Before any application for a "certificate of protection" to be issued by the chief manager of the Universal Exhibition is officially dealt with, an examination must take place in the presence of the applicant, whether the application is provided with the supplementary documents prescribed by law, viz., two identical copies of the specification of the respective objects, or two identical copies of the respective trade mark, pattern, or model, under two distinct covers, on which the object and name of the applicant is to be noted, and if the application is made through an agent, a power of attorney for the latter must be added likewise.

If there is found any deficiency, the application will, without being officially dealt with, be returned to the petitioner in order to have it completed; however, the reason of the return must be notified to the applicant. On the applications being found regular with regard to the above-mentioned requirements, and which are in consequence officially to be dealt with, the day and hour of their presentation must be written conspicuously on the outside of the cover.

It is understood that by a certificate of protection there can be acquired in every instance only one kind of legal protection, viz., either protection by a patent, or of a trade mark, pattern, or model, according to the respective objects being qualified for one or the other kind of protection.

The decision whether such qualification exist in the object, is to be taken according to the provisions of the several Patent and Protection Laws referred to in Art. I. of the Law of November 13th, 1872, concerning the protection by patent according to the paragraphs 1, 2, and 5, of the Law of August 15th, 1852 (Repertory of Laws of the Empire, No. 184), and the protection of trade marks, patterns, and models, according to sections 1 and 3 of the two Laws of December 7th, 1858 (Repertory of Laws of the Empire, Nos. 230 and 237).

The object, therefore, for which a certificate is solicited must be examined in these sense, but inasmuch as a patent is in question, any inquiry into the novelty or usefulness of the object is precluded from examination by virtue of the provisions of section 17 of the law of August 15, 1852.

At the examination insight will be taken into both copies of the specification, respectively of the trade mark, pattern, or model without distinction, whether secrecy has been reserved or not. After which, if the copies have been presented under seal, they will be resealed with the official seal.

Together with this inspection the perfect conformity required of both copies of the aforesaid appendixes shall be verified, and should any disparity be discovered, the applicant will be invited to correct it at once, and by all means before the issuing of the certificate of protection.

For the purpose of duly effecting the above-mentioned examination, the chief manager of the universal exhibition will act in concert with a committee of experts, the constitution of which is left to his choice with the concurrence of the representative of the Royal Hungarian Ministry, in which committee especially mechanics, chemistry, surgical and medical science, architecture, physics, agriculture, mechanical and chemical technology, and mercantile knowledge shall be duly represented.

These experts, in so far as they are not already sworn, as imperial and royal officials, have to declare on oath, in the presence of the chief manager, that they will conscientiously pass judgment and keep secrecy.

Their names will be submitted to the minister of commerce, together with the respective documents recording their having taken the oath.

No certificate of protection can be granted for objects which at the aforesaid examination are declared unsuited, according to the terms of the respective special laws herebefore referred to, either for protection by a patent, or for protection of trade marks, patterns, or models. The respective applications must consequently be returned. Applications for certificates of protection presented to the chief manager after expiration of the legal term of presentation, that is, after the opening of the Exhibition, or if the objects have been introduced later than the opening, after the time of such later installation, shall be refused without even examining the objects for the purpose of stating whether they are qualified or not.

Article II.

In granting the certificates of protection, the chief manager of the Universal Exhibition will always act strictly in accordance with the official appointed for this purpose by the Royal Hungarian Ministry.

The certificates of protection will be issued free of expense by the chief manager of the Universal Exhibition, and countersigned by the aforesaid delegate of the Royal Hungarian Ministry, and must contain, according to the form hereunto annexed,* the name and residence of the applicant, and also the name and residence of his agent, if the application has been made by him, a short description of the respective objects, the kind of protection granted (whether patent, trade mark, pattern, or model protection), finally the day on which the protection begins, to be stated according to the alternative mentioned in Art. II., and the day when it expires.

The chief manager of the Universal Exhibition shall not receive applications tendered to him by holders of certificates of protection during the period of their validity, and with reference to the final sentence of Art. II. concerning the acquisition of a regular patent, or protection of trade mark, pattern, or model, the applicants must be referred to the authorities competent to receive such demands according to the special patent and protection laws.

A refusal shall also be given to any holder of a certificate of protection who applies to the chief manager of the Universal Exhibition with a complaint against third persons on account of encroachments made upon his legal right of protection, as such complaints are to be judged by the competent authorities denoted in the special patent and protection laws. In order to ascertain the facts of the case the said authorities shall apply to the chief manager of the Universal Exhibition for the transmission of an authentic copy of the specifications, trade marks, patterns, or models upon which the certificates of protection are founded, and the chief manager shall, without objection, and stating at the same time whether secrecy is to be kept or not, deliver the said copy under condition of its subsequent return, and after having the fact noted in the register (see Art. IV.)

Article III.

Complaints against the refusal of certificates of protection are legally inadmissible; therefore if made they must be absolutely rejected.

Should however the legality of any certificate be contested, the competent authorities designated in the Patent and Protection Laws will, according to Art. I., have to decide the case.

Such complaints, if presented to the chief manager of the Universal Exhibition, shall not be accepted by him; he shall, however, direct the plaintiffs to the competent authorities.

The transmission of the specifications, trade marks, patterns, or models, on which the contested certificates of protection are founded, to the legal authorities to judge the case, shall be proceeded with according to the analogous rules of Art. IV.

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* A form to be filled up is appended at the end of the regulations

Article IV.

For the certificate of protection granted, and the respective applications, a special register shall be kept in duplicate at the office of the chief manager of the Universal Exhibition, wherein the certificates of protection shall be entered previous to their delivery under consecutive numbers, with the date on which they were granted, and the other essential data pointed out in the regulations, Art. II.; besides it shall be noted in a column of remarks whether the application contained a demand of secrecy for the specification, respectively the trade mark or pattern.

The number under which the application has been recorded shall be marked, not only on the certificate of protection, but also on the respective applications and on the covers of both copies of the specification, respectively of the trade mark, pattern, or model.

The applications, as well as both copies of the above-mentioned appendixes, shall be kept safe on file in successive order according to the numbers of record.

After the close of the exhibition, that is, at the latest on the 15th November, 1873, the chief manager shall transmit one copy of the record, together with the respective applications, and one copy of the specifications, respectively of the trade marks, patterns, or models presented with the same, to the Imperial and Royal Ministry of Commerce, and the other copy of the annexed documents above mentioned, through the delegate of the Royal Hungarian Ministry, to the Royal Hungarian Ministry of Agriculture, Industry, and Commerce, for the purpose of being preserved in the archives of patents of both countries.

Article V.

Every case of granting a certificate of protection is to be published without delay by the chief manager of the Universal Exhibition in the official part of the *Wiener Zeitung* (*Vienna Gazette*).

The analogous publication thereof in the Hungarian official *Gazette*, will be effected by the delegate of the Royal Hungarian Ministry.

The inspection of the record of the certificates of protection granted is open to everyone without restriction, but the inspection of the respective specifications, designs, models, &c., will be permitted only if the owner of the certificate did not ask for secrecy in his application.

Article VI.

Any doubts which might occur, in spite of the preceding regulations, with regard to the application of the present law, shall be submitted to the decision of the Minister of Commerce.

Banhans, m.p.

The great circular roof of the Vienna Exhibition has been fixed in its place, and the building is now finished, with the exception of some unimportant supplementary works. In connection with the exhibition an international agricultural show is to be held. The show will last in all from May 31st to September 27th.

Paris Annual Exhibition of the Works of Living Artists.—The opening of the *salon* of 1873 is announced for the 5th instead of the 1st of May, the usual day, and the closing for the 25th of June. The regulations are almost identical with those of last year. It may be well to remind English artists that the *salon* is open to all the world, subject to the censorship of the jury. All works intended for exhibition must be sent in free of all charges and addressed to M. le Directeur des Beaux-Arts, au Palais des Champs-Elysées, between the 19th and 26th of March, both days inclusive. No one is permitted to send in more than two works in either, or any, of the sub-divisions of architecture, painting and drawing, sculpture, and engraving and lithography.

Dr. Louvel has been awarded a prize of 400 dols. by the French Academy of Sciences, for designing an apparatus for keeping grain in a vacuum, or rather within a vessel in which the air is so rarefied as to kill any granivorous insect.

ON PHORMIUM TENAX.

By P. L. Simmonds.

For several years past much has been published in the Society's *Journal* respecting the so-called New Zealand flax, a descriptive misnomer which both growers and dealers desire to change, in order no longer to mislead manufacturers by the idea that it is calculated to compete with the true flax. Hence the botanic name Phormium has come to be generally adopted in the colony, and is being also used in this country among the fibre brokers and merchants. Notwithstanding what has already been published, there is ample room for more discussion and information, which may tend to ultimate benefit; for certainly among the important fibres of the future that will ere long take a very prominent place in commerce, are the so-called New Zealand flax and the China grass or nettle. When we consider what strides have been made in the production and consumption for fibrous purposes of jute, Manila hemp, and cocoa-nut coir, we have an earnest of the future. What the fleece has become to Australia, that may the *Phormium tenax* be rendered to New Zealand. The demand for the one will be quite as great as the demand is for the other. The green leaf but once transformed into mercantile fibre, the power of production would be so extensive and its cost so moderate, that New Zealand would spring into one of the most commercial and wealthy of England's colonies.

I cannot do better than supplement what has already been published by additions from the Jury Reports of the Otago Exhibition, the report of the Commission of Inquiry in the colony (for which Mr. W. Buller, now at home, is zealously acting) and from various works and notes.

The plant grows indigenous and abundantly throughout the whole of the New Zealand group and Norfolk Island. It flourishes best in valleys and low marshy situations, although it also grows in high, rocky soils, and likewise on the seashore, within the influence of the sea spray. It is of a very hardy character. Thirty thousand acres of the wild plant have been repeatedly met with at one spot, and by culture the plant is necessarily improved. The bogs and rough ground of Ireland, the west coast of Scotland, all our African possessions and West India Islands, New South Wales, and other parts of Australia, are particularly adapted to the *Phormium tenax*. Its introduction has also been recommended for the Mississippi Valley and other parts of North America. It appears, however, to flourish best in an insular position.

Some thirty years ago the plant was cultivated in France, where the fibre was known as *Soie vegetal;* and bell-ropes, cords for window blinds, handkerchiefs, and other manufactures of a silky appearance and most pleasant wear were made of the material.

Mr. C. Thorne has been most active in his exertions to utilise, commercially and practically, this fibre; and his recent letters prove that the prejudice and unfavourable opinion of specimens are not founded on fact, since useful yarn, coarse sheeting, damask towelling, brown twill cloth, Scotch twilled sheeting and linen, canvas and cloths for sacking, have been made from it under his superintendence.

An interesting set of specimens of Phormium, showing the native method of preparing the fibre and of dyeing it black, were sent to the first London Exhibition in 1851 by a native chief; and another very valuable and suggestive set of specimens of the fibre and its tow, by Mr. E. W. Trent, of Old Ford, which he described as having been cleaned and separated by machinery invented by himself without any stripping; it included fishing-lines, rope, and other articles, and received honourable mention. Mr. Donlan, of St. Peter's-square, Hammersmith, also showed samples of Phormium in different stages of preparation, with specimens manufactured from it. Messrs.

Whytlow and Son also showed Phormium cleaned by machinery; and Mr. J. Caradus the flax and twine and line made of it; while several other exhibitors showed flax in various stages and of different qualities.

From the earliest period of European settlement in New Zealand, the value of the native flax has been recognised, and it has always been regarded as one of the most important natural productions of the colony. The desirability of opening up a profitable export trade in the prepared fibre led to numerous attempts on the part of the settlers to discover a method of preparing the fibre by a process less laborious and wasteful than that adopted by the Maories. The Government of the colony, impressed with the importance of the subject, voted a large bonus for the production of 100 tons of fibre of mercantile value which should leave a profit on the process. From a variety of causes the numerous experiments which have been made do not appear to have been attended with complete success, and the Government reward still remains unclaimed.

The first European who drew attention to the value of the *Phormium tenax* was the great navigator, Captain Cook, who spoke of it as something superior to either flax or hemp. To the natives this plant was almost as valuable and necessary as the cocoanut palm is to the savages of the South Sea Islands, or as the bamboo is to the Chinese. With the leaves cut into strips, they bound together the framework of their houses and the defensive palisading of their pahs. Clothing, baskets, fishing-nets, lines, and sails for their canoes were manufactured from the fibre; whilst from the seeds and roots of the plant they extracted useful medicines. As the islands became better known to Europeans, and trade was opened up with the native tribes, the prepared fibre formed an important article of exchange. Specimens of it had been forwarded to England, where they created much interest, and it was regarded as an article the excellence and abundance of which might possibly render the British manufacturers independant of the supply from Russia. A regular trade soon sprang into existence, the natives gladly exchanging the prepared fibre for European commodities. So profitable did the Maories find this branch of industry, that they employed large numbers of their women and slaves in the cleaning of the flax; and there was hardly a single village in flax-growing districts in which the manufacture of flax was not carried on.

In 1828 there was imported into Sydney, from New Zaeland, for shipment to England, 60 tons of prepared fibre, averaging in value £20 per ton, or £1,200. In 1830 the quantity increased to 840 tons, worth at the same estimate £16,800, whilst in 1831 it reached to 1,062 tons, worth £21,240. The official records show how gradually the export of Phormium has fallen off until of late years. In 1853 and 1854 they were returned at about £2,000 per annum. In 1855, owing to the Russian war, they rose to £5,500, then they gradually fell again to less than £1,500, and £2,000, and from 1861 to 1864 scarcely ever reached £260. Within the last five years it has again become an article in the trade returns of the colony. In 1867, 127 tons, valued at £4,256, were exported; in 1868, 534 tons, worth £8,137; in 1869, 2,028 tons, worth £45,245; in 1870, 5,471 tons, worth £132,578. I have not the official figures for the last two years yet.

The flax fibre appears to be extensively used in the colony for stuffing mattresses; and a sample of curled fibre for seating, &c., was shown at the Otago Exhibition. The exhibitor stated that the sample shown was taken from a bed that had been in constant use for ten years, and which still preserved its elasticity. Mr. Honeyman, of Dunedin, exhibited a quantity of prepared fibre for rope, twine, and other coarse purposes, and which the jurors considered would be suitable for spinning by machinery into coarse and medium yarns. The process he adopts is as follows:—The leaves are passed between fluted iron rollers, under a heavy pressure, which bruises the outer skin; they are afterwards steeped in water, and allowed to ferment for several days, until the gum becomes dissolved. The leaves are then squeezed through smooth, iron rollers, which expunge the glutinous matter, and are afterwards steeped for several hours in a weak alkaline lye, then washed in clean water, and finally dried, when the fibre is ready for the hackler. Mr. Honeyman has also tried with success the process of stamping or beating the leaves by means of iron-shod "stamps," worked with revolving cams. The leaf is drawn gradually forward by a pair of holding rollers in front of the beaters, three or four leaves being passed under each stamper at a time. The produce of fibre in the processes described is in the proportion of about one ton to four tons of green leaves, exclusive of waste fibre and other refuse, which would be valuable to papermakers.

Among a variety of specimens shown by Mr. J. A. Smith, of Hawke's Bay, at the Otago Exhibition, illustrative of the applicability of the fibre for various branches of manufacture, were some Auckland-dressed flax, clean but not fine, worth £20 per ton; fine-dressed fibre, worth £40 per ton; and some very fine, worth £70 per ton. The last-mentioned sample was as fine as the best Belgian flax, and capable of being spun and manufactured into very fine fabrics. This was proved by a sample of beautifully fine cambric, which rivalled in its appearance the choicest productions of the looms of France. Samples were also exhibited of stout canvas for steamboats, and of sailcloth of various qualities, as well as white twilled stuff for cavalry trousers. A sample of sewing thread was also shown, which equalled the best thread used ordinarily by tailors. The jurors of this class of goods observed, in their report, "It is impossible, after an inspection of the various specimens exhibited, to doubt the applicability of the fibre of the *Phormium tenax* to the various purposes of the British manufacturer; and the evidence thus afforded should serve as a great inducement to perseverance in the development of the valuable national resource which the native flax supplies."

With regard to papermaking material the *Phormium tenax* must again occupy a first place. Not only is the fibre admirably suited to the purpose, but it is the more valuable inasmuch as the refuse particles of fibre, after its preparation for spinning purposes, are available for the manufacture of paper. In the event of the cultivation of the Phormium there will always be a large quantity of damaged, and, what would otherwise be waste, leaves which would be valuable to the papermaker. Paper was made of it more than thirty years ago, and its special peculiarity is tenacity—a property which must give it value for documents and printings intended to stand a great deal of wear and tear. No better paper could be used for bank-notes or for the printing of valuable standard works.

Mr. J. Murray, in his pamphlet printed on paper made from its leaves, states that the ship Atlanta, which plied between Southampton and the Channel islands, was completely equipped with cordage and rigging made of it, and, he adds, he has seen twine, yarn, lines, sailcloth, sacking, bed-tick, &c., made of *Phormium tenax*, and also fabrics of various kinds, affording demonstrable evidence that its fibre is susceptible of being woven into tissues of the most delicate description, or manufactured into material of the strongest and coarsest kind. Captain Harris's yacht, a perfect gem of naval architecture, was supplied with a mainsail composed of three varieties of New Zealand flax.

From the report of the New Zealand Flax Commission, it appears by the census returns that during the year 1870 there were 161 mills in operation, with an aggregate of 342 stripping machines, employing 1,450 horsepower, and 1,766 persons, the produce being 4,427 tons of fibre. Towards the close of the year, however, the fall in the value of the fibre had so discouraged the proprietors that a large number of the mills were closed.

Although there have been no material alterations in the various processes of manufacture, yet as labour has become more skilled, and experience has suggested modifications in the machinery employed, there has been a marked improvement in the general quality of the fibre produced.

ELECTRO-DEPOSITING COPPER UPON IRON.

By W. H. Walenn, F.G.S.

When, in an experimental course of chemical training, the student is directed to dip a blade or spatula of iron into a solution of the sulphate or other simple salt of copper, and he finds it come out coated with a brilliant covering of the bright red or rather pink metal, he is apt to observe to himself, "how easily this is done, and what a perfect coating this appears." The perfection of the coating however is an illusion, and, however pretty it may look, its value for practical purposes is absolutely nothing; it may often be wiped off the iron, and even when, by cleaning the metal previous to its immersion, some degree of adhesion is obtained, it is only in patches, and the coating itself is porous; in a short time, moreover, it completely ceases, and it is never thicker than a film.

The wisdom of our forefathers is a broad and deep foundation, which has formed, and continues to form, a satisfactory basis for the acquirement of fresh experience and new facts. In utilising this wisdom, it is not well, however, to be too conservative in our principles. While bearing in remembrance, with gratitude and deep respect, the great debt that the present owes to the past—worn intellects, failing health, early death, such are some of the results of the drudgery, little assisted by the aids of science, that workers underwent in past times—we must not forget that the true law of order and development is *progress*, and that the future has more to reveal to us than we have received from the past. Nowhere is this more evident than in the history of manufactures, especially in that of electro-metallurgy. From the time when the workers in the copper mines employed Nature to "transmute" iron rods into copper (by immersing them in a cupreous stream), to the present time, there is just such a change as between the wisdom of those times and the practical results of these times. For those of old revelled in doubtful superstitions; we now delight in realities that will stand the application of well-devised tests.

An interpretation of results, which prominently reveals the weakness of past times, is shown by a story respecting a gilt cup that Dr. Edward Browne drank from, in his travels in Hungary, in the latter part of the seventeenth century. This cup was made of copper, which had been obtained from "two springs of a vitriolat water which turn iron into copper, called the old and the new Ziment," and it bore the inscription "Copper I am, but iron was of old; silver I carry, covered am with gold."

Although, at the present time, the principal amount of copper is obtained from the pyrites, or other ore, solely by smelting, a certain quantity is obtained from cupreous liquors. For instance, the Tharsis Company, at Widnes, one of the most rising manufacturing towns in Lancashire, derive their copper from cupreous cinders, received from the adjacent chemical works; these cinders are ground, calcined, and lixiviated, and the resulting solution has the copper precipitated from it in huge tanks by the immersion of scrap iron therein. The tanks are forty-eight in number, and each contains several thousand gallons. In this application of the experiment heading the present paper, however, every care is taken to prevent the iron from becoming coated or enclosed with copper; but attention will be presently directed to the opposite requirement, namely, that of providing the iron with a perfect coating of copper which is impervious, and which completely encloses the iron.

I have thought fit to begin at the beginning, and for that purpose to notice, in full, a means of coating iron with copper, which is imperfect and only partially dependent upon the principles of electric science for its results, but which is theoretically and chronologically prior to the more perfect methods since employed. Whether the coating obtained by the immersion of a piece of iron in a salt of copper is the result of the action of electric force *ab initio*, or whether merely chemical affinity begins the process (the iron being eager to take the place of the copper in the solution, and so throwing out the copper as a metal), one principle is now certainly known—namely, that from the time that the first particle of copper takes its place upon the iron, the contact of the two metals in the cupreous liquid causes the power of a galvanic current to come into action, and so hastens the further deposit of copper; but the copper being deposited in consequence of the solution of the iron at some part of its surface, and that surface becoming practically less and less, as the deposition goes on, the thickness of the coating is limited, unless some of the iron is laid bare from time to time. We now see that this method of covering iron must always result in a non-adherent coating, and such must be the consequence of any process in which the exterior coating is obtained by the solution of the underneath metal.

The problem of coating iron with copper, by means of a chemical solution, resolves itself, first, into finding out some solution of copper which will not of itself precipitate upon iron immersed therein; second, applying such an extraneous influence to the solution as will cause the copper to fly to the surface of the iron with the requisite mechanical force. No acid or neutral salt of copper will answer this purpose, for, although iron will not readily give way to mechanical force, its power to resist chemical force is very weak, and the above-mentioned requirements render necessary the use of a cupric solution which has an alkaline reaction. Solutions that do not precipitate their copper upon the immersion of iron therein, may contain cyanide of potassium, together with alkaline carbonates, or with ammonia or ammoniacal salts; solutions thus made are used at the present time to coat iron with a film or colouration of copper by many English and foreign electro-metallurgists. The force or influence brought to bear upon the article to be coated is that of electricity, derived from a source distinct from the depositing solution, and applied so as to keep the iron surface in an electro-negative state. This may be accomplished by connecting the iron with the zinc of a suitable galvanic arrangement. If a piece of copper of similar size to the iron be connected to the copper, platinum, carbon, or other negative plate of the battery, and immersed in the solution opposite to the iron article, it will complete the galvanic arrangement, and, by dissolving in the solution, keep up the copper in the solution in proportion as it is thrown out or deposited upon the article to be coated. Thus the two primary conditions of successful coating, first, in regard to the non-action of the solution upon the article; and, second, the employment of an extraneous power to force and determine the metal upon the iron, are fulfilled; and, granting that the proper strength of solution is attained, and the proportional amount of electric power supplied in a given time, it would seem that the resulting coating would be perfect, both in adhesion to the cleansed iron and in solidity of metallic covering; and if the laws that obtain in electro-coating metals by means of acid or neutral solutions were the same for alkaline solutions, undoubtedly the result would be, practically speaking, perfect.

Unfortunately for the adoption of this happy and easy-going method, alkaline solutions of copper do not follow the same laws in their behaviour, under the influence of electricity, as acid or neutral solutions. The criterion of the quality of the deposited metal, as established by Smee, is no longer true when alkaline solutions are employed. Hydrogen has served chemists and physicists well, in being the index or standard for the estimation of vapour density and combining proportions; and Smee's classical researches in the electrolysis of simple metallic salts gave hope that this lightest body in nature might also be employed for the weighty purpose of indicating the quality of electro-deposits. This hope had apparently a firm foundation in the fact that in the salts of the common metals, whenever there is no tendency to evolve hydrogen during deposition, a hard, scanty, crystalline deposit is made. When hydrogen is not evolved, but that point is nearly reached, a practical reguline, soft, and truly metallic coating appears; and when hydrogen is freely evolved, a spongy, highly porous, and amorphous or powdery mass is produced. Smee's laws also apply to acidified solutions of the simple salts, but when neutral solutions are treated with alkalies, so as to yield a precipitate which, by the further addition of an alkali is re-dissolved, the hydrogen test of the reguline character of the metal no longer exists. The metal appears reguline, although hydrogen is evolved, and even when the amount of metal in solution is exceedingly small, no black powdery deposit occurs, but only a more scanty deposit of bright metal. This has been hailed by electro-depositors as a fortunate circumstance, for i appeared, at first sight, to indicate that alkaline solutions could be worked with a greater latitude—so far as quantity of metal in solution is concerned—and therefore required less care in management than the ordinary neutral or acid solution. It is evident, however, that this idea is fallacious, and that to produce a solution which will yield truly reguline and non-porous metal economically, no hydrogen ought to be evolved. This will be seen from two considerations. First, if hydrogen be evolved, it must be at the expense of battery power, the whole of which should be expended in depositing metal; second, the bubbles of gas, as they depart from the surface from which they have originated, affect the metallic deposit by creating pores, for their paths form minute tubes, which are electrotyped upwards as the coating proceeds, and which result in a tubular metallic formation analogous to that of tubercles in the lungs of consumptive patients. As a consequence of these practical facts, the perfection of a coating of copper upon iron rests upon the possibility of the production of a metallic covering by means of an alkaline solution which does not give off gas during deposition. This is difficult of attainment, because, in ordinary alkaline solutions, the point at which hydrogen is given off is not far removed, if removed at all, from the point at which a practical deposit is obtained. Taking these points into consideration, the author has found that the only practical way to obtain such a solution is to take care that plenty of oxide of copper is in solution, and that the solution itself is kept in a saturated or nearly saturated condition in respect to cupric oxide. This is accomplished (see Patent, Specification No. 3930, of the year 1868) by charging the solution, say cyanide of potassium, with cyanide of copper to saturation, and then with the oxide, which it will still dissolve; if any gas is given off on trial, ammonide of copper is added to the cold solution (but not enough to make the solution blue), and the solution is allowed to stand for twenty-four hours; a little free cyanide of potassium is then added. The rationale of this is, that the cupric ammonide carries combined oxygen to the cathode, sufficient to neutralise the hydrogen that would otherwise be evolved; in the mean time, the cupric ammonide has entered into such a chemical combination with the potassic cyanide, as to result in a combination of salts from which ammonia is not given off by the application of heat, and the whole of the battery power is employed in depositing copper in a compact form. When no hydrogen is evolved, the coating may be of any thickness that is required.

It now remains to say a few words upon a portion of the manipulation, which, in the case of coating iron, is of the highest importance—the cleansing of the iron prior to its immersion in the depositing bath. The author prefers to pickle the article in dilute sulphuric acid, say one part of acid to twenty parts of water, then to scrub the wet metal with sand by means of a brush, and to wash the acid completely from the metal by running water, the article being kept under the water the whole time to prevent oxidation. This will suffice if the article is small, but if it is of large size, the chance of a thin film of rust forming on the exposed metal during washing is much increased, and the best plan is to scrub it, as soon as it is thoroughly washed, with a portion of the depositing solution. It does not interfere with the perfection of the result, even if the depositing solution crystallises on the surface of the iron, for a few seconds immersion in the hot solution of the depositing tank, before completing the electric circuit, takes it all off, and the article is in a fit condition to be coated. It is recommended to use a hot solution, for it aids electric conduction, producing a quick deposit, and drives all the occluded air out of the pores. This latter point is very important in the case of cast iron. If the cast iron be porous, and be more like a cinder than a metal—which is sometimes the case—great care must be taken in cleaning, and a weak alkaline copper solution, with intense battery power, must be used for a few minutes prior to the application of the reguline coating in another bath, to obtain a conducting surface all over the iron surface, the article being scrubbed before immersion in the final bath.

Thus we have traced the history, theory, and practice of coating iron with copper from the so-called transmutation of the ancients to the alkaline solutions that have been employed, with evolution of hydrogen gas, both here and in France, to give a film or coloration to iron; thence to the process by which true copper is deposited without gaseous evolution and waste of battery power.

CHEAP DISINFECTANTS.

As the result of a series of experiments with disinfectants, Herr Eckstein, of Vienna, strongly reccommends chloride of lime as the cheapest and best. Bleaching powders rapidly decompose all hydrogen compounds, such as ammonia, sulphuretted hydrogen, sulphide of ammonium, phosphoretted hydrogen, and these are the gases which occasion miasma. It acts rapidly by liberating oxygen, and its chlorine violently decomposes organic matter. At the same time bleaching powders are cheap and accessible. In order to avoid the inconvenience often resulting from the liberated chlorine, the device has been tried of enclosing the bleaching powders in a bag made of parchment paper. By the principle of endosmose and exosmose, the full effect of the liberated chlorine is attained without any inconvenience to the occupants of the house.

Herr Eckstein made comparative experiments with different disinfectants, for two years, with the following results:—1. Two pounds of sulphate of iron dissolved in water and poured into a saucer at first liberated sulphuretted hydrogen, and after twelve hours no longer produced any effect. 2. A solution of sulphate of copper behaved in the same way. 3. Two pounds of crystals of green vitriol retained its action for two days. 4. A mixture of sulphates of iron and copper and carbolic acid lasted two days. 5. Sulphurous acid was suffocating, and ceased to act in one day. 6. Carbolic acid produced a worse smell in the house than the bad gases of the sewer. 7. Two pounds of sulphate of iron in a parchment bag retained its valuable property longer than when exposed free. 8. Two pounds of chloride of lime in a parchment bag continued to purify the air for nine days. 9. Permanganate of soda was successful as long as it lasted, but is too expensive.

Enclosing chloride of lime in a parchment bag, and suspending it in an out-house, or leaving it in a sewer, is recommended by the experimentor as the best disinfectant.

ANCIENT COOKING UTENSILS.

With reference to the cooking section in the approaching Exhibition perhaps some notices of the various appliances used at different periods, ancient and modern, may be not without interest. The present article will deal with the cooking apparatus of ancient times.

The earliest implements of all primitive nations seem to have been much the same. In the East, processes of cooking were always affected by ceremonious and religious observances. Esau's mess of pottage is one of the earliest specified dishes. It was probably made of vegetables boiled up with oil or fat, or with a sort of broth made from bones and gristle. A similar mess is now common in the East. Amongst the Hebrews the meat seems to have been most commonly boiled, either in water or milk, and the meat and broth to have been served separately; salt, spices, and other flavouring ingredients were employed. Roasting on a spit was also a mode of cooking, but one less common than the other. The Paschal lamb was roasted whole, but probably the Hebrews, like the modern Arabs, roasted their meat in small pieces, on spits stuck in the ground, and occasionally turned as the process went on. Birds were roasted whole, and doubtless a common dish was formed of locusts roasted on a spit. The Persians now bake kids and lambs in an oven; perhaps the Hebrews did the same. Fish were generally broiled on the embers or cured. The hearth was formed of stones, with other stones to support the cooking-pots. Of the utensils, we hear of cauldrons, frying-pans, basins, and flesh-hooks or forks.

Wilkinson gives details of the cooking processes carried on by the ancient Egyptians. After the conquest of the country by the Persians, habits of luxury seem to have been introduced, and the Egyptians had the character of being profligate and luxurious, and given to an immoderate love of the table. From various representations in the tombs, a tolerably complete picture of an Egyptian kitchen has been obtained by the author above mentioned. We see the slaughter of the animal, whose blood was often caught in a vase for purposes of cookery. The meat was boiled or roasted. The boiling was effected in a large cauldron, supported on a tripod, over a fire the heat of which was kept up by bellows worked by the feet. The broth was meantime skimmed with a spoon, or stirred up with a large fork. These cauldrons are represented of various sizes, and were probably used for stewing or boiling. Sometimes they are supported on stones over the fire. For roasting, a spit was used, sometimes over a fire contained in a grate of special form. Faggots of wood and charcoal seem to have been the usual fuel. Round balls, apparently of some charcoal or other composition, were also employed. For pounding up various ingredients a mortar was employed. Siphons seem to have been commonly used for drawing off liquids out of the various receptacles in which they were contained.

Pastry and bread were made in the kitchen or in an adjoining room. Both seem to have been of very various kinds and shapes. The forms of animals were not unfrequently imitated in paste, but the commonest shape appears to have been a long roll. The dough was kneaded by the hands and feet. Seeds were often sprinkled over the roll, as is now done in modern Egypt. A sort of macaroni was made of thin paste, stirred with a wooden spatula, and drawn out by pointed sticks. This was baked on a flat pan over the fire.

Turning to the oldest European civilisation, that of Greece, we find that the art of cooking was carried to a considerable height. The Lacedæmonians of course were frugal and temperate in their habits, and it is said that the Bæotians were gross and coarse in their feeding as in all else. The Athenians, at least in the palmiest days of the republic, were noted for their simplicity in matters of eating, but Corinth was luxurious in her feasts. However, it was in Sicily that the cooking art was chiefly cultivated, and Sicilian cooks were ever in greatest request. Even the literature of the art was not wanting. Plato, in his "Gorgias," speaks of a Sicilian book on cookery, and there were many others on the subject, chief amongst them the Γαστρολογία of Archestratus. A lively and tolerably complete account of this last-named book is given in the elder Disraeli's "Curiosities of Literature." Athenæus also gives abundant particulars about Greek cookery. The ordinary meal at Athens was generally cooked by the female slaves, under the direction of the mistress of the house, but for special occasions it was usual to have professional cooks (μάγειροι). There were a great number of these, and the best of them, as above noticed, were Sicilians. They stood with their utensils at a particular part of the market-place, and in another part were cooking vessels and crockery for sale or hire. We have not been able to light upon anything like a list of cooking utensils used in Greece, but we may perhaps be justified in supposing that they did not greatly differ from those in use in Roman houses, which we shall presently describe. The bread was sometimes made at home, but more generally brought from the ἀρτοπώλιδες or bread-sellers. It was of various sorts. The two most common were the μάζα, a kind of frumenty or soft cake (the ρυστὴ μάζα was of barley and wine), and the ordinary wheaten or barley bread.

Of the Roman kitchen and its appurtenances we find an excellent account in one of the excursus to Professor Becker's "Gallus," a book which, it is hardly necessary to say, anticipates any researches into Roman household economy. In earlier years the *culina* or *coquina* (kitchen) was simply the *atrium* or principal room of the house. As luxury increased, a separate chamber was provided, and it was placed at the back of the house, at all events in towns. In the country, kitchen and hall still continued to be the same. Some of the city kitchens were large, and instances are mentioned of their being adorned with frescoes. A usual ornament over the hearth was a snake. Paintings of the Lares, the gods under whose protection was the household furniture, were also common. The hearth or fire-place seems to have been a low, flat platform of brick or stone. It was sometimes divided by partitions. The flues were short. Tripods or braziers were also employed, these latter being portable. In the richer houses there would frequently be a *pistrinum* or bake-house close to the kitchen, but the poorer classes bought their bread from a public baker. The ovens in this bake-house were round, seven or eight feet deep and broad, and were heated by a fire below. The flues were pipes of clay about ten inches in diameter.

As for the utensils, when we remember the immense variety of a Roman banquet under the empire, we can hardly doubt that as many different cooking vessels were required as in a modern kitchen. There were kettles (*ahena*), which were hung over the fire, and had covers (*testa*) or not as required; seething pots (*cacabi, cucumæ, lasana*) of earthenware and metal, sometimes of silver; pans (*sartagines, patinæ*), flat and shallow; vessels of special shape, the *miliarium*, shaped like a millstone, a tall narrow vessel for heating water rapidly, and the *authepsa*, a vessel with a receptacle below for holding charcoal. Then there were tripods for supporting vessels over the fire; gridirons (*craticulæ*); strainers (*cola*), some of these of osier; funnels (*infundibula*), sometimes of glass; sieves (*cribra*); spoons and ladles (*trullæ* and *truæ*); knives (*cultri coquinares*), mortars (*pilæ*); coal-scoops (*prunæ batilla*); steel-yards (*trutinæ*). Vessels, of course, for holding and carrying water there were of various sorts, with and without handles. The *urnarium* was a square table on which the water vessels stood.

In large establishments the work of the kitchen was divided amongst a whole crowd of slaves:—Bakers (*pistores*), pastrycooks (*dulciarii*), cooks (*coqui*), sausage-makers (*fartores*), confectioners (*placentarii*), and others. The marvellous results of their labours have often been remarked upon. We hear of such dishes as a boar half roasted and half boiled, vegetables cooked and carved so as to resemble various sorts of flesh, and other similar devices. A favourite trick was to prepare all sorts of surprises for the guests, and numerous instances of such ingenuity are on record. The curious in such matters may be referred to Petronius, or to the description of the banquet in Professor's Becker's work above cited.

SOME EARLY EXPERIMENTS IN PAPER MAKING.

The various attempts to discover a substitute for rags as a material for the manufacture of paper, furnish a good instance of the tendency to re-invent which is the natural outcome of that impatience for results which prevents men from examining carefully the labours of their predecessors. Our object is not to give a detailed account of all the materials which over-sanguine inventors have proposed as a substitute for rags, but simply to notice briefly a few rare works on the subject, which, though frequently mentioned, have not, as far as we know, been hitherto described with the accuracy to which they are entitled.

The first in order of date is that of Jacob Christian Schäffers, called *Sämmtliche Papierversuche*, which appears to consist of two separate works, entitled respectively, "*Versuche und Muster ohne alle Lumpen oder doch mit einem geringen Zusatze derselben, Papier zu machen*," and, *Neue Versuche und Muster des Pflanzenreich zum Papiermachen und andern Sachen wirthschaftsnützlich zu gebrauchen.* The work is comprised in six thin small quarto volumes, published at Ratisbon, in 1765-71. The author was a Lutheran minister, and was a most voluminous writer on subjects connected with natural history. He was a Fellow of the Royal Society, Correspondent of the Academy of Sciences at Paris, besides being a member of several other learned bodies in various parts of Europe. A second edition of the first volume was issued in 1772, and a Dutch translation of the first and second volumes appeared at Amsterdam in 1770. The original work contains no less than eighty-one specimens of paper made from various substances. Some of them are made entirely without rags, and others with the addition of a small quantity of this material, the proportions being generally stated. Schäffers' first experiments were made with the woolly matter surrounding the seeds of the poplar; and he appears to have tried everything within his reach, which gave the smallest hope of success, such as saw-dust, shavings, moss, hop-bine, nettles, straw, cabbage stalks, cotton grass, stalks and down of thistles, reeds, and wood of various kinds. Some of the results are, it must be admitted, of little value,—the paper is too "short" and too brittle, and does not possess sufficient tenacity to be used either for wrapping or for printing purposes. On the other hand, the later specimens of straw and wood paper, made without any addition of rags, are more than respectable, and certainly do not merit the disparaging remarks of succeeding writers. As might have been expected, Schaffers met with considerable opposition from the paper-makers of his day; and he complains in the preface to the second edition of his first volume that he has been misrepresented, and that the credit of his researches has been given to others. It appears to have been the old story—first of all, the invention was wrong in theory, then it was right in theory but impracticable, and. as a last resource, it was old. He accuses a paper-maker at Halle, who was in the habit of giving lessons in the art, of "spitting out poison and gall" with regard to the new paper. The amount of opposition with which he met would almost make one believe that the paper-makers thought more of the invention than they were willing to admit. The author of an anonymous work, entitled *Unterricht eines Papiermachers an seine Söhne*, published at Leipzig, in 1766, devotes a chapter to the consideration of Schäffers' improvements, of which he has evidently a very poor opinion. He asks what use we can make of the fact that dead leaves when crushed may be made into a sort of useless blotting-paper. "Until," says he, "I see some important and useful work written and printed upon the new Ratisbon paper, my want of confidence in the invention will continue." It is but fair to the author to say that this was written in December, 1765, the same year in which Schäffers' first experiments were published. It is probable that Schäffers' early specimens were not of very good quality, though they must have been bad indeed to have merited the appellation of "a sort of useless blotting-paper." Nothing discouraged, however, by these attacks he set himself resolutely to work, and, having obtained the assistance of a journeyman paper-maker, who acted both as his assistant and instructor, Schäffers learnt the art of making paper. It was his chief employment, he says, in the winter evenings, and he gives a glowing description of the pleasure which his experiments afforded him. With true German tediousness he enters into all his difficulties and successes, and gives the reader the benefit of his impressions at almost every stage of his work.

The rarest of Schäffers' books is, without doubt, his *Erweis in Musterbögen dass die neuen Papierarten von Pappelwolle, Baumblättern, Hanfagen u.s.w. sich allerdings auch zu Tapeten übermahlen und gebrauchen lassen*, which was published at Ratisbon, in 1772. It is a large quarto volume, containing twelve specimens of wall-paper, manufactured by his method. The pattern appears to have been produced partly by block-printing and partly by stencilling. From an artistic point of view they are simply execrable, but the quality of the paper is by no means bad, though much too thick and heavy for the purpose for which it was intended. This book is, as we have said, very uncommon, and, so far as we are aware, has not been noticed by any previous writer. We think it due to Schäffers to say that his books are of extreme interest, showing as they do how much was accomplished by an enthusiastic amateur a century ago. They are not altogether beneath the notice of those who are now, as he was then, seeking for substitutes for rags as a material for paper-making.

In 1786 a small duodecimo volume, containing the *Œuvres du Marquis de Villette*, was printed in London on paper made from the bark of the lime tree, the quality of which is hardly superior to that made by Schäffers. At the end of the volume are inserted specimens of paper made from marshmallow, nettles, hops, moss, reeds, thistles, conferva, and bark of various kinds, such as that of the oak, osier, elm, &c. The copy at the Patent-office Library contains a specimen of straw paper of fair quality, apparently inserted by a former possessor of the volume, on which is written "papier fabriqué avec de la paille, in 1824, près de Jouaret [?]. Depuis près de 40 ans j'en ai le fait avec de la paille aussi et de plusieurs autres fabriqués avec diverses plantes." In some cases the appended specimens show a decided improvement upon those made by Schäffers, but in others the quality is inferior. The paper upon which the body of the work is printed was made by Léorier Delisle, whose name is appended to the dedication. It is stated by Munsell, in his "Chronology of Paper-making" (4th edition, Albany, 1870), that these experiments were carried out at Bruges. In 1808 we find that a French patent was granted to Léorier Delisle for an improved *papier de sûreté*, or paper for preventing forgery. Whether these two persons are identical we are unable to ascertain. No hint of the method employed for producing the paper is given in the work in question, which is simply an uninteresting collection of letters and poems, for which the author richly deserves the fate of *Cinna* in "Julius Cæsar." We may remark that there is a subsequent edition of the same work printed on ordinary paper.

On the 2nd of August, 1800, Mathias Koops took out a patent for "manufacturing paper from straw, hay, thistles, waste and refuse of hemp and flax, and different kinds of wood and bark." No specification of this patent was enrolled, but in February of the following year another patent was granted to Koops for the same object. In September, 1800, he published anonymously an "Historical Account of the Substances which have been used to describe events and to convey ideas, from the earliest date to the invention of paper. Printed on the first useful paper manufactured solely from straw." It is an octavo of 91 pages, and is dedicated to the king. The appendix is printed on paper made from wood alone. Koops' paper is thinner than that made either by Schäffers or Léorier Delisle; and, alluding to the former, he says, "notwithstanding that this author theorised on the subject with great ability he accomplished nothing satisfactory by his experiments, which only tended to prove that various vegetables could probably be so mollified as to make useful paper with the addition of a small quantity of rags; neither himself, nor any other person who has followed him, has ever been able to make it at all without rags, or fit for printing, writing, paper-hanging, or other purposes." These remarks appear to us to be scarcely just to his predecessors. Koops brought out a second edition of his book in the year following. It was printed on paper "manufactured from straw solely, in a more improved state, although not yet brought to such a state of perfection as it will be, made in a regular manufacture, which must be entirely constructed for such purpose." The paper is rather better than that used for printing the first edition. Koops was also the inventer of a process for re-manufacturing old paper, the ink of which was previously discharged, according to a process for which he obtained a patent in 1800. He says in the second edition of his book, p. 250, "I have had the satisfaction to witness the establishment of an extensive paper manufactory, since the first of May, 1800, at the Neckinger Mill, Bermondsey, where my invention of re-manufacturing paper is carried on with great success, and where there are already more than 700 reams weekly manufactured of perfectly clean and white paper, made without any addition of rags, from old waste written and printed paper." The manufactory was afterwards removed to Thames Bank, Chelsea, where it terminated unsuccessfully. The *Gentleman's Magazine* for November, 1808, contains a notice requesting ladies, shopkeepers, and others not to destroy rags, "which are now 7d. a pound." They are also urged to keep envelopes of letters, and waste paper of all descriptions, printed or written, since it may be re-manufactured. It is uncertain whether this refers to Koops' process, but in the *Magazine* for October, 1810, there is a letter stating that "paper made from old paper re-manufactured was found so unfit for use, that it is presumed the manufacture has entirely ceased. The buildings used for it, somewhere about Rotherhithe, were all sold."

The latest attempt which we shall notice is that made by the celebrated William Cobbett. In 1828 that author gave to the world his amusing "Treatise on Cobbett's Corn," a book which was written partly with the object of showing how to "drive the accursed soul-degrading potato out of the land, into which it never ought to have come," and to substitute for it the Indian corn or maize. Amongst the various uses to which that cereal can be applied, Cobbett instances the manufacture of paper pulp; and to show that he is not merely theoretical, he caused some paper to be manufactured from the stalks, and used it for printing the title page and contents of his book. The quality is very fair, and the shade of colour corresponds to that now known as "toned," but the uniformity of the texture is impaired by the presence of small fragments of epidermis. It does not appear from Cobbett's book who the maker was, and no hints are given as to the process by which it was produced, but a writer in the *Mechanics' Magazine* of September 20th, 1834 (vol. xxi. p. 426), states that it was made by a Mr. Rowland. It is said that Cobbett employed the same kind of paper for printing a number of his "Political Register," but we have not been able to verify this statement.

MANCHESTER MILDEW.

The Manchester Chamber of Commerce has just received a letter from the Shanghai General Chamber of Commerce respecting "mildewed shirtings," which will probably open the eyes of those concerned in the matter to the fact that, after all, honesty is perhaps the best policy, and that there is a point beyond which swindling cannot be carried without its evil effect recoiling on its authors. The chairman of the Shanghai Chamber, writing on the 17th of December, 1872, calls attention to the widespread deterioration by mildew of cotton piece goods imported to China from Manchester. The losses from this cause have for some time been very large, but towards the end of 1871 parcel after parcel of gray shirtings, principally if not wholly consisting of second and lower qualities, were rejected by the Chinese buyers as "spotted," and during the past year the evil has become so general that, in September last, it was estimated that 75 per cent. of the entire stock of gray shirtings and T-cloths in Shanghai were unmerchantable as sound goods. The trade was in fact completely disorganised. The cause of the deterioration is, there is strong reason to believe, owing to the use of "size" in undue quantity and of a nature deleterious to the fabric employed to work up inferior cotton, and to increase the weight of the cloth. The results of the extensive importations of unsound goods into China are that large quantities of cloth are forced off at reduced and irregular prices, by which means the tone of the market is lowered, and the value of even sound goods is depreciated. Bales are no longer, as was once the case, accepted unopened on the faith of the sample, but the wrappers have to be cut into in order that the condition of every package may be ascertained. The inconvenience, delay, and loss arising from this practice is obvious. The trouble and waste of time entailed by the necessity of minute inspection, the frequent re-sales of rejected parcels, and the uncertainty as to the completion of any sale until full examination of the contents of the packages has been made, all represent a positive burden on the trade. The destruction of the packages is, moreover, a loss to the native merchant, who can never again pack his goods so securely for inland transport. More important, perhaps, than all is the fact that the confidence of native dealers and merchants in foreign goods is shaken; for they are no longer sure of carrying their purchases to the end of a long journey in a merchantable condition. Such general want of confidence in the soundness of foreign cotton goods must tend, it is urged, to render them unpopular among the Chinese, and, considering that foreign imports, though cheaper, have great difficulty, even under favourable circumstances, in competing with the more durable native manufactures, the trade is not in a position to bear any additional burden. Although, therefore, the first losses from mildew fall upon the importing merchant, while the manufacturers appear to escape altogether, yet such an unequal distribution of the responsibility cannot continue, if for no better reason than that the magnitude of the losses will soon put it beyond the power of the merchants to bear them, were they ever so willing. The result will therefore ultimately affect the Manchester manufacturers as seriously as the China merchants, and the latter urge the Manchester Chamber of Commerce to join with them in a strict investigation into the circumstances, with a view of putting an end to "a crying evil affecting not only the interests of the most important branch of British industry, but also the honour and reputation of British commerce." That it should be found necessary to address this remonstrance to such a city as Manchester is not the least distressing part of the affair.—*Pall Mall Gazette.*

"WHOLESOME HOUSES."

Writing to the *Times* a short time back, Mr. G. Jennings makes the following valuable and practical remarks:—"Ventilation, to be certain and perfect, should be natural—independent of doors or windows, tight-fitting or otherwise, and on no account should external air be admitted through 'cold air gratings,' or warmed over and over again by hot-water pipes. The source of supply should be the purest attainable, and as well known as the gas or water supply, but, unlike either, impossible of derangement, requiring no thought or attention, day, night, or season.

"As this perfect ventilation can be insured without chilling influences, without expensive or complicated arrangements, and with a saving to the country annually of thousands of tons of coal that are now burnt wastefully, giving no returns whatever, I trust you will grant me the space to make this apparent; but, before doing so, as fireplaces and chimneys are the natural vents of all rooms, and necessary to the cheerful open fire—one of the delights of an English home—I would desire to say a few words in relation to both.

"One of the first authorities on chimneys about a century since was Count Romford, who did much to improve them by reducing the throat immediately over the fire. He diminished the draught from the then ill-fitting doors and windows, which our forefathers endeavoured to counteract by the interposition of folding screens and high-backed settles. In a published work by the Count it is asserted that 90 per cent. of heat passes wastefully away up every chimney, leaving only 10 per cent. for radiation into the room.

"I have never heard this estimate even questioned; but, allowing that we now get (owing to improvement in stoves) 25 per cent. of the radiated heat in the immediate neighbourhood of the fire, 75 per cent. of heat still passes wastefully away; in other words we expend 32s. on a ton of coal to get 8s. worth of doubtful heat. Compare this fearful waste, this total loss, with the economy practised in our manufacturing districts.

"The first thought and duty of an engineer is to get from the boiler that may be planned or fixed under his direction the greatest possible amount of steam with the smallest amount of coal; nothing is wasted; everything is utilised, even the exhausted steam is employed to heat the feed water, rather than lower the pressure within the boiler by pumping in cold.

"Now, if it be desirable, on the score of economy, to heat the feed water necessary to a boiler, surely it is equally desirable as regards, not only economy, but health and comfort, that the air necessary to a room should be warmed before admission. This I do, and this for 12 years I have done, by the following arrangement, which requires 'no thought or attention day, night, or season.'

"Over any fireplace, in an old house or a new one, I fix a terra cotta chamber, having a throat or passage through it for the escape of smoke and vitiated air. The terra cotta chamber is six inches deep, strongly made, and of a size sufficient to cover the whole of the fireplace opening, and to take a 4½ inch bearing on the front, back, and side walls, finishing fair with the front of the chimney breast.

"The chimney I employ is circular in form, 10 inches, as a rule, in diameter, enclosed in a square case 14 and in some cases 16 inches square, both being of terra cotta, expressed through a die at one operation, like common drain pipes, and then cut to convenient lengths for use—some square, others bevelled, to enable the bricklayer to take the flue in any required direction. With these flues I form the chimney, commencing at the chamber fixed over the fireplace, and terminating at any point between the eaves and ridge of the building. Above this point the chimney is continued, and completed with plain terra cotta pipes, enclosed in brickwork in the usual manner. At the level at which the air chamber flues terminate I fix in the external wall an air brick of a size proportioned to the requirements of the room, hall, ward, or other enclosed space, and from this source, or from a specially constructed air main, the fresh air flows down the space round the smoke flue into the terra cotta chamber covering the fire, then up to and through openings formed by preference on either side of the chimney breast, as near to the ceiling as the cornice will permit.

"The success of the arrangement I have attempted to describe is now beyond dispute. Thousands of chimneys as I write are warming the fresh air as it passes to supply the exhaust within the rooms they are connected with, raising the temperature from 32 to 61 degrees, thus utilising the heat that in ordinary chimneys passes wastefully away, the chimney shaft being to the room what hot-water pipes are to a vinery or conservatory, with this difference, that the supply is always fresh and continuous for hours after the fire is out, the circulation being of course less rapid and temperature lower as the chimney cools. The arrangement also secures ventilation, with or without fire or light, and perfect joiner's work tends to increase the supply and circulation of fresh air."

NEW GAS COMPANY.

A new gas company is now attracting considerable attention. Its object is to produce from water a gas capable of lighting and heating. The patents under which the process is to be carried on are those of Mr. Ruck. A practicable model gas manufactory has been built at Battersea, and experiments have been there exhibited of the working of the process. Steam is decomposed, by highly-heated coke or charcoal, into free hydrogen, mixed with carbonic oxide and carbonic acid gases, and some sulphurretted hydrogen, which last is separated from the gas, but the carbonic gases remain, unless when the carbonic acid is removed by the help of caustic soda. The resulting gas is to be used for heating purposes only, as hydrogen gas in burning gives little light but much heat. But the gas is also to be converted into gas for illuminating purposes by being charged with petroleum vapour, which is said to form, with the hydrogen, a more or less permanent combination, and a rich hydro-carbonaceous gas, yielding a light equal to 16·6 candles, burning 120 grains of sperm. The heating gas and the gas for light must either be separately prepared and distributed in two separate sorts of pipes, or else provision must be made for carburetting the gas at every point where it is to be used. Either plan appears open to grave objections. The decomposition of water or steam by highly-heated carbonaceous substances into hydrogen and oxy-carbonaceous gases is not new. Some account of what has been done appeared in a former number of this *Journal* (May 6, 1859). Of the various attempts that have been made, the most successful was that of Mons. Gillard, who produced hydrogen gas from super-heated steam, and utilised it for lighting purposes by igniting it under a cap of fine platinum wire gauze. This cap was rapidly raised to a white heat, and diffused an intense white light. An objection urged against the new gas is, that the fuel required to generate the steam would produce directly as much or more heat than can be obtained by combustion of the gas. How far this objection is valid can only be decided by practical experience. The great difficulty is the carburetting process, and if the new company have got over that, they will have conferred upon the public a very serious benefit, by rendering it independent of the fluctuations of the coal supply and the vagaries of coal owners.

A drop of an alcoholic extract of Brazil wood produces on flour adulterated with alum a greyish blue or greyish violet spot.

NATIVE GUANO COMPANY,

Two reports have lately been made to the Metropolitan Board of Works, by Mr. Bazalgette and Mr. Keates, relative to the experimental operations of the company at Crossness. The commercial and financial results are treated by Mr. Bazalgette, and the chemical and sanitary considerations the report of Mr. Keates discusses. Between the 27th of August and the 30th of November, the time allowed for the investigation, 11,672,737 gallons of sewage were experimented upon, being about 1-343rd part of the average flow of sewage discharged at Crossness, and 1·686th part of the sewage of London. The quantity of A. B. C. mixture used in the shape of alum, clay, charcoal, lime, and blood, amounted to 166 tons 14 cwt. 1qr. 13lbs.; and the sewage treated, assuming it to produce 100 grains to the imperial gallon, 74 tons 8 cwt. 3 qrs. 16 lbs., making a total of 241 tons 3 cwt. 1 qr. 1 lb., giving, in the shape of dried residue, called native guano, 133 tons 7 cwt. 11 lbs. There was also in the tanks the equivalent of 8·34 tons of guano. The total expenditure amounted to £895 3s. 3d. This gives the cost of manufacture at £6 6s. 4d. per ton, exclusive of rent, interest on capital, and other incidental items.

About 80 tons of the deposit were sent across the river to Messrs. Sillars, to mix with fish manure. Two or three tons of it were put upon a small quantity of land rented by the company at Crossness; about ten tons remained in a wet state banked up upon the ground, about 40 tons, in a dried state, were in the company's sheds, and a few tons were sent away in small quantities as samples; but, with the exception of a few shillings, says Mr. Bazalgette, the company's books showed no returns in the shape of sale of manure.

As to the chemical part of the question, there were three points to be considered:—The effect of the treatment of the sewage by the A. B. C. process as a means of clarification and defecation; the posibility of completing the preparation of the manure without creating offensive effluvia, which might prove a nuisance to the surrounding neighbourhood; the value of the manure produced from the precipitated solid matter.

On these three points the conclusions of Mr. Keates were:—That the effluent water was, on the whole, very good. The A. B. C. treatment so far clarified and defecated the sewage that, looking solely to the physical condition and chemical composition of the water produced at Crossness, it was in a fit state to be admitted into any ordinary river without producing a dangerous degree of pollution. It was however remarked that the extremely dilute state of the sewage from incessant rain made these results not entirely conclusive. During the preparation of the manure, including the storing of the moist cakes of mud from the process, and the final drying in the drying cylinder, no offensive effluvia were emitted, and taking the experience of Crossness as a guide, it appears that the A. B. C. process may be carried on up to the completion of the manure for the market without producing any nuisance.

The value of the manure, Mr. Keates considered a question for practical experiment rather than chemical analysis, but on the whole he stated that in his opinion it could not be estimated as above 20s. per ton.

In order to render moulds of plaster or gutta-percha used in electrotyping conducting, the use of a solution of 1 gramme silver nitrate, 2 grammes water, 2·5 grammes ammonia (sp. gr. 0·96), and 3 grammes absolute alcohol, is recommended; before the coat is quite dry, it is exposed to a current of sulphuretted hydrogen.

During the year 1872, 1,179,433 bales of cotton were shipped from the three ports of Bombay, Kurrachee, and Carwar, against 1,168,407 bales in 1871. It is estimated that, inclusive of native states, about three millions of acres were last year under cotton cultivation, against three and three-buarter millions in the previous year.

PERUVIAN PETROLEUM.

The northern coast of Peru has important deposits of mineral oil, in the department of Piura, which is bounded on the north and north-east by the republic of Ecuador, and the centre is situated a little to the south of Tumbez, in the province of Ayavaca. The workings have not as yet acquired the importance which seems destined for them, as only four wells have been opened. The petroleum extracted amounts to about 3,000 gallons. Mr. Larkin, a citizen of the United States, is the director of the works, representing a society whose head-quarters are at New York, but which was organised in virtue of a concession made by the authorities of Piura. The charter, however, has yet to be confirmed at Lima, so that this new branch of industry cannot attain the dimensions intended until this formality has been completed.

The mineral oil is to be found in other places, and varies greatly in depth. Sometimes it is to be found near the surface; at others it is necessary to dig for some five hundred feet. The district which is crossed consists of sand, alternating with beds of pebbles. These are recent deposits. Layers of sandstone, of potters' clay, and schist succeed them; these are occasionally interrupted by chalky substances. All these rocks are friable —they crumble on exposure to the air The stratification is very regular; they are generally towards the south-east, at an angle of about ten degrees.

The petroleum seems to come from the schist, which is full of fossils, but the geological formation to which they belong has not been determined.

There are certain differences between the mineral oils of Tumbez and Pennsylvania. The former does not, so to speak, give any paraffin, but yields, by distillation, more than sixty per cent. of kerosene, and about twenty-five per cent. of a heavier oil for machinery; of the fifteen per cent. remaining the principal portion is tar, the proportion of oil of naphtha being unimportant.

The explorations are situated near the sea, which is always calm here. The workmen are Indians, and they earn about half-a-crown a day. Hitherto the petroleum has not been refined, but a factory has been erected, which will begin to work as soon as the company's title has been secured. The price of the raw oil when shipped cannot yet be determined. Mr. Larkin professes to have delivered his merchandise in London at £1 per forty gallon cask. Two cargoes have been sent to England and a third to Australia. The kerosene is worth half-a-crown a gallon, with a tendency to depreciation.

If the coast of Tumbez is as rich in petroleum as is supposed, it will furnish the Pacific republics with mineral oil; it will support Australia, and will be able to dispute the sale of the proceeds of Pennsylvania and Canada in the markets of Great Britain and California. —*Annales du Commerce Extérieur.*

CORRESPONDENCE.

ECONOMY IN THE CONSUMPTION OF COAL.

Sir,—Finding the Society of Arts, in the interest of the public, are actively seeking the means of economising the consumption of fuel in the shape of coals, I take this opportunity of informing you that, having long been of opinion that common white chalk would prove a valuable heat raiser and retainer, and would to a considerable extent save the consumption of coal, I commenced some experiments with my steam boilers some years ago, but the prejudice of my engineer and stokers prevented any success worth speaking of. Within these last few weeks, however, I have commenced my experiments anew, and have succeeded perfectly in making a saving of nearly 25 per cent. in coal.

For the various purposes of my business I employ two thirty horse-power boilers, which are kept up from twelve to sixteen hours every day at a pressure of forty pounds of steam to the square inch. To accomplish this I have been for some years past compelled to consume weekly eight tons of coals; since I have commenced with chalk and coals I have been able to raise the same amount of steam with six tons of coals and one ton of chalk, the coals costing 36s. per ton (Welsh) and the chalk 9s. per ton, thus saving on this small consumption £3 3s. per week, or nearly 25 per cent. I can find nothing objectionable or detrimental in this use of chalk; on the contrary, I find it a great preventor and consumer of smoke, and that the patent fire-bars I use are kept clear from clinkers; and the chalk, when contracted into lime, is not useless, but makes fair limewash for walls, stables, and passages, and is undoubtedly a good disinfectant if consigned to the dust-bin. The chalk requires only a little extra care in stoking. For domestic purposes I feel satisfied it will prove highly useful, especially in kitchen ranges, large close stoves, or any kind of furnace, the only drawback for use in the dwelling house that might arise would be the probable spilling of any of the lime on the carpets in removing the ashes, and this, of course, a little care would prevent.

From the intense heat the chalk gives off in consumption, I am satisfied for locomotive engines it would prove an enormous benefit, reducing the weight of fuel to be carried, and preventing the suffocating smoke from the furnace we all occasionally suffer from in railway travelling. These remarks will also apply to the heating of gas retorts and sea-going steam vessels, and, indeed, in almost all instances where fire is the great active principle.

I have two furnaces at work daily at my factory, No. 8, Finsbury-place North, near Finsbury-square, where I shall be happy to show the operation to yourself, friends, or any member of the Society of Arts, between the hours of ten in the morning and four in the afternoon, and shall be glad to afford any explanation or information that may be required.

I think, Sir, you will admit that at no time has this subject been more important than the present, when the price of coal has risen more than cent. per cent., with a short supply from the pits. I believe the plan may be of importance enough to the public to obtain for me the Society's gold medal, which I should greatly prize if I were considered worthy to receive it, for my application as a substitute for coal of an abundant and easily obtained substance.

I am, &c.,

GEO. BATTY.

15 and 16, Pavement, Finsbury, Dec. 20th, 1872.

GENERAL NOTES.

Technical School for Edinburgh.—A preliminary meeting of persons favourable to the establishment of a technical school in Edinburgh has been held, under the presidency of the Lord Provost. Resolutions were adopted to the effect that such a school was desirable, and that a portion of the surplus funds of Heriot's Hospital might very properly be set apart for its maintenance. A committee was appointed to prosecute the matter.

Cultivation of Coffee in Ceylon.—The total value of coffee from Ceylon in 1837 was estimated at 500,000 dols., and in 1870 the export was over 94,000,000lbs., worth fully 175,000,000 dols. Within the last 15 years the number of plantations has increased from 404 to 1,004; and the extent of land cultivated, from 80,000 to 200,000 acres, which is exclusive of the coffee cultivated by the natives in their gardens, estimated to cover 50,000 acres. There are now 1,004 working plantations, requiring 200,000 Coolies to cultivate and gather the crops, and worth for the land, machinery, and stock, not less than 35,000,000 dols.

Australian Patent Office.—We learn from the *Australian Mechanic* that the Patent and Registration offices at Victoria are to be united. The scheme has been for some time under consideration, but it has now been carried into effect by the Hon. J. W. Stephen, the present Attorney-General. The bill for uniting the offices is now before the Upper House.

Progress of Gas Lighting in New South Wales.—During 1872 another town in this colony has been lighted with gas. It is over 20 years since Sydney, the metropolis, was lighted; it is ten years since West Maitland was lighted; and five years since Newcastle was lighted; and now Bathurst, which is the largest inland town, and, being situated in the centre of a large mineral district, is rapidly rising in importance. The works are the property of the engineer of the Australian Gaslight Company, Sydney, and are constructed to supply at present about 30,000 cubic feet per day. They have been erected under the superintendence of Mr. J. Anderson Ward, a son of the owner. An Act of Parliament has been obtained. The town was lighted for the first time on the 13th of May last, and the event was celebrated by a public dinner given by the proprietor. A company has been formed to light Parramatta, another small town. An Act has been passed, and the works are now in progress.—*Journal of Gas Lighting.*

Self-working Ship Ventilation and Ship Pumginp.—An invention of great advantage to ships has been successfully tried at Plymouth. Foul water and foul air in the lower part of the ship are both pumped out by the mere rolling of the ship. Two iron cylinders, connected below by a tube, are placed one on each side of the vessel. From each cylinder a pipe descends into the air or water that is to be pumped out, and a similar pipe rises as an outlet above. The cylinders are filled with quicksilver, and being connected below, as already stated, each roll of the ship produces an alternate rise and fall of the quicksilver, creates thereby a vacuum, into which the bilge-water rushes, and is pumped out at the vent in a continuous stream. The cylinders which expel air are filled with water; but their action is the same as here described.—*Builder.*

Paper Wheels.—We learn from the monthly scientific paper in *Chambers's Journal* that these are made by treating waste-paper, or paper-pulp, or vegetable fibre with chloride of zinc, and subjecting it to pressure, whereby it becomes hard and tough. The hardness and toughness may be varied according to the strength of the bath of zinc solution, and the material produced will be flexible as leather, or rigid as wood. It takes colour readily, and can be used as floor-cloth; it is a substitute for leather, both soles and uppers; can be fashioned into gas-pipes, handles for whips, for saws, and many kinds of tools; into buttons, combs, pulleys, and so forth, and into large sheets for roofing. It promises to be useful for ornamental purposes; perhaps, for coats and trousers; and paper already manufactured may be toughened by being passed, unsized, through the chloride of zinc bath.

Means for Colouring Parafine, &c., black.—The Frankfort *Jahresbericht des physikalischen Vereines* contains the following curious note:—"For a long time past maunfacturers of candles, wax, stearine, or parafine, as the case may be, have been trying to discover a means for colouring them a deep black (with a view to special occasions, such as funeral ceremonies) by a simple method so as at the same time not to injure the brilliancy of their light. The result can now be attained by melting the substances composing the candles into a vessel containing peeled and bruised nuts of Anarcadium (*Anarcadium Orientale*), where they are to be allowed to digest for a few minutes. This fruit contains a liquid vegetable oil, of a black colour, which unites itself intimately with the matter of which the candles are formed without prejudicing their powers of illumination."

Tasmanian Iron.—Experiments in smelting the Tasmanian iron ore from the Ilfracombe beds have been successfully made. The iron is said by competent judges to be equal to any produced in Europe. A small bell was cast, and is now on view at the Exhibition. The remainder of the ore was run in prepared pig moulds weighing about 1cwt. 28lb. each, and one "sow" of about 3cwt. An influential company has got a lease of a large tract of the iron country, and smelting operations will be begun without delay.—*Melbourne Age.*

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

REPORTS ON THE LONDON INTERNATIONAL EXHIBITION OF 1872.

The reports which appeared in the last volume of the *Journal* on the various sections of the above Exhibition, are now published complete, in a pamphlet form (price 2s.), and can be obtained at the office of the Society.

THE LIBRARY.

The following works have been presented to the Library:—

Census of Victoria, 1871. Part 4, Religions of the People; and part 5, Education of the People.

The Journal of the London Institution. Vols. 1 and 2, 1871 and 1872. Presented by the Institution.

Report of a Grand Banquet given to David Chinery, Esq., F.R.G.S., late Chargé d'Affaires of the Republic of Liberia.

Our Seamen; an Appeal, by Samuel Plimsoll, M.P. Presented by the author.

The Antiquary. Vol. 2. Presented by F. W. Monk.

Gemeinnükige Wochenschript. Vol. 22, for 1872.

Dulwich College and the Endowed Schools Commissioners. By John R. Adams. Presented by the author.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. The following meetings have been arranged:—

February 19.—"On the Virginias; their Agricultural, Mineral, and Commercial Resources." By Major Hotchkiss, late C.S.A., engineer in charge of the survey of Virginia by the Washington and Lee University. On this evening Sir Antonio Brady will preside.

February 26.—Discussion on Lieut.-Colonel A. Strange's paper, "On Ships for the Channel Passage," adjourned from Wednesday, the 12th. On this evening Vice-Admiral Erasmus Ommanney, C.B., F.R.S., will preside.

March 5.—"On Gas-lighting by Electricity, and Means for Lighting and Extinguishing Street and other Lamps." By W. Lloyd Wise, Esq.

March 12.

March 19.—"On Certain Improvements in the Manufacture of Printing Types." By J. R. Johnson, Esq.

INDIA COMMITTEE.

A Conference will be held this evening (Friday), February 14th, at eight o'clock, when Mr. J. H. Stocqueler will open the discussion with a further paper, supplementing the previous one, "On the Progress of India during the last fourteen years." Major-General Nuthall, late Political Agent at Munnipore, will preside.

The next Conference will be held on Friday, 28th instant, when a paper will be read by T. Roger Smith, Esq., architect, on "Architectural Art in India." James Fergusson, Esq., D.C.L., F.R.S., will preside.

A Conference will also be held on Friday, March 14th, when W. T. Blanford, Esq., of the Indian Geological Survey, will read a paper on "The Mineral Resources of India."

CANTOR LECTURES.

The second course of these lectures is "On the Energies of the Imponderables, with especial reference to the Measurement and Utilisation of them," by the Rev. Arthur Rigg, M.A. The remaining lectures will be delivered on the following evenings, at eight o'clock:—

Lecture III.—Monday, February 17th, 1873.

On the Energy of Vitality, with especial reference to the Measurement and Utilisation of it.

Lecture IV.—Monday, February 24th, 1873.

On the Energy of Affinity, with especial reference to Suggestions for Estimating and Utilising it.

Lecture V.—Monday, March 3rd, 1873.

On the Energy of Electricity, with especial reference to the Measurement and Utilisation of it.

Lecture VI.—Monday, March 10th, 1873.

On the Energy of Light, with especial reference to the Measurement and Utilisation of it.

Lecture VII.—Monday, March 17th, 1873.

On the Energy of Heat, with especial reference to the Measurement and Utilisation of it.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...SOCIETY OF ARTS, 8. Cantor Lecture. Rev. A. Rigg, "On the Energies of the Imponderables."
Royal United Service Institution, 8½. 1. Commander Cyprian Bridge, R.N., "Fleet Evolutions and Naval Tactics." 2 Vice-Admiral Ryder, "Tower's Speed-Indicator and Governor."
Entomological, 7.
British Architects, 8.
Medical, 8.
Asiatic, 3.
Victoria Institute, 8.
London Institution, 4. Professor Duncan, "On Physical Geography."

Tues. ...Civil Engineers, 8. Renewed Discussion on "The Mètre Gauge for the State Railways of India."
Statistical, 7¾. Mr R. H. Inglis Palgrave, "On 'Bill' Circulation, with some Banking Statistics."
Pathological, 8.
Anthropological, 8.
Zoological, 8½. 1. Professor G. J. Allman, "Report on the Hydroida collected during the expeditions of H.M.S. *Porcupine.* 2. Mr. W. K. Parker, "On Œgithognathous Birds." 3. Mr. A. H. Garrod, "Notes on the Anatomy of the Binturong (*Arctictis binturong*)."
Royal Institution, 3. Prof. Rutherford, "Forces and Motions of the Body."

Wed. ...SOCIETY OF ARTS, 8. Major Hotchkiss, "The Virginias; their Agricultural, Mineral, and Commercial Resourcs."
Meteorological, 7.

Thurs...Royal, 8½.
Antiquaries, 8½.
Royal Institution, 3. Dr. Armstrong, "Formation of Organic Substances."
Linnæan, 8.
Chemical, 8. 1. R. S. Dale and Dr. C. Schorlemmer, "On Aurine." Researches on the Action of the Copper Zinc Couple on Organic Bodies. 2. Dr. Gladstone and A. Tribe, "On Iodide of Ethyl." 3. Mr. Wills, "Solidification of Nitrous Oxide." 4. Dr. C. R. A. Wright, "Action of Hydrochloric Acid on Codeine."
Numismatic, 7.
Royal Society Club, 6.

Fri ......Philological, 8¼.
Royal Institution, 9. Professor Clerk Maxwell, "Action at a Distance."
Geological, 1. Annual Meeting.

Sat ......Royal Botanic, 3¾.
Royal Institution, 3. Dr. Freeman, "Comparative Politics."

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FRIDAY, FEBRUARY 21, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

TECHNOLOGICAL EXAMINATIONS.

The Programme of Examinations in the Technology of some of the Arts and Manufactures of the country is now ready for issue, and may be had on application to the Secretary.

The subjects selected for 1873 are Cotton, Paper, Silk, Steel, and Carriage-building. Candidates, in order to obtain certificates in any of these subjects, must pass the examinations of the Science and Art Department in certain sciences, which are specified in the programme; and in addition to these, special papers will be set in the technology of each manufacture by examiners appointed by the Society of Arts, and certificates of three grades will be awarded:—"Honours," "Advanced," and "Elementary."

The examinations of the Science and Art Department will be held during the first three weeks of May, the technological paper being worked on the evening of the 17th May. For the dates of the Science subjects candidates are referred to the Science Directory, published by the Science and Art Department.

The following Prizes are offered by the Society of Arts in each of the five subjects mentioned above:—

To the best candidate in Honours, £10.

To the best candidate in the Advanced Grade, £7.

To the best candidate in the Elementary Grade, £5.

In order that these Examinations may really be successful in promoting technical education in this country, it is desirable that encouragement should be given to candidates by the offer of additional prizes and scholarships. With this object the Council appeal to the Companies of the City of London, to merchants and manufacturers, and to members of the Society generally, to aid them by contributing to the Prize Fund.

The following special additional Prizes are offered:—

By Wyndham S. Portal, Esq., to the Second and Third best Candidates in the Elementary Grade, Paper Manufacture:—

A Prize of	£3
A Prize of	£2

By G. N. Hooper, Esq., to the Second and Third best Candidates in the Elementary Grade, Carriage Building:—

A Prize of	£3
A Prize of	£2

A letter has been received from Colonel Akroyd, M.P., promising to contribute £5 in prizes whenever Examinations are held in the Technology of the Worsted Manufacture.

The Council beg to announce the following contributions to the Prize Fund:—

The Worshipful Company of Vintners	£10	10	0
Dr. Crace Calvert, F.R.S. (annual)	5	5	0
Sir Daniel Cooper, Bart.	5	0	0
R. L. Chance, Esq.	5	5	0

The Council invite the aid of masters and managers in promoting these examinations by encouraging their workmen to take advantage of them. An explanatory handbill, suitable for being suspended in factories and workshops, may be had on application to the Secretary of the Society of Arts, Adelphi, London, W.C.

PRIZE FOR STEEL.

1. The Council have resolved to award the Gold Medal of the Society to the manufacturer who shall produce and send to the London International Exhibition of 1873 the best collection of specimens of steel suitable for general engineering purposes.

2. The specimens exhibited must include a complete illustration of the applications of the varieties of steel submitted.

3. Each manufacturer should send with his specimens a statement of the nature of the tests he has applied to each kind of steel submitted, and give the results of such tests.

4. The samples tested are to be exhibited together with duplicate samples, or portions of the same samples; these will be submitted to tests should the Council consider it desirable.

5. All persons using steel for general engineering purposes, who are not manufacturers of such steel, are also invited to exhibit specimens on the above terms and conditions.

6. The Council reserve to themselves the right of withholding the premium, in the event of the specimens exhibited not being sufficiently meritorious.

PROCEEDINGS OF THE SOCIETY.

ELEVENTH ORDINARY MEETING.

Wednesday, February 19th, 1873, Sir Antonio Brady in the chair.

The following Candidates were proposed for election as Members of the Society:—

Barton, R. Harvey, 2, Great St. Helen's, E.C.
Booth, John Billington, J.P., Overleigh-house, Preston.
Burton, H., Newport, Monmouthshire.
Eckstein, Miss, 10, Prince's-square, Bayswater, W.
Messel, Louis, 34, Wiltshire-road, Brixton, S.W.
Munn, Major William Augustus, Churchill-house, Dover.
Nevill, Charles William, J.P., Llanelly Copper Works, Llanelly, and Westfa, Llanelly.

The following Candidates were balloted for and duly elected Members of the Society:—

Fitzjames, Frank, 57, Thistle-grove, S.W.
Johnston, William, M.D., F.G.S., 6, Gloucester-terrace, Weymouth.
Kay-Shuttleworth, Ughtred James, M.P., Gawthorpe-hall, Burnley, Lancashire.

The Paper read was—

ON THE VIRGINIAS; THEIR AGRICULTURAL, MINERAL, AND COMMERCIAL RESOURCES.

By Major Jed. Hotchkiss,

Of Staunton, Virginia (late C.S.A.), Engineer in charge of the Survey of Virginia by the Washington and Lee University.

The States of Virginia and West Virginia, that prior to 1843 formed the State of Virginia, are so intimately and naturally associated in their geographical relations, and in the development of their resources, they require to be treated as one in a paper like the present; in fact, the only available census returns of the United States, those for 1860, from which statistics upon these subjects can be drawn, are made for the whole area of the two States, and more, that census alone shows what the capabilities of these regions are.

The Virginas are situated between 36 deg. 30 min. and 40 deg. 40 min. of N. lat., opposite Spain and Portugal. Their area is, in round numbers, 64,000 square miles (42,000 in Virginia and 22,000 in West Virginia), some 6,000 square miles more than that of England and Wales.

The population of the two was, in 1860, 1,596,318 (Virginia, 1,219,630; West Virginia, 376,688); in 1870 it was 1,667,177 (Virginia, 1,225,163; West Virginia, 442,014). The white population of Virginia, in 1860, was 691,773; in 1870 it was 712,089. That of West Virginia, in 1860, was 355,526, and in 1870 it was 424,033. The blacks, in 1860, in Virginia were 527,457, and in 1870 they were 512,841. In 1860 West Virginia had 21,162, and in 1870, but 17,980.

The territory of the Virginias is naturally divided into seven distinct belts of country, extending throughout it from south-west to north-east, parallel with the general trend of the Atlantic coast. These belts, taken in the order in which they succeed each other, from the Atlantic, north-west, to the Ohio, are:—1st, the Tidewater Country; 2nd, the Middle Country; 3rd, Piedmont Virginia; 4th, the Blue Ridge; 5th, the Valley of Virginia; 6th, the Appalachian Country; 7th, the Trans-Appalachian Country.

Tidewater Country.

The Tidewater country of Virginia embraces ten or more of the large peninsulas that have the 1,500 miles of their abundant outline washed by the tidal waters of Chesapeake Bay and of that far western indentation of the middle Atlantic coast known as the Virginian Sea. This section is, most of it, a hundred miles in width, and over 120 in length, making an area of about 13,000 square miles. It is the Tertiary plain of the Atlantic, a region of Eocene and Miocene clays, marls, and sands, bordered by recent formations. The tidal creeks penetrate far into each separate peninsula, so that the navigable waters on opposite sides are often less than a mile apart, and the watersheds never rise more than a hundred feet. Most of these waters are deep, and in some of the broad estuaries, as Hampton Roads, Elizabeth river, the York, and elsewhere, the largest vessels afloat can easily reach the wharves or find safe anchorage; in fact, the navies of the world could find a common harbour in Hampton Roads, free from ice at all times and completely land-locked, and when the Chesapeake and Ohio, the Atlantic, Ohio, and Mississippi railways shall have completed their western connections, as they soon will, and other railways in contemplation are finished, all terminating near this great harbour, it is but fair to suppose that one or more of the world's well-known commercial cities will grace the terminal lobes of these Virginia Moreas.

The population of the 36 counties that may be classed in the Tidewater division of the State was, in 1860, 421,308. Of these 203,944 were whites, and 217,364 blacks; in 1870 there were 198,345 whites and 216,981 blacks, a total of 415,326, a loss of one and three-sevenths per cent on the entire population, of two three-fourths of the whites, and a loss of blacks of two-sevenths of one per cent. The Tidewater region is one where it costs but a small effort to live, so abundant are the resources of the waters, and therefore numbers of negroes from other parts of the State congregate there. Of the eight million acres in this section two and a-half were in cultivation, and two and three-quarters more were enclosed, leaving nearly three millions for the waters and unfenced woodlands.

The waters here are as valuable as the lands, if not more so, for the abundant scale and shell fisheries there found. The cultivation of oysters is a business as regularly carried on as the cultivation of the soil, and it is estimated that 30,000,000 bushels were taken from Virginia waters during the past year; the small State tax was collected on over twenty million bushels. Great numbers of herrings, shad, and numerous other varieties of fish are annually taken. The demand for the oysters of this region extends over the United States and Canada, and now Europe comes in for a share of the production of the hundreds of square miles of Virginia's oyster plantations.

In some of these peninsulas there are large swamps—like the Great Dismal—valuable for the fine cypress, pine, oak, and other timber in and around them, and for that which will yet be mined from them. The rank cane vegetation of their borders now furnishes a vast supply of material for the manufacture of paper. Large forests of pine, the well-known Virginian yellow pine, one of the most durable of woods, still abound, and the trade of this section is very large in this and other kinds of timber. The lumber-ships run to the vicinity of the steam saw-mills upon the shores for their cargoes. Wood is also sent from here in great quantities to the cities of the North.

The character of the soil, the early opening of spring, and the accessibility of this section have made it the early market garden for the large cities of the Atlantic border; and already the products of a small portion of the country around Norfolk bring an annual return of more than 20 million dollars. Especially is this region noted for the production of peaches, pears, and strawberries; the fig thrives also, and bears abundantly.

The lands along the rivers are very fertile, and return large crops of wheat, Indian corn, Irish potatoes, sweet potatoes, pea nuts, peas beans, barley, and oats, a considerable quantity of tobacco; even 13,000 bales (of 400lbs. each) of cotton were raised here in 1860, and larger quantities have been made since. Stock of all kinds do well, and when root culture is introduced, and its attendant sheep rearing, and the lands are improved by the use of the fertilising marls that there abound, there is no reason why this region may not become as fertile as the famous Tertiary lands of England.

The mineral wealth of this section is in its green sand and other marls that abound in all parts of it. There are some deposits of iron ore in various places, but their extent is unknown.

THE MIDDLE COUNTRY.

The Middle country of Virginia has very nearly the form of a right-angled triangle, its base of 130 miles resting on the North Carolina line, and extending from the Piedmont to the Tidewater section; the right angle is on the east; the perpendicular extends northward, past the heads of the tidal rivers, 180 miles to the Potomac, while the hypothenuse of 220 miles runs with the broken ranges of the South-west mountains at the eastern border of the Piedmont country. The area is about 12,000 square miles, or 7,680,000 acres, divided into 21 counties, each nearly the size of Monmouthshire.

The Middle country is a region of primary and metamorphic rocks, gneissoid and granitic, with micaceous, talcose, argillaceous and chloritic slates, dipping at high angles, generally to the east, and with a strike corresponding to the trend of the mountain ranges.

Over the eastern portion of this triangle lies a second triangle, of what Professor Rogers calls the middle secondary formation, a series of sandstones, shales, &c., nearly horizontal in stratification. The whole forms a great, moderately undulating plain, having an average width of 80 miles, rising from a height of 200 feet at the granite rim, that marks the limit of the Tidewater region, to 500 or 600 at the base of the South-west mountain.

The great variety of composition in the basis rocks has given a corresponding variety to the soils of this part of Virginia, and they are found possessed of all degrees of fertility, from the poor grey or light brown ridges, forming the watersheds of the principal streams, to the rich, dark bottom lands along the streams themselves.

In some places the epidotic or greenstone rocks predominate, and make neighbourhoods famed for the fertility of their soils. The tobacco of this section is especially noted for its fine quality, and the wheat for the perfection of its ripeness, making it very desirable to grind into flour for exportation to warm climates. Extensive forests, principally of oaks and pines, cover large portions of the country. If a forest of oak is cut down, it is succeeded by an almost impenetrable one of pines exclusively—and if these are cut down a forest of oaks and similar wood succeeds, almost equally thick—making the "Wildernesses" of this region. The native grasses there are sedges (*Carices*); the other kinds must be cultivated. While there are quantities of fertile lands in the Middle country, still much of it must await improved methods of husbandry, and the use of the marls and limes so convenient to them on both sides; their proximity to the tidal waters and large cities will reclaim and make them fertile, as it has similar lands in New Jersey and elsewhere. The climate is generally mild, and only for a short time during the summer is it disagreeably warm.

The population of these 21 counties, in 1860, was 300,643—the whites 134,142, the blacks 166,501. In 1870 it was 294,971—the whites 132,572, and the blacks 162,399. The loss on the white population was 1 per cent., on the black 2½ per cent.; on the whole, 1¼ per cent.

The improved lands were 2½ million acres, so only one-third of the land was in some sort of cultivation, another third was enclosed, leaving one-third as wild land. The value of the farms was 64 million dollars, about 12½ dollars per acre. The farming implements were valued at 1⅔ millions—1-38th of the value of the land. The live stock, 41.000 horses, 12,000 mules, 54,000 cows, 24,000 oxen, 78,000 sheep, 135,000 cattle, 233,000 swine—577,000 in all—were valued at 8 million dollars; the nine leading cereal crops, including potatoes, yielded 13 million bushels, 3 of wheat, 6¼ of Indian corn, 2¾ of oats, ¼ of Irish, and ¼ of sweet potatoes—over 43 bushels to each inhabitant. The wool produced was 277,000 pounds, the butter 1,733,483, the cheese 4,000, the beeswax 19,000, and the honey 245,000. The value of domestic manufactures reached 304,000, and the animals slaughtered were valued at 2¼ million dols. The flax raised was 33,000 pounds, and its seed 1,500 bushels; there were 4,000 bushels of clover and grass-seeds, and 42,000 tons of hay; the orchards yielded 48,000, and the market-gardens 56,000 dollars' worth, and 11,000 gallons of wine were made; the tobacco crop was 74 million pounds, or 246 to each of the people. The returns give rice, cotton, hops, hemp, silk cocoons, &c., as produced in the region. The value of staple crops and animals slaughtered amounts to over twenty million dollars, two-thirds of its value to each acre for the year. These results show the capacity of this section for production in a very favourable light, they also indicate what may be done again upon the same acres, and what may be expected when the other two-thirds of the country is improved. No part of this section is more than ten hours from market by freight or goods trains, and most of it is within three hours of tidal waters, advantages of great value to the producer.

The mineral resources of the middle country are very great and valuable. The edge of the belt, as before stated, is a granite rim rising some 200 feet above the tide waters, setting bounds to their further flow inland, furnishing fine water power by the falling of the rivers over it, and sites for commercial and manufacturing towns. This grey granite is of the very best quality for building purposes; 15 million dollars' worth of it are now being quarried for the buildings for the Department of State, in course of erection at Washington. Occupying basins, or depressions in the granite, are several coal fields belonging to the New Red

Sandstone, or Oolitic era, extending in detached oval masses from near Richmond to the south-west; the principal one is known as the Richmond coal field, covering some 150 square miles.

In the part of this field upon the north side of James river five seams of coal have been opened, varying in thickness from two and a-half to eight feet, giving an aggregate of more than 20 feet, as at Carbon Hill. On the south side of the river, at Midlothian, three seams have been opened, varying in thickness from 4 feet to 40, making from 50 to 60 feet of coal (the sections show the location of the seams at each of the places named). One of the seams on the north side, from two and a-half to six feet thick, is a natural coke (the coal having been coked by the intrusion of a trap dyke) known as carbonite; the other seams are coking coals, highly bituminous, as they should be, for they are young coals, and therefore fat, as the adage says, and admirably adapted to gas-making. For this purpose the mines are extensively worked.

Professor Hull, in the last edition of his work on the "Coal Fields of Great Britain," says:—"The Richmond coal-field contains several beds of valuable coal, one of which is from thirty to forty feet in thickness, highly bituminous, and equal to the best coal of Newcastle."

These mines are admirably located for commercial purposes, and the coals are highly commended by all that have used them. The other fragments of the Middle country coal-field have not been developed, except perhaps in Prince Edward county.

Midway in the middle country is a strip of land from 15 to 20 miles in width, and running for two hundred miles through the state; that has long been known as the "gold belt" of Virginia. The rocks of this belt are the slates, traps, steatites, &c., of the Primary, dipping at high angles, generally to the east, and striking with the belt. Interstratified with these are numerous veins of gold-bearing quartz, magnetic, hematite, and specular iron ores, and sulphurets of iron and copper. It may be safely asserted that there is a great abundance of each of these valuable minerals throughout most of the length of this belt. Large amounts of gold have been taken from it, especially where it is crossed by the Rappahannock and the James, and their tributaries; and practical men state that if the same skill and capital were employed in working these as there is in working the California mines the results would be as satisfactory. Small quantities of gold are constantly being obtained from surface washings. The veins of iron ore are numerous, some of the magnetic ones having a thickness of four feet; the beds of hematite ore, particularly those upon either border of the belt, as along James river, where it runs parallel with it, and in the Wilderness, near the Rappahannock, are very thick and extensive. The first successful furnaces in America, those of the Colonial-Governor Spotswood, were supplied from the latter beds. There are also large beds of this ore where the Chesapeake and Ohio Railway crosses the belt, and iron is manufactured there at this time; from the same vicinity the sulphurets of copper are also sent to market. The introduction of cheap coal, just beginning, will surely lead to the smelting of these abundant and valuable ores, so well situated for markets. The slates of the whole Middle country are very excellent for all purposes, notedly those from its western border along James river, in Buckingham, where they are extensively quarried for roofing, flagging, mantles, &c.; for marbleizing they are considered the best known, and the slabs can be obtained of almost any required dimensions. In Fairfax county chromate of iron is found, and in Buckingham an extensive deposit of kyanite. Some of the rocks of this region furnish a grey or light brown soil; this is naturally poor. Others, like the epidotes, which contain a marked amount of lime, furnish a dark and fertile soil. The sandstones of the imposed middle secondary are valuable for building purposes, as are also the "brown stones" of the Red sandstone, which are extensively quarried at Manassas. The infusorial earth, so abundant at Richmond, is valuable as a polishing material.

Piedmont Virginia.

Piedmont Virginia, is composed of the tier of 13 counties, lying adjacent to, and east of, the Blue Ridge, a belt of country some 250 miles long and 25 wide, having an area of over 6,000 square miles, or four million acres; a territory eight times the size of your Surrey.

The eastern base of the South-west mountains (which belong, by their character, to the Piedmont) is about 500 feet above tide. These irregular mountains are from 500 to 800 feet higher, but they are generally very fertile and well adapted to cultivation to their very summits; and on these are many old residences, like Monticello, the noted home of Jefferson, that overlook the great plain of the Middle country on the east, and have the grand forms of the Blue Ridge to bound the view on the west. The country between these mountains and the Blue Ridge is made up of numberless beautiful valleys, surrounded by hills and ridges, having an endless variety of forms. This intermediate region is from 600 to 800 feet above tide, gradually rising to the long valleys that run into the Blue Ridge, which boldly mounts more than 2,000 feet above them.

In 1860 there were in cultivation nearly two million acres, and about the same quantity of woodland was embraced in farms, leaving from one-half to three-fourths of a million acres for wild land; this was mostly on the eastern slope of the Blue Ridge, which belongs to these counties. The value of the land was 64 million dollars—about seventeen and a half dollars per acre.

The population in 1860 was 202,282, of which 90,064 were blacks; in 1870 the numbers were 198,943, the blacks being 83,024, so the whites had increased three and a-third per cent., and the blacks decreased eight and a-half. The numbers to a square mile in 1860 were 33.

Much of this country is known as the Red Land district, from the colour of its soil, formed from the disintegration of the azoic rocks of the Blue Ridge and the Piedmont itself, which are gneissoid, containing talc, chlorite, iron pyrites, and hornblende. The soil is very fertile and easily cultivated, but so friable it requires careful attention to keep it from wasting by the action of the elements. The whole region is quite broken, and has heavy ridges and hills, but it is exceedingly romantic, and nothing can exceed the beauty of the rounded enclosed valleys, locally known as "coves." The waters are abundant and good; the forests are composed of many fine trees. The whole is a veritable

Piedmont, a sinking down of the mountains into the plains, a mingling of these surface elements into the most picturesque and yet symmetrical confusion.

The productions attest the exuberant fertility of the soil. The value of the farming implements employed was only one and a-half million dollars, only one-forty-third of the value of the land. The horses were 44, the mules five, the milch cows 45, the oxen 14, the other cattle 90, the sheep 115, and the swine 212 thousands, or over a half million head of live stock, two and three-fifths to each person, worth over seven and a-half million dollars. Those slaughtered had a value of two million dollars, a dollar to each acre cultivated. The wheat raised was two and one-fifth millions, the rye one quarter, the Indian corn five and a-half, the oats one and three-quarters, and the potatoes (Irish and sweet) nearly half a million bushels, in all, over eight million bushels of cereals, or forty bushels to the individual. The tobacco crop was over twenty-four million pounds, or 120 per capita, this region being well suited to crops requiring hoe cultivation. The wool sheared was one-third of a million pounds. The buckwheat and barley were twelve, and the clover and grass-seeds fifteen thousand bushels. The wine made was 106,000 gallons, the orchard products valued at 106,000 dollars, and that of the market gardens at 12,000 dollars. No country is better adapted to the fruits of temperate climates. The butter made two million, and the cheese ten thousand pounds; 60,000 tons of hay were cut, 17,000 pounds of hemp, 58,000 of flax, 1,300 of hops, 215,000 of beeswax, and 331,000, of honey were produced. The domestic manufactures were estimated at 164,000 dollars. The census gives returns also of the production of maple sugar and molasses, sorghum molasses, silk cocoons, and rice. The lowest estimate of the value of production from agriculture alone, will give over sixteen million dollars, or eighty dollars to each one of the population, and half the value of each acre cultivated.

At various places in the Piedmont, mines of lead and barytes have been opened, and it is well known that there is an abundance of plumbago, manganese, and fire-clay, but the character of these has never been properly tested, except perhaps at Warminster, on the James, where extensive deposits of manganese have been opened.

The stratification of this section is generally regular, striking north-east and south-west with the Blue Ridge and South-west mountains, the boundaries of the Piedmont, and dipping steeply to the east. In this stratification are fine quarries of roofing and other slates, as in Amherst county, near the James River gap, and at Keswick, east of the South-west mountains, on the Chesapeake and Ohio Railway, for the eastern boundary of this belt is very properly at the eastern base of the South-west mountains, where a stratum of what has been called Secondary limestone extends in detached lenticular masses nearly through the state, and separates two very distinct qualities of soil and country. From the prevalence of schistose rocks it is probable that numerous localities will be found where good slates can be quarried.

The clays for brick-making everywhere abound, and bricks are generally made from the excavations for a building.

The limestone before referred to, from its location is very valuable, and at numerous points it is quarried for lime; on the James it may be cut as a dark marble.

There are some good building stones found among gneissoid sandstones and trap dykes; and the epidotic and granitoid rocks and the schists make good rubble work.

The most valuable minerals in the district will probably be found to be the magnetic, micaceous and specular ores of iron that are found interstratified with the formations, and in good workable seams. The want of mineral coal has prevented their use hitherto, and so no effort has been made to test the quantity of the ore; but now that the way is open for coal from the Kanawha fields, these extremely rich ores will be in demand to work with the softer hematites from the Valley and Appalachian country. The lines of outcrop of these ores can be traced on the surface often for miles; and horse shoe nails have often been made, in a blacksmith's forge, directly from the ore. In 1868, one-seventh of all the iron made in the United States was from these very ores found in the extension of this belt into New Jersey. It will be seen that the lines of traffic are well located for the development of these ores.

In the north-east, a lenticular mass of New Red sandstone is imposed on the ordinary formation of the district, introducing another variety of soil and of good building material.

In the range of low hills known as the Catoctin mountain, in the north-east, and even nearer the Blue Ridge, is found a brecciated marble that has obtained some repute as an ornamental stone. The disintegration of the rocks of this section furnishes a constant renewal of the fertility of the soil, and in this it has a source of wealth of untold value.

THE BLUE RIDGE.

The Blue Ridge is one of the most interesting features in the Piedmont and Valley landscapes of Virginia. It extends for more than three hundred miles diagonally across the state, varying in width from three miles, at the gorge made by the Potomac in passing through it at Harper's Ferry to more than twenty in the southwest, near the Tennessee line, where it expands into a broken concave plateau, drained by New River, not far from where that singular stream takes its rise at the culminating point of the Appalachian system. The general elevation of the Blue Ridge at the Potomac is 1,800 feet above the tide, that increases to the south-west until, at White Top, on the Tennessee border, it reaches 5,000 feet; it is generally about 2,000 feet above the great Atlantic plain on the east, and from 1,000 to 1,500 above the Virginia Valley on the west. It is very irregular in the outline both of its contour and of its relief. From a distance it presents the appearance of a wavy line of the deepest blue, but near at hand it is resolved into swelling domes, connected by long ridges, meeting between the high points in gaps or notches, while long spurs, many of them miles in length, are sent out in all directions from the general range, but more especially on the eastern, or longer slope, these in turn often sending out other spurs, the whole giving a wonderful development of surface and exposure, and a peculiar adaptation to special cultivation.

The Blue Ridge, geologically considered, is

Azoic, or Primary, in its eastern slopes, generally so in its summits, and often in some of its western spurs; made up of schists and granitoid and epidotic rocks—a region of greenstones, it may very properly be called; for wherever it is the misfortune of a railroad to have to tunnel through it (as the Hoosac, that has been in progress for twenty years) the core, or section of the mountain, is mostly of greenstone. This mountain was the shore of a primeval ocean that extended westward over the valley of the Mississippi; and we find upon the westward flank of this mountain, as the backbone that holds it in shape, the Potsdam sandstone that once formed the shore and bed of this old ocean, and that now stands as broken ridges or foot-hills, buttressed back to the mountain in a singular way.

Some 3,000 square miles, or two million acres, of Virginian territory pertain to the Blue Ridge—a region twice the size of your Sussex—most of it covered with a fine growth of original oak, hickory, chestnut, and tulip-poplar forest, with here and there a valuable grazing or fruit farm, a patch of lighter green on the sides or summits. These greenstone rocks, as is well known, crumble into soils rich in colour and in the elements of fertility—soils especially adapted to the wants of the vine, such as most of the world's great vineyards are situated upon. The forests of the Blue Ridge abound in grape vines of a large size and very productive—the originals of the Catawba, Norton's Virginia, and other well-known American grapes; and thousands of gallons of brandy are annually distilled from these by dwellers along the mountain—in fact, during the late war, one man made 11,000 gallons in one season. Recalling what was said of the topography of this range, it will be seen that almost any aspect can be chosen for a vineyard; the soil has a special adaption to the vine, the latitude—that of France—gives length of season, while the elevation, above the "frost line" of the valleys, secures the maturity of the grape—an indispensable requisite for the production of good wine. Numerous vineyards are now in successful operation; at Belmont, near Front Royal, is one, covering some seventy-five acres, that has now an annual yield of 20,000 gallons of wine, the pure juice of the grape, and 10,000 gallons of brandy, the vines that are in full bearing yielding from 300 to 500 gallons of wine to the acre. The grapes are notably rich in saccharine matter, and diseases of the vine are unknown. Nearly a million acres here are adapted to this culture, and offer a pleasant and profitable field, and a virgin soil in a most genial climate for this leading industry.

This section has also an established reputation as a fruit-producing one,—its apples, pears, peaches, and other temperate climate fruits attain a flavour and perfection rarely equalled elsewhere; its Albemarle pippins command prices that have induced the planting of large orchards of that single variety. It is no uncommon thing for 500 bushels to be gathered from an acre, and an English eighteen pence per bushel would yield a large profit to the orchardist. The day is not distant when Blue Ridge apples will form a staple article of export to Europe, and one of the greatest blessings that can be conferred upon any people is an abundance of cheap fruits to take the place of stimulating drinks. Four railways and two canals now pass through or over the Blue Ridge, and others are in progress, making all parts of it accessible. The great convulsion of nature that cracked the Appalachian mountain system through, opened a channel for New River and its continuation, the Great Kanawha, depressed the northeastern part of that system, and sunk the Atlantic plain; so that New York is near the foot of the Blue Ridge, and the real shore of the ocean is out at sea a hundred miles; this convulsion disturbed the levels, and made water-sheds in the valleys; so we find the higher drainage ridge of the Atlantic slope beyond or west of the Blue Ridge; and the Potomac, the James and the Roanoke, that rise in that higher range, and in the Virginia Valley, break through the Blue Ridge to reach the sea, but New River and the head waters of the Tennesse run to the westward; still the Blue Ridge gives rise to many fine rivers.

The expansion of the Blue Ridge in the southwest, as before stated, gives some 2,000 square miles, divided into three counties, that contained, in 1860, a population of 24,500, of which only 1,380 were blacks. In 1870, the population was 28,558, an increase of 17 per cent. This sparse population had improved or cleared but one-eighth of the country, and that had only an average value of 6 dollars per acre. A glance at some of the results of this people's industry will give a good idea of the agricultural resources of the Blue Ridge. They had 5,000 horses, 20,000 cattle, 30,000 sheep, and 37,000 swine, valued at three-fourths of a million dollars. The cereals raised were 880,000 bushels (peculiar in that 28,000 bushels were buckwheat, showing the elevation of the region). The tobacco produced was 455,000 pounds; 34,000 bushels of Irish and 2,000 of sweet potatoes; the wool clipped was 56,000 lbs.; the orchard products were worth 30,000 dollars; the butter produced was 260,000 and the cheese 15,000 pounds; the hay crop for the 85,000 head of stock was only 9,000 tons (a striking comment on the mildness of the climate); 32,000 pounds of flax and 3,000 bushels of flax seed; 800 gallons of molasses, and thousands of pounds of sugar from the maple (*Acer saccharinum*); 30,000 pounds of honey; the value of domestic manufactures, the results of the home spinning-wheel and loom, 62,000 dollars; and the animals slaughtered were worth 190,000 dollars, not to mention the peas, beans, barley, clover, and grass seeds, hops, hemp, wine, and other productions credited to them in the census. It will be readily seen that there was here a large surplus over the wants of the people, a great and cheap production *per capita*. It has been successfully proven that in no portion of the United States, except distant Texas, can cattle be as cheaply reared as in this section, where they are less than two days by rail from the sea.

The mineral wealth of the Blue Ridge is great, and destined to be quite important, from its nearness to the sea-board. In the ranges of foot hills, lying along the western base of these mountains, the whole 300 or more miles of their length, are found very extensive deposits of brown hematite iron ores of the best character, giving from 60 to 65 per cent. of metallic iron in the yield of the furnace. It is not correct to say that these deposits are continuous, and yet they have been so regularly found, when sought after, as almost to justify the use of that term. In some places they are deeply buried in the *debris* of the mountain; at others they show themselves as interstratified masses, conforming for long distances to the formations of the district, as near where New River leaves the Ridge, at Radford Furnace, where the stratum is over thirty feet in thickness, while at other places the ore, in a soft state, forms hill-like masses, as at the Shenandoah Ironworks, in Rockingham. At one place in Rockbridge, where the stratification is nearly vertical, striking with the mountain, this ore appears as a hard central stratum, forming the crest of a spur more than 600 feet above its base. The western flank of the table-land in the south-west is known as the Iron Mountain, from the quantity of this ore there exposed. There are numerous furnaces now in blast, and others are being built, along the line of these deposits, making charcoal iron of a high character, such as now readily commands 60 dollars a ton in the United States, using the timber of the Blue Ridge for fuel. One of these had a yield of 65 per cent. of iron from the ore put into the furnace in the run of a season.

Between these hematite ores and the main ridge is found a massive and somewhat persistent deposit of specular ironstone, yielding from 20 to 30 per cent. of metallic iron; this had not attracted any attention until lately, when it has been advantageously used, mixed with the richer hematites, as at Mount Torrey furnace, in Augusta.

In the primary rocks of the Blue Ridge there is everywhere a very considerable quantity of copper ore of good quality. At a point near Luray this ore was mined and sent to Connecticut, at one time with satisfactory results. From the fact that the Ducktown copper mines, in this ridge in Tennessee have been successfully worked, it is probable that like valuable ones may be opened in Virginia.

In the same ranges of hills, with or near the hematite ores, are important beds of manganese of an excellent quality, as has been proven by the price obtained for considerable quantities of it that have been sent to Europe from points near the railways.

On the slopes and at the foot of these hills are numerous deposits of fire-clay. At one place, in Augusta, this kaolin is used in the manufacture of a good quality of Rockingham ware. The demand for fire-bricks will soon be so great in that region that it must lead to a larger use of these abundant clays.

The disintegration of the fine-grained and highly-silicious Potsdam sandstone has formed banks of the finest and sharpest pure sand in the gorges of the western slope, well adapted for use in the arts.

In the south-west, beyond New River, in Wythe, the outlying western ranges of the Blue Ridge contain extensive deposits of lead and zinc ores, pronounced by competent authority to be of the best quality. Lead mines have there been worked for more than a hundred years with great profit, but by no means as extensively as the character of the deposits will justify. Some two million pounds per annum were produced there during the late war. No use has been made of the zinc ore, although there seems to be no doubt of its richness and abundance.

There are some mineral deposits on the eastern slope of the Ridge, but, from what has been stated, it may be concluded that its summits and eastern slopes are especially adapted to tillage, pasturage, and the cultivation of fruits, while the western slope abounds in mineral resources favourably situated for mining and manufacture.

It is proper to add that the Blue Ridge and its slopes mark the general boundary, with some exceptions, southward, of the natural sod-forming nutritious grasses—the grasses that belong to comparatively cool climates, such as are the pride and the unfailing sources of fertility and wealth to these United Kingdoms. East of the Piedmont the grasses must be constantly renewed by cultivation, and then they yield abundantly.

The Valley of Virginia.

West of the Blue Ridge lies the Valley of Virginia, 320 miles in length, and averaging 25 in width; it is the central portion of what is known as the great Appalachian valley, a belt of Silurian limestone land, extending for 1,500 miles from the St. Lawrence to the Alabama, famed for its fertility and for the surpassing beauty of its scenery. The Virginia Valley is better known by the names of its sub-divisions, as the Shenandoah, James, Roanoke, New River, and Holston valleys, which succeed each other, in the order given, from the Potomac or Maryland line, in the north-east, the boundary of Tennessee, in the south-west.

The whole Valley is longer than the distance from London to the northern extremity of England, and its five million acres of land could be divided into more than 29 counties the size of your famous Middlesex.

Ranges of remarkably long, straight, narrow, and steep mountains, parallel and standing in echelon, form the western boundary of the Valley, having various local names, as the Little North, Walker's Clinch, &c., but known by the general term of Kitatinny, the Indian name, meaning "the Endless," from the appearance of the ranges when viewed from a distance.

The Valley, as the result of a combination of river basins, is composed of a series of ascending and descending planes, rising from levels of from 600 to 1,000 feet to those of 2,000 or 2,500. These slopes are either north-east or south-west, but the whole Valley has a very decided inclination, besides, to the south-east, the western edge being generally 500 or 600 feet higher than the eastern; it follows from these data that the streams, obeying two forces, flow eastwardly, and their united waters find a channel at the very western bases of the mountains until they can force a passage through them. A moment's reflection will suggest that a country arranged as this is, and having an ample water supply, must furnish a wealth of water power almost beyond estimate, and drainage and irrigating resources that leave nothing to be desired. It is well to add that the courses of the streams, like all those in limestone countries, are very winding, in some cases five times the length of the air line distance from source to mouth. This distributes the fall of the water through longer reaches, and presents it to more of the country.

The rocks of the Valley are those of the Lower and Upper Silurian—blue and grey limestones, slates, shales, and sandstones—the first layers of deposition in the sea that had its eastern shores at the Blue Ridge, a sea that had "life abundantly," and has left, among other remains, its great coral reefs to form belts of land of unrivalled fertility. These rocks do not present themselves as a horizontal plane, or a sloping one to the west, but they have been forced up until they stand at an angle of some 45°, dipping generally each way from the middle of the valley as an anticlinal, and presenting their edges in lines of strike extending north-east and south-west, often unbroken for miles. Upon these upturned drain slopes are the deep clay and other rich soils. The result of the convulsions that have upheaved these rocks is a broken and undulating country—a great valley, as a whole, when looked down upon, but a great number of valleys when considered in detail. Time forbids entering into the particulars of the bold and peculiar topography of this pleasant region.

The average elevation of the Valley is not greater than that of the plain that forms a large part of the state of Ohio. At the same time, its mountain boundaries guard it from the fierce winds that sweep over the west, leaving death behind them, and break the force of the chill ocean winds from the east.

As before stated, the Virginia Valley contains some five million acres of land; 1,700,000 of these are improved, or cleared, and in grass or under cultivation, and 1,800,000 more are embraced in farms, so barely one-third of the country is under any kind of cultivation. These lands in farms were valued at 73 million dollars, or about 20½ dollars per acre. The white population was 174,190; the black, 43,200; in all, 221,350, or about 28 to the square mile. In 1870, the white population had increased five per cent., and the black decreased over eight per cent., giving 226,080 as the population (the decade having embraced the four years' war, during which the Valley was the field of active operations).

The census returns, dry figures, give the only evidence that is conclusive as to the productive capacity and resources of this region:—1,700,000 acres, the area of Lincolnshire, under cultivation, with 221,350 inhabitants, using agricultural implements worth seven millions, one-tenth of the value of all their lands, reared 58,000 horses, 2,000 mules, 49,000 milch cows, 3,500 working oxen, 101,000 other cattle, 139,000 sheep, 254,000 swine, 606,500 in all, valued at eight million dollars, while the animals slaughtered were worth 1,850,000 dols. The clip of wool was half a million pounds, and the flax reared 66,000, and from these the domestic manufactures were worth a quarter of a million dollars. The crop of cereals—wheat, Indian corn, rye, oats, and buck-wheat—was eleven million bushels, 3¼ of it wheat and 5½ corn. The potato crop (Irish and sweet), 370,000 bushels; orchard products were worth 115,000 dollars. The butter produced was 2¾ million pounds, and the cheese 80,000; hay, 120,000 tons; clover seed, 27,000 bushels; grass seed, 25,000; maple sugar, 55,000 pounds; and molasses, 13,000 gallons; honey, 171,000; and tobacco, 3,000,000 pounds (although the people of this section are averse to the cultivation of "the weed"). It would weary to give the production of wax, sorghum, silk, hemp, hops, garden products, wine, barley, peas, beans, cotton, and other items that make up the 48 columns of the census returns and present handsome showings for the valley, proving its adaptation to a wide range of varied agricultural production. With 1-142 of the population of the United States it had 1-107 of the horses, 1-174 of the cows, 1-146 of the other cattle, 1-156 of sheep, 1-132 of swine, 1-135 of value of stock, raised 1-57 of the wheat, 1-152 of the corn, 1-115 of oats, 1-145 of tobacco, 1-190 of orchard products, 1-120 of wool, 1-167 of butter, 1-158 of hay, 1-35 of clover seed, and 1-112 of value of animals slaughtered, and had 1-95 of land in cultivation, with 1-91 of the value of farms.

This was the balance-sheet of agricultural production in the Valley—a surplus for more than two million people—when the great war began; and I hope you will pardon me for the long detail, as it will enable you to understand why it was called the "backbone of the Confederacy," why "Stonewall" Jackson had opportunity to make it and himself famous for ever; and why an order was issued to lay it waste, so that a crow flying over it must carry his haversack.

The mineral wealth spoken of in connection with the Blue Ridge, along its western flanks, belongs as well to the Valley—for the approaches to, and outlets from, its mines, are into the Valley, and its motive power and agricultural resources will be used in their exploitation.

Limestone, as before stated, forms the basis of the Valley. Of this there are many varieties to be found in the upturned strata of a formation several miles in thickness. There are dark marbles, hydraulic limestone for cement, fissile and flaggy for architectural purposes, and others that make fine agricultural lime, or good stone for fluxing in the manufacture of iron. Since there is but little limestone, and that of an inferior quality, in the 175 miles between the Blue Ridge and the sea, there will always be a great demand for these limestones and their products in this large intervening territory.

The edges of the great sand rocks that rise beyond the Valley in long and almost unbroken ridges, like the crests of successive waves, outcrop in the Valley in broken fragments of rounded hills, or short, low ridges, but situated in lines ranging with the mountains; sometimes they become great double ranges, rising in the Valley and dividing it into two parts, extending, like the Massanutton in the Shenandoah Valley, for forty or fifty miles, and comparing in height and magnitude with the Blue Ridge itself. In the vicinity of these ranges of hills and in "the doubles" of the Valley mountains are found extensive deposits, or pockets, of brown hematite iron ores, generally soft or cellular in structure, smelting readily and producing an iron of great tenacity. There are not less than four of these lines of pockets in the Valley in Augusta county, and the out-crops and fragments upon the surface indicate that they are general throughout the region. There have been some furnaces that have drawn their supplies from these ores, but the timber of the Valley has been too valuable to use for such purposes. Now that coal is accessible, these very fine and rich ores will attract attention. The clays of the Valley, almost everywhere, make fine hard bricks of a dark colour, owing to the presence of so much iron in them.

In the vicinity of these ore beds are found valuable deposits of umber, and considerable quantities of it have been used in the manufacture of paints.

There are found on the eastern side of the main Kitatinny mountain, throughout its extent, detached and broken fragments of what some call the proto-carboniferous, and others the false coal-measures (overlying the old red sandstone it is said), brought into these topographical relations by a great downthrow of the higher formations. These fragments are generally of small extent, as in Augusta, yet they furnish two or more seams of good semi-anthracite coal, but so disturbed and crushed as to be of little value. In the New River basin is found, on the contrary, a very well-developed coal-field of this era, containing, among others, two very accessible seams of good coal, varying in thickness from two to three and a-half, and from six to nine feet. The better part of the field is thought to be the thirty miles of the length of it lying north of New River, in Montgomery county; hence the whole is often spoken of as the Montgomery coal-field, but very good openings have been made through 100 miles in length of a somewhat narrow belt along the west side of the valley. These coals have only been used for domestic purposes, but the proximity of the great hematite iron deposits, hereafter mentioned, must soon lead to their trial for manufacturing purposes. The profitable area of this field may be roughly estimated at 100 square miles.

In Washington and Smyth counties, on the north fork of Holston river, are extensive beds, of great thickness, of gypsum, or plaster of Paris, of the best character for agricultural and other purposes, and it is much used as a fertiliser, especially upon the grass lands.

In the same region are deposits of rock salt, that have been penetrated more than a hundred feet in sinking wells to supply brine to the extensive works at Saltville. The annual production there is very large, and the salt bears an excellent reputation. During the late war the larger portion of the salt used in the Confederacy for a long time was manufactured at Saltville. The area of the salt and plaster field is unknown, enough is known, though, to justify the belief that it is large.

The forests of the valley are great park-like groves of many kinds of oak, hickory, locust, walnut, and yellow pine, with chestnut upon the ridgy lands, with little or no undergrowth, and the result, apparently, of one great seeding, so uniform are the trees in size and height. The timber of these trees is of a very superior quality for manufacturing purposes, and the traditional regard of the inhabitants for forests has kept more than half of these valuable farming lands in woods. When the country was settled, tradition says it was an open prairie-like region, covered with tall grass, and abounding in buffaloes, deer, and other game, a great hunting-ground of the Indians, which they annually burnt over to keep down the growth of timber, and which they only parted with after many bloody struggles. The white man kept down the fires, and the forests sprang up. He remembered the difficulties he experienced in getting wood and timber from the distant ridges and mountains, and cherished the crop so bountifully sown by the Great Husbandman, and now, after 150 years, few countries can offer a finer harvest of choice, sound timber.

The Valley is an extremely rich farming and grazing region, covered with natural grasses, especially the blue grass that forms perennial pastures famed for their fattening qualities; its productions show that it is unsurpassed for these purposes; and lying as it does in the midst of great mineral wealth, it must soon have ample demands for its products.

The climate of this Valley is the happy medium between the extremes of north and south, and may be characterised as the mild temperate.

THE APPALACHIAN COUNTRY.

The Appalachian portion of the Virginias succeeds the Valley on the west. It is a belt of country over 360 miles long, varying in width from 20 to 50 miles, having an area of over 13,000 square miles, or eight and a-half million acres,—one and three-eighths of a million more than great Yorkshire, or equal to a fourth of Scotland. This territory is about equally divided now between Virginia and West Virginia. In general terms it may be described as a series of comparatively narrow and long parallel valleys, separated by ranges of mountains, as a rule equally parallel, long, and narrow, and of considerable elevation. In crossing some sections of this belt at right angles there would be found as many as twelve prominent ranges of mountains and valleys in a space of 50 miles, each valley watered by a very considerable river. More than half of this region is drained by tributaries of the Potomac and the Monongahela, flowing due north-east; the other half by those of the James, New River, and the Tennessee, mostly flowing due south-west.

The heads of the valleys are some 2,500 feet in elevation, and they descend to from 800 to 1,500. The mountains, the repeated outcrops of the great waves of the upper Silurian and Devonian sandstones, are from 3,000 to 4,000 feet in altitude, while the valleys, the denuded edges of the softer interstratified limestones, slates, and shales, have a general height of 1,500 feet. The elevation and arrangement of the mountain system secure to this region a constant supply of moisture; the character of the rocks, a soil of great natural fertility, especially where they are the soft and highly fossiliferous limestones common to the formations here developed, while the depth and direction of the valleys guarantees a high, summer-day temperature. These given, nothing is wanting but cultivation to make sure ample grass, Indian corn, and root crops, and for these the valleys of this region are famous, especially those of the South Branch of the Potomac and the Clinch and Powell's rivers. It has long been the beef-producing region of the eastern portion of the United States, and from it the best cattle are obtained.

The population of the ten Virginia counties in this belt was 68,500 in 1860, and 72,635 in 1870; that of the ten West Virginia counties was 73,836 and 75,874, a total of 142,336 and 148,509 in the same years, a gain of some 4½ per cent. The negro population of the West Virginia portion of the region was 7,631 in 1860, and 4,355 in 1870, a loss of nearly 43 per cent. The average to a square mile in 1860 was 20, but most of the population is located at three centres, the extreme north-eastern and south-eastern parts, and on the waters of the Greenbrier branch of New River, south of the central portion, where the limestone valleys are widened, and where highways have long been opened; there are hundreds, almost thousands of square miles of this region, especially on the head waters of Cheat and Greenbrier rivers, covered by dense unbroken forests of pine, black spruce, cherry, maple, hickory, and oak, where the traveller on the great turnpike roads built by Virginia across and through these mountains in all directions, will find but one or two clearings in a day's ride.

The great forests of the mountains of New York and Pennsylvania are rapidly disappearing (a single one of the counties of the latter state, no larger than these, having sent 500,000,000 feet to market last year, that was sold at an average rate of 20 cents per cubic foot), so the day is not far distant, in this railway building age, when these great bodies of timber must come into the market. It is no uncommon thing to find a hundred or more hickories, white oaks, tulip poplars, or wild cherries, upon an acre, each of which will exceed two feet in diameter, and afford a shaft of that size, without a branch or limb, of sound and merchantable timber 40 or 50 feet in length; the pines and spruces will furnish longer ones.

The improved lands were 1,287,802 acres; the unimproved in farms 3,982,975, so only one-third of the $5\frac{1}{4}$ million acres claimed to be in farms was cleared—a fact readily accounted for when the custom is known that there prevails of fencing in forest land for grazing stock cattle, or claiming the whole country as a range. In reality not more than one-eighth of the country is cleared. The average price of the land in farms was seven and three-quarter dollars per acre.

The United States Patent-office, when the Department of Agriculture formed part of it, ascertained officially that a steer that at three years old cost 25 dols. in New York, 24 dols. in Ohio, 15 dols. in Illinois, and 12 dols. in Iowa, would only cost 8 dols. in the mountain regions of Virginia. This shows the great advantage this region must have in rearing stock of all kinds, for the first cost is not half the average of the states named, while most of them are from twice to four times as far from the great markets.

The climate of the valleys of this region is a very agreeable one, and very favourable to the health of man and beast. The isotherm of 55 deg. passes diagonally across this region. At Lewisburg, at an elevation of 1,800 ft., the average of the spring months is 54 deg. Fahr., of the summer 73 deg., the autumn 56 deg., and the winter 35 deg., giving an annual mean of 55 deg., or about the same as Baltimore and St. Louis, and higher than that of Philadelphia or Cincinnati. These may be taken as fair means for the elevated valleys. The spring and winter winds at Lewisburg are generally south and south-west. The rain-fall is from 32 to 36 inches in this section. The mortality statistics of 1850 show that the comparative deaths of this region are as 96 to 238 in the Mississippi Valley proper, 125 in the New England States, 101 in the North-Western States, and 92 in California. It should be remembered, too, that the population of the Virginian mountains is an old and fixed one, while that of the west is constantly filled up with a picked people.

Time forbids more than a glance at the productions of the Appalachian region. It had in 1840 over 608,000 head of live stock—four and a-half to each one of its people—valued at seven million dollars. The cereals produced were over seven million bushels, or 50 bushels to each inhabitant, at the same time large quantities of tobacco, flax, &c., were cultivated, and millions of feet of timber sent to market.

General Sherman states that he made his well-known march, with a great army, from the mountains of Tennessee to the Atlantic seaboard, without a commisariat, by having the census of 1860 in hand, and choosing his line of advance by its statements of production. In like manner large armies, in the early part of the late war, subsisted on the sparsely-settled valleys of these mountains, and constant supplies were drawn from these unfailing sources during its continuance.

The mineral resources of the Appalachian belt are very great, especially in iron ores of a superior quality, and favourably situated for mining. The ranges of mountains adjacent to the valley generally consist of a great sand rock, that dips at a high angle to the eastward, forms that face of the mountains, and gives them a bold, sharp, and ragged crest line; under this rock, on the western slope of these ridges, is a softer red shale or sandstone dipping in the same direction, and this is generally succeeded by a stratum of brown hematite iron ore from 20 to 50 feet or more in thickness, and extending to unknown depths, apparently coinciding in extent with the associated strata. The softer shales and sandstones between the crest of the mountain and the iron ore weather away and leave the iron ore exposed in many places as a series of knobs or shoulders; on the western side of the mountain, at a somewhat lower level than its top, as the ore is softer than the sand-rock, so the mountain has a shallow trough, or "double," as the people of the country call it, along its summit, sometimes extending for miles, and furnishing a way for a road-bed. Some of these bluffs or knobs of iron ore are 25 or 30 ft. in height, and of large dimensions, as at Elizabeth Furnace, on the line of the recently opened Chesapeake and Ohio railway. These peculiar features are repeated as often as the successive waves of the same formations come up, so there are sometimes three or four parallel ranges not far apart, each bearing these valuable ores upon their backs, and indicating the rich burden, by the same topographical feature revealing the iron deposit to the eye as far as it can see the outlines of the ranges. The limonite ores contain from 74 to 83 per cent. of sesquioxide of iron, and often from 1 to 10 per cent. of sesquioxide of manganese, adapting them well for use in the manufacture of iron or steel by Bessemer's process. These ores are found both massive and porous, and sometimes decomposed into beds of great thickness, as a thoroughly pulverised mass, as at Longdale.

In some of the valleys are found pockets of red hematite, and in the low limestone hills masses of brown hematite. It is difficult to conceive of the quantity of these superior ores that must exist in these long ranges of mountains, extending for hundreds of miles, or to estimate the importance and wealth they will give to Virginia now that they are made accessible by railway and are brought by the same means in communication with the great coal-field of the Kanawha basin. The iron now made here in charcoal furnaces from these ores readily commands the highest price in the market as car-wheel iron. Furnaces are in process of erection for making iron with the splint and other coals from the field before mentioned.

Adjacent to the iron ore is generally found a thick stratum of good fire clay, and this is succeeded by a highly fossiliferous limestone, conforming to the dip of the other rocks, containing ninety-four per cent. of carbonate of lime. This is a superior flux for use with the adjacent ores, and for burning into lime. The low foot hills lying west of the limestone are black slates, containing several per cent. of petroleum (which, it has been suggested, might be utilised in some way) and aluminous shales, enclosing nodules of sulphuret of iron. These shales are used in some places in the manufacture of alum. The springs that flow from these various mineral strata are strongly impregnated with their properties, and at intervals throughout the belt are chalybeate, alum, sulphur, and other medicinal springs held in high repute as remedial agents. There are many kinds of valuable building stones, some of them of great beauty, as the well-known rich brown Tennessee marble that abounds in the Clinch valley.

Many of the valleys, as before stated, are limestone, the rocks belonging to the Devonian and Sub-carboniferous formations. All these are noted for their fertility, and the limestones are the best of their kinds for all purposes.

Salt-wells have been bored, and some salt made in several places in the south-west, in Mercer and Scott.

In some of the western ranges, especially the low broken one known as the Poor Valley Ridge, lying just east of the Great Conglomerate, the base of the coal measures that forms the Cumberland mountain, the boundary between Kentucky and Virginia, and its extension as the Great Flat Top and other mountains, is a very persistent stratum of fossil red hematite iron ore, locally known as dyestone, because sometimes used for colouring purposes. This stratum is conformable to the sub-carboniferous rocks, and is remarkable from the fact that it extends from Alabama to New York, from 1,200 to 1,500 miles. It is known in the latter state as Clinton ore, and is so highly prized it is taken hundreds of miles to the Pennsylvania furnaces. In the last-named state a seam of it, eight inches thick, is held to be very valuable. This stratum of ore in Virginia is from 28 to 38 inches in thickness, and very favourably situated for mining. Still little or no use has been made of it, as no railways have been completed to the region where it is exposed. No ore can be more favourably situated for manufacture, for it is not more than four or five miles through the Cumberland mountain to the Kentucky coal, and a little farther to the north-east this ore is found on one side of a narrow mountain and the coal on the other, with water-gaps at several points between them. Large quantities of iron are made in Tennessee from these ores, where they yield from 60 to 75 per cent. of metallic iron. This ore is generally found as a solid stratum, of a rich, dark colour, and so full of fossil remains as to look like a mere mass of encrinal and crinoidal buttons, the whole so soft in the quarry that it can be cut into blocks or slabs with a saw, or hewn with an axe; sometimes it presents itself as a lenticular or oolitic mass. The value of these Virginian deposits is very great, and the interest lately manifested in these ores—(a late number of the *Iron and Coal Trades Review*, of London, states that English capitalists even are about to work the poorer seam in Pennsylvania)—must lead to their development, not only in the south-west but in the central parts of the region under consideration, where they are known to be well developed. Nitrous earth is abundant in the caves of this region, and quantities of saltpetre have been made.

Trans-Appalachian Country.

The remainder of the Virginias may be called the Trans-Appalachian country, although the term is not strictly correct, for this is really the western slope of the Appalachian region itself—the descent from the outcrop of the Great Conglomerate, the base of the coal measures, to the trough of the Ohio river. Nearly the whole of this territory—a hundred miles in width from south-east to north-west, and averaging 175 miles in length from south-west to north-east, an area of 17,500 square miles (over 11 million acres)—is underlaid with coal; it is carboniferous. The general elevation of the eastern mountain border is 2,500 feet; that of the edges of the plateau along the Ohio about 900 feet; the Ohio itself, at the mouth of the Great Kanawha, is only 550 feet above tide at New Orleans, 1,800 miles distant by the Ohio and Mississippi.

This Trans-Appalachian region can be best understood by regarding it as a great plane, inclined to westward at a low angle, from which the channels of the streams have been eroded to a great depth in forming cañons, in many places a thousand feet deep, so that navigable waters penetrate to the very heart of the plateau, so most of the country is on a much higher level than the principal streams; still, there are great bottoms—level alluvial lands—along the rivers, of wonderful fertility, walled in by the lofty escarpments of the plateau, and having conditions of climate and production belonging to places many degrees farther south. All of this region but about 1,000 square miles—the counties of Wise and Buchanan, in the south-western part of Virginia—is in West Virginia. The population of the Virginia portion was 7,301 in 1860, and 8,562 in 1870—a gain of over 17 per cent. The population of the West Virginia portion was 302,852 in 1860, and 367,140 in 1870, a gain of over 21 per cent.; a rapid increase, but readily accounted for when it is known that during the decade petroleum and other great interests were developed.

The negro population was 13,533 in 1860, and 13,625 in 1870, a very small gain, but accounted for by the fact that the negroes had left the mountain region and gathered into the towns along the Ohio. The negroes do not constitute 1-25th of the population. The average of population to the square mile was 22 in 1870. The negroes in the Virginia portion were 123 in 1860, and 115 in 1870.

The improved lands were $1\frac{1}{2}$ million, and the unimproved, in farms, 6 million acres, a total of $7\frac{1}{2}$ millions, valued at $6\frac{1}{3}$ million dollars, an average of $8\frac{3}{4}$ dollars per acre. There were over 3 million acres not held in farms—wild lands, generally owned in large tracts for their undeveloped mineral or timber resources, so not more than one-sixth of this large territory is under cultivation, leaving enough unused to make ten counties the size of England's Suffolk.

The production of cereals was 10 million bushels. More than half of this was Indian corn, but the wheat, oats, buckwheat, and potato crops were large. The average was 33 bushels to the person. The live stock numbered 855,000, valued at $8\frac{1}{3}$ million dollars, giving $2\frac{4}{5}$ animals to each individual. This section produced several million pounds of butter and cheese, large quantities of tobacco, and thousands of gallons of wine. Its agricultural capacity is very great, and nowhere is the husbandman more fully rewarded by bountiful harvests of everything that will grow in temperate climates, while domestic animals are reared with but little expense, and thrive well. It is most favourably located between the great markets of the east and the west.

The mineral resources of the Trans-Appalachian region are very great. Especially is it rich in the abundance of cannel, splint, and bituminous coals, one or more of these varieties being found under 16,000 square miles of its territory. The great Appalachian coal-field extends from northern Pennsylvania to northern Alabama, an irregular oval area, widest on the line of the Kanawha river, which crosses it at right angles. This part of the coal field is one-quarter larger than the great coal fields of the British Isles.

On the eastern border the seams of the lower coal measures are found, having an exposed aggregate thickness of some 50 feet in the gorge of New River—the line of the Chesapeake and Ohio Railway—a cañon from 1,200 to 1,500 feet below the general level of the country. One of these seams is over six feet thick, furnishing a good coking coal; another seam of block coal is four and a-half feet thick. There are several other seams, three and four feet in thickness, furnishing bituminous coals of good quality. These seams have only a moderate inclination to the north-west, and are all above the river and railroad level. These lower measures descend more rapidly than the rivers, and so pass beneath the water level some 50 miles from their eastern outcrop. The strata of the upper coals come to the horizon as the mouth of New River is approached, and not far below the junction of that river with the Gauley to form the Great Kanawha. At Armstrong's Creek, a section in the 600 feet of bluff above the level of the Kanawha, shows 13 seams of coal varying in thickness from two and a-half to nine feet, with an aggregate of 61 feet. Below this place, at Cannelton, on the other side of the Kanawha, there are five seams of coal open, in the 1,300 feet of the face of the bluff, aggregating 29 feet. More than 100 feet of stratified coal has been proved here. The seams vary from 8 to 14 feet in thickness, and embrace gas, shop, splint, and cannel varieties. The seam producing the cannel is double, giving 4 feet of cannel and $2\frac{1}{2}$ of splint coal. This cannel will yield 60 gallons of oil to the ton of 2,000 lbs. A section on Cabin Creek and vicinity, ten miles below Cannelton, by Prof. Ansted, gives 68 feet of coal, in some 13 seams, varying in thickness from $2\frac{1}{2}$ to 11 feet; 22 feet of these seams are cannel and from 7 to 11 splint coal. At Campbell's Creek, still lower down the river, in the 400 feet of bluff, are 6 seams, from $4\frac{1}{2}$ to 6 feet thick, that furnish 29 feet of coal. This coal is peculiar in its formation. Near Clay Court-house, on Elk river, the coal strata are from $4\frac{1}{2}$ to 11 feet thick, making 41 feet of coal in the 500 feet of bluff; 19 feet of the coal being splint and 6 cannel. At the mouth of Coal-river a stratum of coal, from 4 to 8 feet thick, is found at a depth of 300 feet: of course the other seams are found there also, but at greater depths. These may be considered fair samples of the sections throughout this great coal-field, ample enough to satisfy the wants of untold generations, and so accessible as to require no special skill in mining nor expenditure for drainage and ventilation. The Baltimore and Ohio Railway, with its Parkersburg and Wheeling arms and numerous branches, now crosses the northern part of this field and opens it to markets. The Chesapeake and Ohio Railway has just crossed it in the south, where the Great Miner has "torn asunder the mountains," and well and wisely cut an open gangway, more than a thousand feet deep, across the rich strata, exposed them to daylight, and at the same time made way for the railroad, at very low grades, to carry this "bottled sunshine" to the great markets. The coals found here are used in making iron without coking, and the choice for any special purpose is very great, the quality being unexceptionally good.

On the Little Kanawha river are some of the most abundant oil wells in the country, and millions of gallons are annually exported from them. In the same region is mined a solidified petroleum, as it were, highly valued for the manufacture of lubricating oils.

The salt-bearing rocks underlie this region, and these have been penetrated by artesian wells at various points, especially on the navigable streams, and large quantities of salt manufactured. On the Great Kanawha, above Charleston, the capital of West Virginia, from two to three million bushels of the very best salt are annually manufactured. One establishment, the Snow-hill, producing a half-million bushels, draws a brine that gives a bushel of salt to 45 gallons, from 9 wells from 800 to 900 feet deep, and mines the coal to evaporate it from the hills that overlook the works. Bromine is made from the waste at the same point. The iron ores peculiar to the coal measures are found in all parts, and these, though yielding but 30 per cent.—like most of the ores from which England manufactures her seven million tons annually, the half of the world's production—will undoubtedly be utilised and worked with the 60 per cent. ores of the Appalachian belt. Fire-clays are also found in the coal region, and valuable building stones are abundant, especially sandstones, having great durability and yet easily wrought, admirably adapted to the construction of extensive works. Clays for brick-making abound, as well as good building and glass-making sands.

Few countries surpass this in the quantity and quality of its timber. The original forests of birch, walnut, maple, white and yellow tulip-poplar, oaks, and some pines furnish trees of great size and length, and perfectly sound. There is an abundance of water-power, and already millions of feet are annually produced. It would require a volume to give an adequate idea of the resources of the Virginias and of their availability in every way. It may be truthfully said there is no country that more nearly resembles in these respects the epitomised world that is found in Great Britain.

DISCUSSION.

Mr. Hyde Clarke said it was hardly necessary to look for a word of sympathy for Virginia, because Virginia was closely connected with this country a century before the union with Scotland was effected. That connection lasted so long as even to have extended during the early period of the history of the Society, and in common with other colonies it received the fostering counsels of the Society of Arts. At that period Virginia more than once had its claims advocated within these walls, and by the organs of the Society. It might even be said that at the period when the connection between Virginia and this country took place there was a greater amount of sympathy with the cause of independence here than there was in the provinces of America which established that independence. They sympathised with Virginia in every respect, and it was that feeling which had led English people to invest large sums for the benefit of the State of Virginia. Those investments were still further increased after the late war, by those who visited the country and saw the resources of the land, and the character of its citizens. This society had been among the first to invest its funds in American bonds. So far as Virginia was concerned, he felt it his duty, as the Secretary of the Council of Foreign Bondholders, and also as Secretary of the Committee of Virginian Bondholders, to say that the feelings of confidence were not disturbed at the present moment, but that Virginia was in such a position of financial trouble that it very much affected the possibility of any undertakings for the development of its resources being assisted in England. Virginia must set her affairs in order before she could apply to England for further assistance. It could scarcely be said that it was the fault of her own citizens that this had not been done, because the government had on various occasions come forward as the open asserter of the just rights of the creditors, and he thought the documents and addresses which had been published did great honour to that country. The dividends due to the people of this country had not been paid, and although decisions had been given by the courts in Virginia in favour of the creditors, they had not got the benefit of them, and at the present time there was a conference sitting at Richmond, between the legislators and the creditors of the state, whose decision might be announced by telegraph at any moment, offering a compromise. It was their duty, he considered, under those circumstances, to call the attention of Major Hotchkiss, as a representative of Virginia, to the state of the case, so that he might press upon his fellow-citizens to take all the measures necessary to restore the position and reputation of the state. At the present time, no less than ten of the Southern States, which had been precipitated into difficulty through the late war, were more or less scenes of repudiation, and the amount of money due was producing great suffering. It was in Virginia that the confidence of the people of this country had been most placed, and, therefore, they looked to that state to set an example to the others. There were many people in London deeply interested in Virginia, who had the strongest desire to promote the welfare of the country, and to develop its great resources. With regard to Richmond, he looked forward to the day when it would become one of the great ports. If that was to be done, it could only be accomplished by Virginia upholding her credit, because credit was a capital beyond natural resources, and was greater than money.

Professor Ansted, F.R.S., said it was nearly 20 years since he first visited Virginia, and examined some of its mineral riches. The last speaker had referred to a subject which he thought had better not be discussed, as it would only occupy a great deal of time and do no practical good. He could speak personally and positively as to the nature of the coal-fields alluded to, which provided one of the greatest resources of mineral wealth of Virginia, and one which would no doubt prove in the long run the most important of all. They might form a good notion of the real value of this coal-field by drawing a comparison between Virginia and England, two countries of nearly the same size. In Virginia the coal-fields extended across the country from north-east to south-west,—as if two-thirds of England were one coal-field,—the coal not being difficult to work, involving very few mechanical difficulties with water, and scarcely any danger from explosions. The communications by railway were quite equal to those of England. It was true the coal-fields did not come actually to the coast, but they reached almost to the Ohio and the Mississippi, and he felt sure that the Mississippi itself would ultimately be as great a highway for America as the Atlantic was for England. There being easy communication with the Atlantic coast, he did not think it was too much to expect that in course of time Virginia would send over coals to England if the labour question remained as it then existed. At the present time they exported coal largely from Newcastle, from the neighbourhood of Liverpool, and South Wales, and he saw no reason why some of the great Appalachian coal-fields should not export coal with equal convenience to Europe as we did to New York. For a very long time past the whole of the gas burnt in New York had been made of English coal, notwithstanding the facility they had for getting it from their own country; but if the price increased much more they would have to use their own. As to the existence of coal in Virginia there could be no question, but it had never been properly worked; indeed, there was no coal-field which was more important, and, although there were places where the seams were thicker, there were none where they were more accessible or of a better quality; and he did not think it was always the case that the thickest seams were the most valuable. The coal-fields in the Appalachian range were nearly all horizontal, intersected by convenient valleys, and could be worked from numerous points at the same time with ease, and might be looked upon as inexhaustible. As soon as they were opened up, the country would be in a position to put themselves before the world in such a way that all recollection of the past misdeeds, referred to by Mr. Hyde Clarke, would be entirely forgotten. Virginia was also rich in iron fields of every variety and quality, and he saw no reason whatever why, if the same amount of energy and intelligence were applied to the manufacture of iron as in England, Virginia should not take precedence, in the present state of the labour market, in that important manufacture. Something of this kind must inevitably take place, unless things were altered, of which he saw no chance; and in this respect Virginia had the chance of being one of the most important states of America, and one of the wealthiest countries in the world; for, although up to a comparatively recent kind it had been neglected, there was no reason for it so far as the physical condition of the country was concerned. No country had greater resources of wealth; for besides coal and iron there were other minerals, gold having been obtained in many districts with advantage, and it was certainly not yet exhausted. There was also copper, limestone, marble, salt, and other earthly minerals, which he would not allude to. With all these advantages, he looked forward to Virginia being one of the countries of the future, and he was happy in being able to lend what assistance he could in pointing out these matters, because he had visited it at a time when it was much less populous than it was now, and had foreseen that when the coal was worked it must rise in importance.

Mr. Thos. Sopwith, F.R.S., desired to draw attention to the maps by which the paper had been illustrated. The large map of Virginia, showing topographical features, was quite a model of its kind, and some smaller maps which he had seen, also by Major Hotchkiss, one only of which had been engraved and published, were of the same excellent character. Some years ago he had occasion to make himself acquainted with the Virginia coal fields, and the information which then reached him entirely accorded with what had now been stated.

Mr. Christopher Cooke asked what was the climate of Virginia, as he had heard it stated, though he believed erroneously, that it was unhealthy; also if there was a good system of landed property, with registration of title.

Mr. J. Bowron (Newcastle) said that two years ago he spent some months in Virginia, more particularly for the purpose of investigating its mineral resources, and he could concur in all the remarks of Professor Ansted. There was no doubt of the regularity of the coal-fields throughout the whole of Western Virginia, while the country was so intersected with valleys that it was very easy indeed to open up at any point coal seams which could be readily identified with the same seams occurring 20 or 30 miles off. He himself followed one seam a long distance, and its regularity he could hardly have believed if he had not traced it. On approaching the Appalachian region he found such immense deposits of hydrated hematite ore as he had never seen elsewhere, though he was familiar with deposits of a similar kind in Cumberland and also in Spain. Besides these resources, the capability of Virginia as a paper-producing country were greater than he believed existed anywhere else. It had the materials at hand for producing those chemicals for which, at present, America depended mainly on England, being well supplied with metallic sulphurets, salt, limestone possessing 98 per cent. of carbonate of lime, manganese, pure water, and coal, and having these, it could not lack anything for chemical manufactures; and it possessed besides such a growth of non-resinous trees and plants, suitable for the manufacture of paper, that he had no hesitation in saying that the one state alone could easily supply paper for the whole of the civilised world.

Mr. Newton said he had twice recently visited Virginia and Western Virginia, for the purpose of ascertaining its suitability as a colony for English agriculturists. He found that the land was richer than in England, and the climate better; land could be bought for little more than one year's rent in this country; every crop that would grow here might be cultivated there, and some especial ones besides; there were as good markets, and every necessary could be obtained at a lower price. In fact, all that an English farmer wanted was a little capital to start with, and he could not fail of doing well there.

Mr. Etheridge, F.R.S., referring to the recent statement of Sir William Armstrong, that under the present prices of coal England was paying what was equivalent to an annual tax of £45,000,000 on that article, drew special attention to the rich mineral resources of Virginia, and expressed his opinion that unless some solution of the difficulty could be found at home—and there was no absolute necessity for such famine prices, seeing that at the present rate of consumption our own coal-fields would not be exhausted in less than 500 years—Virginia would, at no distant date, be found supplying the whole world with coal and iron. He recommended everyone who was interested in the coal question—and very few were not in these days—to peruse the Report of the Royal Commission on Coal supply, which would be found very instructive; and trusted that something would be done before long to bring about a more satisfactory state of things in the labour market.

Colonel Montgomery (U.S.A.), said the mineral resources of Virginia did not lie wholly in the future, for at the present moment negotiations were going on for the supply of Virginian coal in the London market, as well as to France and Belgium. Virginia could contract to deliver coal in London at 20 per cent. under present prices, and still retain a profit of 20 per cent. All that was required was a little English capital, and he had no doubt this would be forthcoming, to the great advantage of both countries.

A Gentleman inquired if an Englishman could hold land in Virginia.

The Chairman said he could answer that question in the affirmative, as far as regards Virginia. In West Virginia it was necessary for foreigners to hold lands through a trustee.

Major Hotchkiss, in replying to the various observations and questions, said it was as impossible to give an exhaustive account of Virginia in an hour as it would be to do so with regard to England in the same time. As to the public debt, he would simply say that the population of Virginia consisted of 500,000 blacks and 700,000 whites, and 500,000 of the latter were undoubtedly in favour of paying the interest not only upon two-thirds of its bond debt, but upon the whole if need be. And the voice of the people would make itself heard. The Courts had decided that coupons should be received for taxes, and the state had backed out of its false position, and effaced from the statute book the law which said that should not be. A conference was now being held between the bondholders and the representatives of the state, for the purpose of settling, not the terms, but the time of payment. The last census of the United States had with it a map of wealth, showing in golden figures the wealth of its people. Golden streaks stretched across from New York to the Mississippi, and Chicago, and St. Louis, and California, but the southern portion of the country was represented by a *tabula rasa;* far different, however, was the census of 1860, nor would it bear the same appearance in 1880. Virginia had been called "a neglected state," but it was not so in 1860. There was no land the sun shone upon which poured into the laps of its people such abundance of wealth. It had no need to look abroad for people to occupy it; it was self-supplying and self-supporting by means of its own agriculture. When that was swept away by the war, its present capital was destroyed, but there still remained its magnificent mineral resources and prolific soil, as the basis upon which to rebuild. Already in one of the centre counties of the Valley, which was literally swept with the broom of destruction—the torch having been applied to every manufactory, mill, granary, and even to many of the dwelling-houses—the traveller might pass through it without finding a trace of the war. Its people, with their own unaided hands, had recuperated and restored it and were now beginning to lay aside their earnings to pay their debts. The same sentiments which prevailed in England swayed the hearts of the Virginians, and before long, he would venture to predict that she would be restored to full credit in the commercial world. The development of manufactures in one district had already doubled the amount of taxable property, and the same would happen elsewhere. It was said to be a good thing in any country to own the species of property which was held by the majority. Unfortunately, in Virginia the majority held land, and they disliked levying a tax upon it, so that at present the tax was not more than one-half per cent. from that source, but that would be increased if necessary to meet the demands of the state. Still, as he had said, the amount of taxes had doubled in one county through the development of manufactures, and by that means the interest on the bonds and all other claims would be paid. That this view was held by the public appeared from the fact that members of the present legislature, which would expire next May, had been rejected as unworthy stewards, when recently candidates for office, on account of the manner in which they had discharged the trust before confided to them. With regard to holding land, a law had been passed placing foreigners on the same footing in this respect as citizens, and it was expected that the law of Western Virginia would be assimilated to it; but in the latter state foreign landowners were put on the same footing as resident foreigners. The question of climate was fully dealt with in the paper, though, from want of time, he had omitted reading it. It was a healthy country, and its people were healthy—

much the same as Englishmen, True, the lower country was for a part of the year rather unhealthy to persons not acclimatised, but even there, if favourable locations were selected, away from the swamps and malarious districts, there was nothing to complain of. Through all the middle, Piedmont, and the valley and mountain regions, the climate would compare with that of any country in the world. If time had permitted. he should have liked to say something about the commercial position of Virginia, but he would confine himself to mentioning the railway system. The growth of almost every portion of the United States had taken place as the result of developing through lines of railway; and Virginia embarked in this enterprise very soon after railways were invented; indeed, some of the oldest lines in the world were to be found there. The Virginians had now more than 1,800 miles of completed railway, as shown on the large map, there being no less than three distinct lines of communication across the States from east to west, besides branches intersecting all the mineral resources at right angles he mentioned, besides other lines running north and south. Many others were in course of construction, in fact, the railway kings were having a fight there, and when they had done, the state would be as the Almighty intended it should be, one of the most flourishing countries in the world.

The Chairman, in proposing a vote of thanks to Major Hotchkiss, said he had recently visited Virginia, and could readily endorse all that had been said as to its enormous natural advantages.

At the close of the meeting a model of an improved apparatus, for lowering and floating ships' boats at sea, was shown and described by the inventor, G. E. Nicholas, M.D., formerly Assistant-Surgeon, R.N. The description will be found at page 253.

ANNUAL INTERNATIONAL EXHIBITIONS.

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The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

The first meeting of the Committee for the exhibition of Wine, Spirits, Beer, and other drinks, and Tobacco, was held at Gore-lodge, Kensington, on the 12th inst. There were present—Lord Skelmersdale (in the chair), the Hon. E. Drummond, Colonel C. Baring, Mr. J. Prestwich, F.R.S., F.S.A.; Mr. H. Mattheissen, Mr. M. Yeatman, Mr. C. H. Kayser, and Mr. E. Charrington. Mr. Cole, C.B., also attended, and Mr. E. J. Craigie, as deputy commissioner, who acted as secretary. The committee discussed the general course to be pursued, suggested certain arrangements for affording the public every facility of acquiring some knowledge of the respective processes of manufacture, formed themselves into various sub-committees, and then adjourned.

The fourth meeting of the committee for Ancient Objects was held on Friday, the 14th February. There were present Mr. C. Drury Fortnum (in the chair) Mr. Campbell, Mr. Franks, Mr. Moody, Mr. Soden Smith, and Mr. Thompson. The committee having considered the applications received to exhibit ancient silks and velvets, observed that while English and French silks of the last century are well represented, and Italian silks and velvets are partially represented, there is no representation of ancient silks and velvets from China and other oriental countries, Spain, Portugal, and Germany. More specimens of the old Genoese velvet are also required.

The second meeting of the Sub-Committee on a Colonial Court in connection with the current series of Annual International Exhibitions in London, was held 14th February, at the Royal Commissioners' Office, Gore-lodge, South Kensington. The Right Honourable Hugh C. E. Childers occupied the chair.

The Permanent Fine Arts Committee held its second meeting, at the Albert-hall, on Saturday, the 15th of February. The following gentlemen attended:—Mr. S. Addington, Mr. T. O. Barlow, A.R.A; Mr. E. L. S. Benzon, Mr. H. Bolckow, M.P.; Mr. F. Cosens, Mr. B. Dobree, Mr. H. W. Eaton, M.P.; Mr. C. Lucas, Mr. H. O'Neill, A.R.A.; Mr. J. Pender, M.P.; Mr. S. Redgrave, Mr. J. Reiss, Mr. W. Smith, F.S.A.; Mr. Charles Waring, Mr. W. Waring, and Mr. Kemp Welch. Mr. H. Cole, C.B., attended on behalf of her Majesty's Commissioners. It was resolved that, as the French Commission does not propose to act this year, a special effort should be made to show the best French pictures possessed by English gentlemen. Sub-committees were formed for the representation of foreign paintings, specially those of French artists, for the representation of British oil paintings, specially works by Phillip, R.A., and Creswick, R.A., and for the representation of British water-colours. The Committee decided to recommend that there should be no limit of date as to the execution of these works.

The third meeting of the Committee appointed to promote an adequate representation of French Art and Industry in the forthcoming International Exhibition, was held on Saturday afternoon, the 15th of February, at the Royal Commissioners' Offices, Gore-lodge, South Kensington, at 4 p.m. M. P. Dutreil, of the French Embassy, occupied the chair, and among the other members of the committee present were—MM. A. Casella, J. Lebeau, E. P. Lintilhac, C. Waring, &c.

The fourth meeting of the Committee on Surgical Instruments and Appliances took place on Monday, 17th February, at the Royal Commissioners' Offices, Gore-lodge, S.W. The members present were—Mr. Cæsar H. Hawkins, F.R.S. (in the chair), Dr. P. Allen, Mr. R. Brudenell Carter, Mr. W. White Cooper, Dr. H. J. Domville, C.B.; Dr. Arthur Farre, F.R.S.; Mr. J. Hilton, F.R.S.; Mr. Liebreich, Mr. J. Luke, F.R.S.; Dr. A. G. Mackay, Mr. J. Marshall, F.R.S.; Mr. T. W. Nunn, Dr. W. S. Playfair, Mr. R. Quain, F.R.S.; and Mr. E. Saunders. The committee, after transacting the general business of the meeting, considered the applications, more than sixty in number, which had already been received. They adjourned until Monday, the 17th March, the date of receiving the goods being Tuesday, the 11th March next.

The sixth meeting of the Committee for Silk and Velvet was held on Tuesday, the 18th February, Sir D. Cooper, Bart., in the chair. There were also present—Lady Dorothy Nevill, Mr. Blakely, Mr. D. Chadwick, M.P.; Mr. P. Graham, Mr. A. Lewis, Dr. Mann, Mr. C. A. Peters, and Mr. Tucker.

Her Majesty's Commissioners have resolved that the season tickets to the exhibition shall also give admission to the daily musical performances in the Royal Albert Hall. These will consist of concerts of a high standard, directed by Mr. Barnby, and performances on the great organ by Mr. Best and Dr. Stainer. The tickets will be ready for sale on the 1st March, and will be issued at a guinea each.

The following are the rules for the reception of British goods:—

1. The entrances for the reception of goods will be as follows:—1, east entrance, in Exhibition-road; 2, west

entrance, in Prince Albert's-road; 3, south entrance, in Exhibition-road.

2. All objects must be delivered at the building, at the entrances specified, and on the days named below:—Saturday, 1st March, and Monday, 3rd March, class 1, paintings in oil and water colours, drawings, &c., west entrance; Tuesday, 4th March, and Wednesday, 5th March, class 2, sculpture, east entrance; Thursday, 6th March, class 7, reproductions, west entrance; Thursday, 6th March, class 1, stained glass, west entrance; Thursday, 6th March, classes 2 and 6, fine art furniture and all decorative work, west entrance; Friday, 7th March, classes 2 and 6, fine art furniture and all decorative work, west entrance; Friday, 7th March, class 12, substances used as food, wine, &c., tobacco, implements for drinking, and utensils for the table, east entrance; Friday, 7th March, class 4, architectural designs, west entrance; Saturday, 8th March, class 3, engravings, west entrance; Saturday, 8th March, class 5, tapestries, west entrance; Saturday, 8th March, class 12, cooking and its science, west entrance; Monday, 10th March, class 12, cooking and its science, west entrance; Monday, 10th March, class 9, steel, cutlery, and edge tools, west entrance; Tuesday, 11th March, class 10, surgical instruments and appliances, east entrance; Tuesday, 11th March, machinery and raw materials, west entrance; Wednesday, 12th March, scientific inventions, west entrance; Wednesday, 19th March, class 8, silk and velvet fabrics, &c., east entrance; Monday, 17th April, class 11, carriages, south entrance.

3. All objects must be delivered to the officers appointed to receive them, unpacked and ready for immediate inspection, and free from all charges for carriage, &c. The only exception to this rule will be in the case of machinery, which may be sent in cases, but must be unpacked by exhibitors.

4. Packing cases of exhibitors of machinery must be removed from the buildings as soon as the goods are unpacked.

5. To every object a label, form No. 19 (for Fine Art, form No. 19a), must be securely attached. The number on this label must correspond with the number of the object in first column of delivery order (see rule 6).

(N.B.—It is recommended that labels be attached to objects by wire.)

6. Delivery orders (form No. 31), duly filled in, must be sent in with the exhibits. These forms must contain a complete list of all objects submitted for exhibition, and the numbers in the first column must correspond with the number on the labels (see rule 5).

7. The doors will be opened at 8 a.m. daily, and will remain open until 4 p.m., except for one hour, viz., from 12 to 1 o'clock.

[Note.—Exhibitors of pictures and sculpture need not conform to these rules so far as they relate to forms of labels and delivery orders. A written label must, however, be attached to each picture or work of sculpture, and a note, giving list of works sent in, must accompany them.]

The following are the conditions of tender for the privilege of taking and selling photographs:—

The contractor will have the privilege of taking general views of the Royal Albert Hall, the Exhibition Buildings, and the Gardens of the Royal Horticultural Society, as well as of the interiors of the several galleries, and portraits of visitors, together with the right of selling the photograps within the exhibition.

Her Majesty's Commissioners will allot not less than six spaces for the sale of the above-mentioned photographs.

The contractor will also have the privilege of taking photographs of objects, upon producing the written authority of the exhibitors; but, without their express permission in writing, the contractors will not be permitted to copy, by means of photography or of any other process, the works of the several exhibitors.

No pictures, statues, or other objects can be moved from their places for the purpose of being photographed without a special order from one of the executive superintendents.

The contractor will have the opportunity of making an arrangement with the publishers of the official catalogues to supply them with photographs for the purposes of the illustrated edition, which they have the right of publishing.

All buildings, fittings, and furniture necessary for the above-mentioned purposes shall be supplied by and at the expense of the contractor, subject to the absolute control of the Secretary of Her Majesty's Commissioners.

The contract shall continue in force until one month after the close of the exhibition, namely, till the 30th day of November, 1873.

Tenders must be sent in not later than the 28th of February, 1873.

Her Majesty's Commissioners do not bind themselves to accept the highest or any tender.

The following rules for the sale of specimens of food (not including tobacco) manufactured in the building in illustration of process or machinery are issued by H. M. Commissioners:—

1. *Objects consumed in the building (by tasting) by visitors to the Exhibition.*—In this case the exhibitor must fix some charge, to be as moderate as he pleases, for the consumer to pay. This charge must be approved by the executive, as a part of the charge made will be paid to the refreshment contractors, who have the sole right of supplying all that comes under the head of refreshments.

2. *Objects manufactured in the building in illustration of the process which the visitor purchases and carries away for trial.*—Every proposal, as to amount and price, must be approved by the executive.

The following prizes are offered by the Company of Coachmakers and Coach Harness Makers for competition among persons engaged in the trade of coachmaking, being masters, foremen, workmen, or apprentices, viz., for freehand or mechanical drawing applicable to carriages, or parts of carriages, or the ornamentation thereof—1st prize, the company's silver medal and £3, 2nd prize, the company's bronze medal and £2; for practical mechanics, 1st prize, the company's silver medal, 2nd prize, the company's bronze medal. Each of the aforesaid prizes will be accompanied with the certificate of the company. The awards will be made by the Science and Art Department at the examinations held (in connection with the Department) throughout the country. Information on this point may be obtained at any of the schools of art. The company, in addition, offer the following prizes:—For drawings of carriages or parts of carriages to the scale of one inch to the foot, for competition among foremen, workmen, or apprentices engaged in the trade of coachmaking, open to natives of England, Scotland, Ireland, and Wales, or any British colony, viz., 1st prize, the company's silver medal and £3; 2nd prize, the company's silver medal and £2; 3rd prize, the company's bronze medal and £1. Each of the above prizes will be accompanied with the certificate of the company. The awards will be made by judges nominated by the court and being members of the court. The freedom of the City of London and of the company will be presented to such successful candidate as the judges may recommend to the court as having distinguished himself sufficiently to entitle him to such an honour, upon his satisfying the court as to his general moral character. The drawings for competition for the above prizes to be sent free to the hall of the coachmakers (Noble-street, Cheapside, London) on or before the 30th of March, 1873, so that they may be adjudicated upon the 1st May following, in order (if possible) that the prize drawings may be exhibited in the carriage department of the forthcoming International Exhibition, South Kensington. The drawings are to have a distinctive mark put upon them before being sent in, and are to be accompanied by a letter containing the name, age, occupation, and address of the competitor, which letter is to be enclosed in an envelope bearing the same mark as that placed upon the drawings. These letters will not be opened until the judges have made their award. The drawings sent will remain the property of the competitor, but are liable to be retained for a time for exhibition in the hall. Care, however, will be taken of them, but the company will not hold itself responsible for their safety. Candidates must remove their drawings at their own expense within a week after being called upon to do so.

Army and Navy Amateur Fine Arts Exhibition.—A meeting of the Committee was held at the Royal Albert-hall, February 14, to consider the rules and to decide on the space to be occupied by the collection. There were present—Captain his Royal Highness the Duke of Edinburgh, R.N.; Captain Count Gleichen, R.N,; Admiral Hon. J. R. Drummond, Colonel Colville, Colonel Elliott, Admiral Oliver, R.N.; Admiral Ewart, R.N.; Colonel Crealock, and Major Donnelly, R.E., secretary. Mr. H. Cole also attended on the part of her Majesty's Commissioners and the Exhibition. It was arranged that the collection should be exhibited in the Eastern Picture Gallery.

EXHIBITIONS.

Vienna Universal Exhibition.—A meeting of Her Majesty's Commissioners was held at Marlborough House on Saturday, the 15th instant, under the Presidency of His Royal Highness the Prince of Wales, K.G. There were present—H.S.H. Count Gleichen, the Marquis of Ripon, K.G.; the Earl Cowper, K.G.; Lord Henry Gordon Lennox, M.P.; Lord Acton; the Right Hon. Hugh C. E. Childers, M.P.; Sir Anthony de Rothschild, Bart.; Sir Francis Grant, P.R.A.; Mr. Henry A. Brassey, M.P.; and Mr. P. Cunliffe Owen, secretary.

EXAMINATIONS OF THE SOCIETY OF ARTS.

The *Birmingham Daily Post* of Tuesday, 11th January, makes the following remarks on the subject of the Society's examination:—"The examinations of the Society of Arts have long been deservedly popular among the students attending the science and other classes in connection with the Birmingham and Midland Institute, and similar classes in other local institutions, having one common object in view—namely, to advance education, more particularly scientific education, in relation to industry. Considerable disappointment was felt when the announcement was made by the Council of the Society of Arts of its intention to discontinue these examinations. Strong representations from many scientific institutions (among others from the Birmingham and Midland Institute) induced the Council of the Society of Arts to take a wiser course." After a sketch of the programme the article proceeds:—"The manufacture of silk, cotton, or paper may not be locally of special interest, but the manufacture of steel in Birmingham is rapidly absorbing the production of cutting and edge tools; the town has two or three important paper mills; and in carriage building it has manufactories of importance. In these three last-named subjects, let us hope, not a few students will enter the lists as competitors. Regarding the technological examination as a test of the previous studies which lead up to it, we cannot help congratulating the Society of Arts on being the pioneer in this as in other matters. Should the council of the society receive encouragement by a fair number of students presenting themselves as competitors, the list of subjects, as opportunity offers, will be increased, and will embrace subjects for examination more especially connected with Birmingham manufactures and their specialities—such as working in gold and silver, brass, copper, and bronze, electro-metallurgy, the manufacture of acids and alkalies, &c. A very large number of students are directly interested in these manufactures, and competitors in this locality may therefore be expected to be numerous when the subjects last named are introduced on the programme. It will be well to bear in mind that the Society of Arts is cosmopolitan in its aims and objects. It was impossible, in its first programme of technological examinations, to embrace all the manufactures of this country. Examiners are not easily got, and besides, it must be remembered that the society is entirely dependent for support on yearly subscriptions. These considerations will show that it is impossible to do more than it has done on the present occasion. For a hundred and twenty years the society has encouraged Art and manufacturing industry, and has been the pioneer of many important improvements, social and educational, through its original examinations, and it now affords the means of testing the knowledge gained through its instrumentality. We venture to think that among the many good works the society has done it never did a better than in taking 'occasion by the hand,' and beginning a system of 'technological examinations.' The programme of these examinations will soon be accessible at the Midland Institute, and intending student competitors would be well to procure a copy and study it."

The *Birmingham Daily Gazette* also says:—"The deservedly popular examinations of the Society of Arts, so largely taken advantage of by the students attending the Midland Institute, and other societies in our town and other towns, have had a new element added thereto in the present session, 1873, viz., technological examinations. The feature is a novel one, and is the natural outcome of previous elementary studies, which will be tested by their examination as to practical results. The manufacture of paper, steel, &c., and carriage building, will appeal in a greater or less degree to Birmingham industrial students, and it is obvious that in succeeding years the Society's programme will include other subjects for examination of local interest, as the manufacture of glass, metal working in all its departments, which will appeal more directly to a greater number of Birmingham students. The only return the Society of Arts can have is by numerous students presenting themselves as competitors. Money prizes (liberal) form the reward of the successful. Intending competitors would do well to procure a copy of the programme from Mr. Edwin Smith, at the Birmingham and Midland Institute. Study it well, and 'go in' for examination."

IMPROVED APPARATUS FOR LOWERING AND FLOATING SHIPS' BOATS AT SEA

The object of this invention, which is by Mr. George Edward Nicholas, M.D., Wandsworth, formerly Assistant-Surgeon, R.N., is to secure safety with greater facility of use and expedition than is attainable by the ordinary boat "tackle" in present use.

Its novelty consists essentially in the employment of a cradle, attached to and suspended from a frame, by means of which and a suitable tackle, the boat, resting in the cradle but not attached to it, is lowered and floated without the intervention of any detaching or other mechanical appliance whatever. The whole apparatus is made of iron.

The frame consists of two long vertical arms, connected together by transverse bars, to secure strength and rigidity. These arms are hinged at their lower ends to the ship's side at a suitable distance (about one-third) from the water-line, parallel with and beneath the davits ordinarily in use, and carrying the cradle suspended by pivots between their upper ends. The latter have eyes or rings to receive the hooks of the blocks of the tackle employed in lowering the frame. The frame is shaped to the ship's side, except at its upper third, where it curves outwards until its upper ends come under the line of the davit blocks. Immediately below the point where it curves outwards, it is held in position, when secured for sea, by a pin (or it might be a chain and hook) passed in front of each of the vertical arms.

The cradle is formed of a longitudinal bar of suitable strength, its shape corresponding with a longitudinal midship section of the boat, which it is intended to carry, the upper points of its vertical rods being bent at right angles, and pivoted through the upper ends of the vertical arms of the frame, so that whatever the position of the frame be, the cradle is free to maintain its horizontal position. Two crutches are fixed to the bar transversely, at about the distance of a fourth part from the stem and stern of the boat respectively, and shaped to the form of the boat at those parts, so that the boat, when *in situ*, rests by the whole length of its keel on the longitudinal bar, whilst its displacement laterally and longitudinally is prevented by the position of the crutches in relation to the shape of the boat. Although its several parts are mentioned for the purpose of description, the frame, as a whole, is free to move as a single lever. It is lowered by means of a tackle rove through three double blocks, one of which is hooked to the davit's head, another to the upper end of the frame, opposite which a third is attached to the standard or upright part of the davit. This tackle is used in addition to the ordinary tackle employed for hoisting the boat, which is done in the usual manner, with this difference only, that the cradle is first brought into its original position by means of its own tackle, then the boat is hoisted to the davit's head, and then readily powered into its cradle, where it is secured for sea in the usual manner.

The frame being hinged by its base to the ship's side, and being controlled in its upright position by the lowering tackle only, it is obvious that when the latter is eased off, the frame with the cradle carrying the boat will move upwards and downwards, causing its upper ends to describe a half-circle. By such motion also it is equally obvious that the boat will be conveyed in its cradle to the water, on reaching which the boat will be floated, while the cradle, continuing on its course, will pass now rapidly in consequence of its acquired momentum from beneath the boat as well as away from the line of the boat's flotation; the latter effect being assisted by the curve given to the upper ends of the frame for that purpose.

Among the many advantages claimed for this invention by its author are simplicity of action, facility of use, and expedition, combined with safety in the manning, the lowering, and the floating of the boat. By its use the boat can receive its crew, &c., from the ships' deck, and can be at once set afloat by simply lowering away its tackle—a proceeding which can be effected either from the ships' deck or from the boat itself. It can be adapted without displacing any of the parts of the ordinary apparatus now in use.

Upwards of £12,000 have been subscribed towards a fund for the establishment in Glasgow of a Technical College, in which the different branches of practical engineering, spinning, weaving, &c., are to be taught on scientific principles.

The crude ammonia salts, resulting from the purification of coal gas, are said to have been found to contain sulphocyanates, which render them unfit for manure. In some cases the amount of sulphocyanate of ammonia present was sufficient to destroy the crops where it was applied.

SUB-WEALDEN EXPLORATION.

Since the last quarterly report, troublesome accidents have delayed this undertaking. On the very day of the meeting in Jermyn-street in December last, the drilling tool broke off close to the edge, leaving a flat chisel (9 in. wide tapering up to 2 in.) at the bottom of the bore. A fortnight was lost in the endeavour to extract it. Mr. Bosworth's ingenuity and patience were sorely tried; but he at last succeeded in bringing it to the top from a depth of about 96 ft. 34 ft., consisting of narrow bands of calcareous shale, alternating with argillaceous limestone in layers from 4 to 6 in. were passed through; but on January 28, at 131 ft. from the surface, a bed of pure solid white gypsum, 4 ft. in thickness, was reached and perforated, the new trifid drilling tool bringing up solid cores. This is the first time a bed of gypsum of this character has been found in Sussex, and it probably indicates the presence of Purbeck beds. If so, strata hitherto unknown to exist in Sussex are now added to our geological information, and the scientific world will have its interest re-awakened to this, the first boring attempted in England for purely scientific purposes. Boring is a tedious and expensive process, and we hear that the preliminary cost of machinery has exhausted the treasury. Subscriptions are earnestly requested to complete the second sum of £1,000 promised on condition that £2,000 be raised. Mr. Henry Willett, Arnold House, Brighton, will be pleased to receive any sums for the purpose. It would be a great disaster indeed if the boring had to be stopped for want of funds; but we feel sure that when the state of matters is made known to the friends of science Mr. Willett will soon have to report a full treasury.—*Nature.*

SCIENCE AND ART MUSEUMS IN NEW YORK.

New York appears to be progressing rapidly in the creation of new buildings for the accommodation of science and art.

The new Natural History Museum is to be 800 feet long by 600 wide, and will be the largest building in America. £100 000 was voted last winter by the legislature to commence it, and 200 men are already blasting for its foundations. It is eventually to cost £2,000,000 sterling, and fifteen years will be occupied in its construction. This great building is to cover fifteen acres of ground, and is to be situated on Mountallan-square, facing Eighth Avenue and Central-park.

The front portion is to be finished directly, and the back portion is to be finished from time to time as needed, and as appropriations are made for it. The material is to be granite. The building is to be four stories high, with students' rooms in the upper story, and rooms and shelves for specimens illustrating natural history, zoology, botany, and mineralogy on the ground floors. A grand entrance is to be made into Central-park, where now is Seventy-ninth-street. This will be called the Central entrance. The carriage entrances will be on Seventy-seventh and Eighty-first streets. The plans were drawn by Calvert Vaux and J. Wrey Mould.

The architecture of the building is to be a kind of French *Renaissance*, similar to the Luxembourg or the buildings around Fontainebleau.

Another great building is to be the new Art Museum. It is to ultimately cover about ten acres, and when finished it will be 800 feet long and 500 feet wide. It is to be built in Central-park, between the Croton Reservoir and Fifth-avenue, directly opposite Eighty-second-street. It will cover a section in the park as far as from Eightieth-street to Eighty-fourth-street. £20,000 is already appropriated for its commencement.

The front portion is to be built in the spring, and the back portion will be built from year to year as wanted; £100,000 will be spent this season on the new building.

THE ST. GOTHARD RAILWAY.

The machinery to be used for piercing the St. Gothard is now in a forward state. The large turbines for driving the air-compressors are being made by Messrs. Escher, Wyss, and Co., the well-known engineers of Zurich, who are also constructing the heavy portions of the air-compressors, whilst the more delicate parts are in the hands of M. Plainpalais, of Geneva. The erection of the temporary machinery, made in Belgium (which will be used until the permanent machinery is ready), has been somewhat retarded on account of the the heavy floods during the last few months.

The experiments with some Anglo-American tunnelling machinery at Geneva are said to have given most satisfactory results, and there seems to be no doubt of its being adopted for the tunnelling of the St. Gothard.

The question respecting the purchase of the machinery and plant used at the Mont Cenis tunnel seem at last to have been satisfactorily arranged on both sides, M. Favre, the contractor, being exonerated from the agreement by which he was bound to purchase all the plant from the Italian Government. It appears now that it is thought advisable to retain the air-compressors at Bardonnèche and Modane, and M. Favre has agreed only to take a quantity of pipes that were used for the transmission of the compressed air, the reservoirs, earth waggons. and some of the old tunnelling machines.

The advancement in the tunnel at the north side, at Göschenn, up to the 31st December, was at the rate of only 0·30 per day, the heading here driven in the hardest granite, the total length driven up to that date being twenty metres. The number of persons employed at this end is about 100.

At Airolo, the rock met with is somewhat softer, and 102 metres were tunnelled up to the close of the year. At this end the masonry is also begun, and from 170 to 200 persons are employed.

Specimens of every description of rock that is met with during the excavation of this tunnel will be kept, so as form ten collections, sets of which will, on their completion, be given to the Italian and German Governments, and to some of the technical schools in Switzerland. At the offices of Göschenn and Airolo a complete geographical record of the strata met with during the tunnelling operations will be kept, as also a register of the daily meteorological observations that are taken.

CORRESPONDENCE.

THE MACKIE SHIP.

Sir,—It is said that good looks are the best letters of recommendation; if so the Mackie boat is well recommended, for it must be evident to all that her lines are very graceful. Also she possesses the look of swiftness in her build, like the form of the swallow or dolphin; and there may be more in this than meets the eye, for when you see a really good rifle or piece of ordnance, they are sure to have a "varmint" look about them—like a wasp —as if they could sting. So, as to swiftness, the Mackie boat possesses a promising expression of speed. And, as regards beauty, in the prevalence of ugliness in the floating metal monsters that have lately been put on the waves, which even the genius of Vandevelt could not make picturesque, it is quite refreshing to find offered to public view and favour so graceful a production as this model. In her science does not seem to have swallowed up art—as in so many of our late marine productions—but, for once, to have gone hand in hand with her.—I am, &c., Epsilon.

February 15, 1873.

A mixture of four parts borax and three parts magnesium sulphate is stated to be as useful as tungstate of soda for rendering fabrics fire-proof.

GENERAL NOTES.

Railways in China.—It is stated that the Chinese are about to construct 100 miles of railway, as an experiment; if such be the case the Celestial Empire will be an immense field for engineering enterprise, and it is to be hoped that our engineers will not be behind-hand in availing themselves of it.

Wood Pulp.—Prince Bismarck's paper mills at Varzin cannot meet the English demand for the paste board which is manufactured from pine wood in them. The present mills work up annually 600 cords of wood, and a new factory is being built which will consume in this production 1,500 cords. The prince has purchased adjacent forests, which will supply him with raw materials for this manufacture for years to come.

Swedish Matches.—The manufacture of safety matches in Sweden has developed itself the last two years in a remarkable manner, for, whereas until lately the town of Jonkoping stood alone in this respect, supplying the whole of the Continent, and several of the safety match-makers in England, there have now sprung up similar, though smaller establishments in many of the provincial towns, which drive a very brisk trade, and are scarcely capable of meeting the ever-increasing demand for this match. The quantity exported in 1871 was 8,351,028 pounds, of which more than half went to England.

Export of Cattle from Italy to France.—During the first nine months of the present year, the number of head of cattle sent from Italy to France was as follows:—Bullocks, 40,630; cows, 23,400; calves, 8,000; sheep, 100,000; pigs, 46,000; showing a great increase on the exports from Italy during previous years. The greater part of the cattle is sent to France from Piedmont *via* the Col de Tenda, and the remainder principally from the island of Sardinia, where it is shipped for Marseilles. The increasing demand for live stock in France has tended to raise the price of meat in Italy.

Oysters.—Mexican oysters, it is said, can be imported to San Francisco at a cheaper rate than eastern oysters can be bought in New York. The *San Francisco Bulletin* says:—"From Guaymas to Acapulco, on the Mexican coast, almost every bay, inlet, and estuary abounds in oysters of a large size, and equal in flavour to those of the Atlantic coast, and these shell-fish spawn, mature and die undisturbed by man. This immense stock of bivalves could easily be made to supply the California market, and return a handsome profit to parties engaging in the enterprise. Oysters can be placed on board the Mexican steamers at Mazatlan at less than 15 dollars per ton, and the freight-charge to this port is only 10 dollars per ton, making a total of 25 dollars."

Lava as a Building Material.—The lavas, says the *Building News*, are extensively used in many parts of the Continent for building purposes. They are generally highly silicated, the principal rock of the kind, known as trachyte, containing 50·67 per cent. of silica. This term is generally adopted for volcanic rocks having a rough felspathic base formed of sanidine, oligoclase, with augite and mica, silica, or hornblende. When it contains crystals or grains of free quartz or sanidine, it becomes trachyte or porphyry. Trachyte is, as a rule, of a light grey colour, occurring in sheets or thick beds alternating with basalt, or, as in the district of Auvergne, forming the central cones of volcanoes. The lavas of Central France have been employed from the time of the Romans in churches and bridges; while that of Andernach, obtained from subterranean caverns at Niedermendig, is now chiefly used for the well-known millstones, and is exported to all parts of Europe and Britain. The utilisation of the lava rocks for this purpose is of very ancient date, the corn-mills found at Pompeii being formed of ancient lava-sheets obtained from Vesuvius.

Extraction of the Precious Metals from Copper Pyrites.—The incombustible residue from copper pyrites, after the sulphur has been burnt off in the process of vitriol making, is powdered, mixed with common salt, and then roasted in a reverberatory furnace. The mass is then treated with water acidulated with hydrochloric acid. The solution contains the chlorides of copper, silver, and gold; the insoluble ferric oxide is used for the fettling of iron puddling furnaces. The precious metals are precipitated by addition of a soluble iodide (solution of kelp, for instance). M. Claudet has found that the iodide of silver is much less soluble than the chloride in a solution of salt, and that the precipitate obtained by the addition of an iodide to the hydrochloric solution contains nearly all the silver and gold present in this burnt ore. Hydrochloric acid is then added, to remove all traces of copper from this precipitate, and the gold and silver are reduced by metallic acid. The iodide of zinc solution obtained is used for the precipitation of a fresh quantity of silver. The copper remaining in the mother liquor after the separation of the gold and silver is precipitated by metallic iron. Works have been established at Widnes Docks, Lancashire, for carrying out this process; in the course of one year 16,300 tons of burnt ore were subjected to this treatment, and yielded 10,715 ounces of silver and 102 ounces of gold.—*Iron.*

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

REPORTS ON THE LONDON INTERNATIONAL EXHIBITION OF 1872.

The reports which appeared in the last volume of the *Journal* on the various sections of the above Exhibition, are now published complete, in a pamphlet form (price 2s.), and can be obtained at the office of the Society.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. The following meetings have been arranged:—

February 26.—Discussion on Lieut.-Colonel A. Strange's paper, "On Ships for the Channel Passage," adjourned from Wednesday, the 12th. On this evening Vice-Admiral Erasmus Ommanney, C.B., F.R.S., will preside.

March 5.—"On Gas-lighting by Electricity, and Means for Lighting and Extinguishing Street and other Lamps." By W. Lloyd Wise, Esq. On this evening Capt. P. H. Colomb, R.N., will preside.

March 12.—"On Signalling at Sea, with special reference to Signals of Distress." By Capt. Colomb, R.N.

March 19.—"On Certain Improvements in the Manufacture of Printing Types." By J. R. Johnson, Esq.

March 26.—"On the Edible Starches of Commerce, their Production and Consumption." By P. L. Simmonds, Esq.

April 2.—

April 9.—*No Meeting.*

April 16.—"On the Condensed Milk Manufacture." By L. P. Merriam, Esq.

INDIA COMMITTEE.

A Conference will be held on Friday, 28th instant, at 8 p.m., when a paper will be read by T. Roger Smith, Esq., architect, on "Architectural Art in India." James Fergusson, Esq., D.C.L., F.R.S., will preside.

A Conference will also be held on Friday, March 14th, when W. T. Blanford, Esq., of the Indian Geological Survey, will read a paper on "The Mineral Resources of India." Sir Louis Malet, K.C.B., will preside.

The report of the last India Conference is postponed till next week.

CANTOR LECTURES.

The Second Course of these lectures is "On the Energies of the Imponderables, with especial reference to the Measurement and Utilisation of them," by the Rev. Arthur Rigg, M.A. The remaining lectures will be delivered on the following evenings, at eight o'clock:—

Lecture IV.—Monday, February 24th, 1873.

On the Energy of Affinity, with especial reference to Suggestions for Estimating and Utilising it.

Lecture V.—Monday, March 3rd, 1873.

On the Energy of Electricity, with especial reference to the Measurement and Utilisation of it.

Lecture VI.—Monday, March 10th, 1873.

On the Energy of Light, with especial reference to the Measurement and Utilisation of it.

Lecture VII.—Monday, March 17th, 1873.

On the Energy of Heat, with especial reference to the Measurement and Utilisation of it.

The Third Course of Cantor Lectures for the present session will be "On Wines; their Production, Treatment, and Use," by J. L. W. Thudichum, Esq., M.D. The Course will consist of six lectures, the first of which will be given on Monday evening, the 21st of April, the remaining five on the Monday evenings succeeding.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...**SOCIETY OF ARTS, 8.** Cantor Lecture. Rev. A. Rigg, "On the Energies of the Imponderables."
Institute of Surveyors, 8. Mr. R. B. Grantham, "Private Agricultural Railways."
London Institution, 4. Professor Duncan, "Physical Geography."
Royal Geographical, 8½. 1. Mr. J. Thomson, "A Journey in Southern Formosa." 2. The President, "Notes on Badakhshan and Wakhan."
Medical, 8.
Actuaries, 7. Mr. Samuel Brown, "On the Measurement of Man."

Tues. ...Medical and Chirurgical, 8½.
Civil Engineers, 8.
Royal Institution, 3. Prof. Rutherford, "The Forces and Motions of the Body."
East India Association, 3. (At the House of the Society of Arts.)

Wed. ...**SOCIETY OF ARTS, 8.** Adjourned discussion on Lieut.-Col. Strange's paper "On Ships for the Channel Passage."
Geological, 8. 1. Dr. James Bryce, "On the Jurassic Rocks of Skye and Ramsay." 2. Mr. D. Mackintosh, "Observations on the more remarkable Boulders of the North-West of England and the Welsh Borders." 3. Mr. J. Lucas, "On the Origin of Clay-ironstone."
Royal Society of Literature, 8½.
Archæological Association, 8.
Society of Telegraph Engineers, 7½. Adjourned discussion "On Telegraph Poles."
London Institution, 7. Mr. R. H. Scott, "On the Result of Recent Meteorological Inquiry."

Thurs. ...Royal, 8½.
Antiquaries, 8½.
Royal Institution, 3. Dr. Armstrong, "On the Artificial Formation of Organic Substances."
Royal United Service Institution, 8. Captain J. Sladen, "Shot and Shell, and How to Use Them."
Philosophical Club, 6.

Fri ......**SOCIETY OF ARTS, 8.** India Conference. Mr. T. Roger Smith, "On Architectural Art in India."
Royal United Service Institution, 3. Captain Gun, R.E., "Manteuffel's Campaign in the East of France."
Royal Institution, 9. General Sir Henry C. Rawlinson, "On Livingstone's Explorations in Africa."
Quekett Club, 8.

Sat ......Royal Institution, 3. Professor W. K. Clifford, "On the Philosophy of the Pure Sciences."

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,058. Vol. XXI.

FRIDAY, FEBRUARY 28, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

TECHNOLOGICAL EXAMINATIONS.

The Programme of Examinations in the Technology of some of the Arts and Manufactures of the country is now ready for issue, and may be had on application to the Secretary.

The subjects selected for 1873 are Cotton, Paper, Silk, Steel, and Carriage-building. Candidates, in order to obtain certificates in any of these subjects, must pass the examinations of the Science and Art Department in certain sciences, which are specified in the programme; and in addition to these, special papers will be set in the technology of each manufacture by examiners appointed by the Society of Arts, and certificates of three grades will be awarded:—"Honours," "Advanced," and "Elementary."

The examinations of the Science and Art Department will be held during the first three weeks of May, the technological paper being worked on the evening of the 17th May. For the dates of the Science subjects candidates are referred to the Science Directory, published by the Science and Art Department.

The following Prizes are offered by the Society of Arts in each of the five subjects mentioned above:—

To the best candidate in Honours, £10.

To the best candidate in the Advanced Grade, £7.

To the best candidate in the Elementary Grade, £5.

In order that these Examinations may really be successful in promoting technical education in this country, it is desirable that encouragement should be given to candidates by the offer of additional prizes and scholarships. With this object the Council appeal to the Companies of the City of London, to merchants and manufacturers, and to members of the Society generally, to aid them by contributing to the Prize Fund.

The following special additional Prizes are offered:—

By Wyndham S. Portal, Esq., to the Second and Third best Candidates in the Elementary Grade, Paper Manufacture:—

A Prize of	£3
A Prize of	£2

By G. N. Hooper, Esq., to the Second and Third best Candidates in the Elementary Grade, Carriage Building:—

A Prize of	£3
A Prize of	£2

A letter has been received from Colonel Akroyd, M.P., promising to contribute £5 in prizes whenever Examinations are held in the Technology of the Worsted Manufacture.

The Council beg to announce the following contributions to the Prize Fund:—

The Worshipful Company of Vintners..	£10	10	0
Dr. Crace Calvert, F.R.S. (annual)	5	5	0
Sir Daniel Cooper, Bart................	5	0	0
R. L. Chance, Esq.	5	5	0

The Council invite the aid of masters and managers in promoting these examinations by encouraging their workmen to take advantage of them. An explanatory handbill, suitable for being suspended in factories and workshops, may be had on application to the Secretary of the Society of Arts, Adelphi, London, W.C.

PRIZE FOR STEEL.

1. The Council have resolved to award the Gold Medal of the Society to the manufacturer who shall produce and send to the London International Exhibition of 1873 the best collection of specimens of steel suitable for general engineering purposes.

2. The specimens exhibited must include a complete illustration of the applications of the varieties of steel submitted.

3. Each manufacturer should send with his specimens a statement of the nature of the tests he has applied to each kind of steel submitted, and give the results of such tests.

4. The samples tested are to be exhibited together with duplicate samples, or portions of the same samples; these will be submitted to tests should the Council consider it desirable.

5. All persons using steel for general engineering purposes, who are not manufacturers of such steel, are also invited to exhibit specimens on the above terms and conditions.

6. The Council reserve to themselves the right of withholding the premium, in the event of the specimens exhibited not being sufficiently meritorious.

COMMITTEE ON THE MEANS OF PROTECTING THE METROPOLIS AGAINST CONFLAGRATION.

The Committee met on Friday, February 20th. Present—Mr. A. J. Kay Shuttleworth, M.P., in the chair; Col. Marcus Beresford, M.P.; Mr. E. Chadwick, C.B.; Lord Alfred Churchill, Major-General Eardley-Wilmot, F.R.S.; Lord George Hamilton, M.P.; Mr. John Holms, M.P.; and Mr. Seymour Teulon. Mr. W. P. Reynolds, manager of the London and Southwark Insurance Company, and Mr. J. Quick, C.E., engineer to the Southwark and Vauxhall and the Grand Junction Water Companies, attended and gave evidence, which will shortly be published in the *Journal.*

BETHNAL-GREEN MUSEUM.

The following declaration is in the course of signature, and has already been signed as below. Any Member of the Society desirous of having his name attached thereto is required to communicate with the Secretary of the Society of Arts, and give him authority for that purpose :—

1. We the undersigned members of the Council and members of the Society for the Encouragement of Arts, Manufactures, and Commerce, request the attention of Her Majesty's government to the remarkable proof of the public desire for instruction and pure enjoyment afforded by the examination of works of Arts and Science, which has been shown by the opening of the Bethnal-green Museum.

2. This Museum, established in one of the poorest and busiest districts in London, where men, women, and children are most laboriously employed, has been frequented during three months by more than 700,000, visitors, a number which probably exceeds that of the visitors to all the other metropolitan museums and galleries during the same period.

3. The undersigned submit that this museum could never have come into useful existence, and have been instrumental in conferring great benefits on the people, without the aid of Parliament; and they desire to press this fact upon the consideration of Her Majesty's government with the hope that they will submit to Parliament the policy so essentially national of voting increased means to facilitate the establishment of museums, libraries, and galleries of Science and Art in large centres of population, wherever such localities are willing to bear their share in the cost.

(Signed)

Abel, F. A., F.R.S., *Vice-Pres.*	
Akroyd, Col. Edward, M.P.	Halifax.
Amory, John Heathcote, M.P.	Tiverton.
Arkwright, A. P., M.P.	Derbyshire (N)
Backhouse, Edmund, M.P.	Darlington
Baines, Edward, M.P.	Leeds
Ballesteros, His Excellency José Merino	
Baring, Thomas, M.P.	Huntingdon
Bartley, G. C. T., *Member of Council.*	
Bath and Wells, Bishop of	
Bazley, Sir Thomas, Bart., M.P.	Manchester
Botly, William	
Boyes, J.	
Brady, Sir Antonio	
Brassey, Thomas, M.P., *Member of Council*	Hastings
Beaumont, Somerset A., M.P.	Wakefield
Bessemer, Henry, *Member of Council*	
Bodkin, Sir W. H. (*Assist.-Judge*), *Vice-Pres.*	
Bourne, Lt.-Col. James, M.P.	Evesham
Brocklehurst, William C., M.P.	Macclesfield
Brooke, Edward, *Auditor*	
Brooke, William	
Brooks, William Cunliffe, M.P.	Cheshire (E)
Campbell, Archibald, M.D.	
Carpenter, William B., M.D., LL.D., F.R.S.	
Carter, Robert, J.P.	
Cassels, Andrew, *Member of Council.*	
Cawley, Charles Edward, M.P.	Salford
Churchill, Lord Alfred, *Member of Council.*	
Clarke, Hyde, *Member of Council.*	
Clements, R. G., F.R.G.S.	
Cockerell, W.	
Cole, Henry, C.B., *Vice-Pres.*	
Cole, Rev. A. R., M.A.	
Colman, Jeremiah James, M.P.	Norwich
Cooper, Sir Daniel, Bart., *Vice-Pres.*	
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Dilke, Sir Charles W., Bart., M.P.	Chelsea
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Ducie, Earl of	
Dyke, W. H., M.P.	Kent (Mid.)
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Fortescue, Hon. Dudley F., M.P	Andover.
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Longford, Earl of	
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McArthur, William, M.P.	Lambeth.
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McLagan, Peter, M.P.	Linlithgow.
Millar, John, M.D.	
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Paget, Admiral the Right Hon. Lord Clarence, K.C.B., *Member of Council.*	
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Parry, Love Jones, M.P.	Carnarvonshire.
Pease, Joseph Whitwell, M.P.	Durham (S.)
Potter, T. B., M.P.	Rochdale.
Rawlinson, Maj.-Gen. Sir Henry, K.C.B., *Vice-Pres.*	
Rawlinson, Robert, C.B., *Member of Council.*	
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Russell, Earl, K.G.	
St. David's, Bishop of	
Salomons, Sir David, Bart., M.P.	Greenwich.
Samuelson, Bernhard, M.P.	Banbury.
Saye and Sele, Lord	
Scott, Robson J.	
Smith, W. H., M.P.	Westminster.
Spiers, R. J.	
Stevenson, James C., M.P.	South Shields.
Stone, J. B., Chairman of the Corporation Art Gallery and Industrial Museum Committee, Birmingham.	
Straight, Douglas, M.P.	Shrewsbury.
Strange, Lieut.-Col. A., F.R.S., *Member of Council.*	
Sutherland, Duke of	
Tite, Sir William, C.B., M.P.	Bath.
Torrens, Lieut.-Col. Sir Robert R., M.P., K.C.M.G.	Cambridge.
Tufnell, E. Carleton, *Member of Council.*	
Twining, Thomas, *Vice-Pres.*	
Varley, Cornelius, F.R.M.S.	
Vaughan, Henry	
Vernon, Lord	
Ward, W. G., Chairman of School of Art Committee, Nottingham.	
Ware, James T., *Auditor.*	
Westbury, Lord	
Westminster, Marquis of	
Whatman, James, M.P.	Maidstone.
Whittington, Rev. R.	
Whitwell, John, M.P.	Kendal.
Wilton, Earl of	
Wingfield, Sir Charles, M.P.	Gravesend.
York, Archbishop of	
Young, Frederick	
Zetland, Earl of	

PROCEEDINGS OF THE SOCIETY.

INDIA COMMITTEE

A conference took place on Friday, February 14th, Major-General Nuthall in the chair. Mr. J. H. Stocqueler opened the discussion with a second Paper, supplementing the previous one, on—

PROGRESS IN INDIA.

In the paper which I had the privilege of reading in this hall, I necessarily left untouched several subjects of great interest in connection with the advance that had been made in solving the problem of good government in India, because it was desirable that my hearers and readers should not be worried with figures and details. I am flattered and pleased in being invited to resume the subject, for I may now hope to render it as complete as the information accessible to me will permit.

In the letter from Mr. Edwin Chadwick, which the secretary, Mr. Foster, read to the meeting, it was justly remarked that any account of the progress of India would fall short in a foremost element which should omit to set forth the sanitary progress made as a guarantee and promise of future advances in the improvement of the physical and moral condition and the productive power of the population. I was quite sensible of the omission in my paper of any mention of the sanitation of the past fourteen years, but it was unavoidable, for I did not obtain access to the latest report of the measures adopted to remove or check disease until two days after the meeting. If I had merely given the facts as far as they had fallen into my possession, I should have failed to render justice to the untiring efforts of the government and its officers down to the middle of the past year.

Another point, to which little or no reference was made in the former paper, concerned the water communications and irrigation of the land, affecting as they do the commerce and agriculture, and, therefore, the revenues of the country. Here, also, I was at fault, or lacked a sufficiency of information. I trust now, in some measure, to supply the past deficiencies.

For some weeks past there has been considerable ferment in political circles respecting the ulterior purposes of Russia in her advance upon the Khanate of Khiva. The impression is strong that this is only one step further in the attempt to accomplish a long-cherished object—that of the invasion of British India. It is merely a revival of the old bugbear which periodically awakens apprehension in the East, and in which I for one cannot share.

But there is really a danger in Russian advances into Central Asia, which it is not prudent to ignore. The natives of India, ignorant generally of geography, unaware of our military faculty of resistance, acquainted through their histories, traditions, and ballads with the successful inroads and usurpations of Mahmood the Ghuznevide, Zinghis Khan, Timour Leng, and Baber, will believe in the probability and success of a Russian invasion, so long as we allow ourselves to apprehend it, and withhold from them the means of gaining the knowledge which would disabuse them of this idea, an idea which will always furnish a weapon to the disloyal against the British raj, whenever opportunity occurs for its display.

Hence it becomes a duty we owe, alike to ourselves and to the people of India, that the quality of the civilisation we offer shall be of the most solid and exalted character compatible with our means, consistent with our reputation for intelligence and integrity, and apparently the best calculated to confer happiness upon the ruled. Opinions are, of course, antagonistic relative to the most effectual method of enlightening the natives of India. "Educate them—cover the country with a network of schools," says one class of earnest advocates of improvement, "and begin with the higher classes;" "educate the people by all means," cry another body of patriots and philanthropists, "but begin with the lower classes, and work upwards;" "teach them English in the first instance," exclaim some enthusiasts; "leave English to the last, and begin with the vernacular," urge their zealous opponents; "let the morals of the people be your primary object of consideration," say many ardent friends of the advancement of the masses; "give them the sciences first, and their capacity to receive moral truths will follow as certainly as the day follows the night," is the doctrine maintained by many more. This last proposition is admirably put by Mr. Arthur Howell, of the Bengal Civil Service, in an address to the Social Science Association, at Calcutta, in March, 1870:—"It should be remembered," says Mr. Howell, "that although the government system does not directly impart the principles of Christianity, yet the whole course is negatively Christian, in that it excludes everything to which Christianity is opposed. I would go further, and maintain that instruction in the natural sciences, which should form an important part of the curricula of our schools, will make the first breach whereby the armies of truth will march into the strongholds of superstition, and so give the best, and, indeed, the only aid to the missionary that the government can give without the slightest deviation from its strict policy of neutrality."

I do not see why all the systems proposed should not be tried at one and the same time. In fact, the government appear to me to act upon the principle already, for do they not establish and encourage schools for the high and the lowly? Are not English and the vernacular simultaneously taught? And does not a study of the natural sciences inevitably tend to the destruction of the geographical theories on which the faith of the Hindu is built, and so open his mind to the contemplation of a religion in which the culture of the heart takes precedence of the inculcation of ceremonial virtues, and the observance of forms of penance? But enthusiastic Christian friends of the people, who deem the eternal beatitude of their protégés of more consequence than their mundane prosperity, insist upon the priority of moral teaching. They speak with the courage of conviction. A noble audacity overides their discretion.

"Hitherto," says a writer in the *Calcutta Review*, "the religion of all the countries which have attained the highest civilisation has been some form or another of Christianity, and clearly this circumstance is not merely matter of accident. The principles of living and the motives to intellectual activity which are characteristic of Christianity must necessarily have place in an advanced progressive civilisation."

Acting upon this dogma, we should approach the threshold of proselytism, and alarm the consciences of the pupils and their parents. Besides, we raise a disputable question among ourselves as to the best form of instruction and conversion. "Your orthodoxy is not my orthodoxy; your morality is not my morality," argue the champions of that kind of preferential teaching.

Now, I do not pretend to any pet theories of my own on any of these points of difference—though I may have my preference—but there is one measure in connection with the civilisation of the people on which I do not think sufficient stress has been laid—I mean the education of the women of India. I hold that to be the grand preliminary to the enlightenment of the men—the great fulcrum on which the lever of their moral elevation must rest.

It has been said—indeed, it may be affirmed every day, and Englishmen have happily the means at hand of endorsing the assertion—that in moral influence woman is unquestionably superior to man. "Woman's character produces a wider and more powerful impression on man than man's character on woman. She makes him better or worse, according as she is good or bad, for what she is he more or less becomes. Where women are educated and trained to virtuous habits, men rise in the scale of civilisation; where women are cribbed and confined, shut out from the gateways of knowledge, and treated mainly as the ministers to man's lusts, man deteriorates and decays." Now, though the women of India have very much descended from the position they occupied in social life before the Mahomedan had planted his foot at Lahore or Delhi, and the terrible Mahratta horsemen had spread desolation in provinces, and uprooted domestic relations in a thousand quarters, we may hope that the elements of goodness, and even of greatness, still abide in their gentle bosoms. If the Hindu men will not accept the moral tenets of Christianity, let them take to the study of their own teachers in respect to the sex. It is one of the most commendable features of the institutes of Menu, that the peculiar care of woman is invariably inculcated. He insists upon tenderness and affection, and denounces violence in emphatic language. Other sages have followed in his footsteps. "Strike not, even with a blossom, a wife guilty of a hundred faults." And these and similar manly injunctions had their fruits in giving women their proper position and influence. Several of them, placed by the accidents of birth in the possession of power, manifested great wisdom and administrative ability. We read that in the thirteenth, seventeenth, and eighteenth centuries women reigned; and, in contradiction to the axiom that "when women reign men govern," those females jealously kept the reins in their own hands. The reign of Ahalya Bài, a Mahratta woman, of superior mind, occupies one of the brightest pages in Indian history. For thirty years she governed many millions; and Sir John Malcolm, than whom no one had more closely studied the history of the people of Central India, said of her, "She appears to have been one of the purest and most exemplary rulers that ever existed, and affords a striking example of the practical benefit a mind may receive from performing worldly duties under a deep sense of responsibility to its Creator." Other examples might be cited of able female rulers. The Begum Sumroo, who died some five-and-thirty years ago, had many fine qualities; and the present Begum of Bhopal, with whom Lord Northbrook has lately had an interview, is a very superior person.

But in spite of institutes and dogmas, injunctions, entreaties, and threats—in spite of the protection afforded by the British government—notably in the abolition of suttee and the suppression of the cruel practice of female infanticide, which touched the tenderest chord in woman's nature, the women of the East have unquestionably fallen from their ancient estate, and receive hard measure at the hands of their lords and masters. It is an ascertained fact that in 1871 there were no fewer than 244 cases of wife murder in India—not amongst the lower classes and violent Mahomedans only—but amongst the Brahmin and Rajpoot castes, who are told in the Máhâbarhat that "of all sins killing women is most heinous."

Let us efface this monstrous outrage; let us raise the Hindu and Mahomedan women from their abject and degraded condition, and convert them into mighty instruments for the intellectual and moral elevation of their fellow-creatures. How this is best to be accomplished will be a subject well worthy the attention of the government, and not less befitting the ministers of our Queen than other noble acts of statesmanship. I believe that if English and American ladies of the Nightingale and Carpenter stamp were encouraged to acquire a philological knowledge of Hindostanee, Guzeratte, Tamul, or Mahratta, to begin with—leaving a colloquial acquaintance with one or other of the languages to a later period, and amidst the opportunities of direct intercourse with the people—they would soon fit themselves to undertake the direction of native female schools. And if the Government would apply the magnifying-glasses of an enlightened statecraft to the claims of the educators, make them a liberal allowance in promotion of their studies, send them out to India in a manner befitting their lofty mission, and give them handsome salaries, there is no doubt that a firm foundation would be speedily established for the civilisation of the whole empire. The position and duties of governesses and schoolmistresses in England have not been sufficiently honoured to impart much zeal to my countrywomen in the work of education, but during a five years' residence in the United States of America, I was in the habit, almost daily, of visiting the public schools, and there beheld numerous ladies of gentle birth and breeding engaged in the solemn duty of imparting to thousands of their own sex the rudiments of material knowledge, and impressing upon them the value of moral conduct in the affairs of life. From among such women —if our own country does not supply the adequate *personnel*—many admirable instructresses might be selected. For some time past the American mission in Burmah has enjoyed the co-operation of such persons, and I believe the results have been very favourable.

I now approach the subject of sanitary improvements which her Majesty's government have very properly comprehended in their scheme of progress.

During the great wars of the French Revolution the First Napoleon was made responsible for all the evils that afflicted England. The witty authors of the "Rejected Addresses" ask—

> "Who makes the quartern loaf and Luddites rise?
> Who fills the butchers' shops with large blue flies?"

Bonaparte, of course.

> "Base Bonaparte, filled with deadly ire,
> Sets one by one the playhouses on fire!"

And he, too, caused all the fogs, the storms, and the other visitations of nature, as well as the enhanced price of bread.

Now, I will not go the length of saying that the critics of the government of India ascribe to the Viceroy and Secretaries of State all the mischiefs of which the great sun himself is the real author, but they certainly consider them bound to mitigate the evil resulting from climatic influences; and those authorities have cheerfully recognised the obligation.

It would be a "tedious difficulty" to go back to the period when the people and the troops in India were comparatively uncared for. Health statistics were not much in vogue prior to the mutiny of 1857, and for two or three years subsequent to that disastrous occurrence the men suffered from the miserable accommodation in the shape of barracks that had hastily been run up to meet the exigencies of the moment. So large an influx of European troops had never been anticipated. From the year 1860 only can we, therefore, date the introduction of what has been appropriately called 'sanitation' in reference to the European troops. At a later period a Government Sanitary Commission was created, which applied itself to the formation of municipal bodies in large towns, and the establishment of a system of general purification.

It is unnecessary to go into any details as to the means employed at the instance of the Commission, and, independently of that body, by the medical officers of the army, to prevent or mitigate disease among the soldiery.

Drainage, cleanliness, diet, clothing, all had their share in the sanitary operation, and here we note the result. In 1861 there were nearly 24 deaths per thousand men from cholera, five-and-a-half per thousand from dysentery and diarrhœa, and six-and-three-quarters from fever. In 1865 the cholera deaths had fallen to three and one-tenth. Five years later (1870) they had been reduced to less than one in a thousand, while the deaths from bowel complaints had been reduced to two per thousand. Fevers, however, had remained stationary throughout the decade. It seems impossible to check them, for they are the inevitable result of the temperature, exposure, and personal excesses. Indeed, a new class of fever, called dengue, of unaccountable origin, has within the last few months visited each Presidency, causing much suffering without destroying human life.

In the chief towns of India, and especially the presidency cities, much had been accomplished through the agency of the municipalities. A better system of drainage was introduced. The cremation of the dead bodies of Hindus had been brought within proper limits and obscured from view, instead of being exhibited on the banks of rivers and the seashore, offending alike the eyes and the nostrils of the citizens. Large numbers of sweepers and scavengers were employed to remove offal and other offensive accumulations in the streets, and sink the floating carcases of those pious Hindus who had been cast into the Hooghly; and care had been taken to improve the channels which conveyed drinking water to the abodes of men. The rate of mortality consequently declined; and in a very recent exhaustive publication it is stated, "The Calcutta of 1861, probably the most unsanitary city in the world, differs most essentially from Calcutta in 1871, which bears favourable comparison with London, and actually exceeds in healthiness some of the principal cities in England." Similar statements are made in reference to Madras. In ten years, sickness, according to actual returns, had been reduced by one-half of its original prevalence, and deaths by three-fourths. Bombay has been less fortunate, owing chiefly to indifferent drainage; still it is shown conclusively that the annual mortality stood at one death in every 25 persons in 1864, and at one in 40 in 1871.

It were much to be desired that similar favourable statements could be advanced in regard to the millions occupying the country districts. The melancholy truth, however, remains, that the people continue in almost precisely the same condition they were in a hundred years ago, and in some districts have changed for the worse. Epidemics of disease and endemical disorders continue to afflict the multitudes, and the scourge will not cease while they are permitted to make their dwellings and the ground about them, and the reservoirs whence they draw their water supplies, receptacles for every form of filth. How they are to be checked is the problem. There are thousands of villages scattered over the empire, and it is supposed that it would require an immense augmentation to the strength of the police and a well-organised and vigilant health-preserving establishment to control the actions of the inhabitants. The expense would be enormous, but even with a debt of one hundred millions sterling pressing on the resources of the country it must somehow be incurred. I am sure the government is impressed with its urgency; but I humbly think that if, instead of applying the revenue to the structure of elaborate works to promote effectual drainage, more advantage were taken of the materials which nature has placed at our command, the effect would probably be better and the cost contemptible. Why should it not be obligatory upon the head men of the villages to cause excavations to be made, a short distance from the dwellings of the people, cast every kind of filth into them, and then cover them with the earth that had been displaced? This would utterly prevent impure exhalations and, at the same time, fertilise the soil. We boast now of our latrines, and it was considered a great advance in sanitary matters when a patent was taken out, a few years since, for machines adapted to domestic purposes, in which pulverised earth did the duty which water had previously performed. But if we look into Deuteronomy, chap. xxiii. and verses 12 and 13, we shall find that expedients were employed in the time of Moses, on exactly the same principle, and with an avowed sanitary and respectful object. In the rainy season the water would form a decomposing agent in the same pits; and where neither water nor earth are susceptible of application, surely fire might be called into action profitably? Heaps of offal, ordure, decayed vegetation, fish-bones, and other refuse, might be heaped up and converted into a bonfire, at least once a week, at the simple expense of a lucifer match and a very little labour. If the conflagration evolved some noxious gases they would neither be so offensive nor so perilous as the malaria engendered by the preserved filth. However, these are speculations to which Science might oppose objections, and it may be presumptuous on my part to throw them out. But I believe in well-directed efforts of any kind. Call me an optimist if you will. I am content to hold to the doctrine enunciated by the pedant in Voltaire—*Tout est pour le mieux dans ce meilleur de mondes possibles.*

It has been objected that the cotton trade of India still languishes, and that a possible competition with the United States of America is impeded by the want of adequate water and other carriage. It would be abject flattery to say that the government of India has done all that can be accomplished in the construction of canals, roads, and railways. The fact stares us in the face that only about one-fourth of the surface of India is yet cultivated, owing, as Colonel Kennedy has well put it *, to the deficiency of roads for the conveyance of produce to market. But my purpose is, and has been, not so much to point out what remains to be done, but to demonstrate that much more has been accomplished under the new order of things than the government has had credit for with the British public generally. It was, if my recollection serves me, some time in 1841 or 1842, that that sturdy old soldier, Sir Charles Napier, riding over some of the cotton districts, and meeting a few crazy carts laden with bales of cotton, which the cacti and other thorny plants caught occasionally in their fond embrace, exclaimed, "How short-sighted is the East India Company's government in delaying to make proper roads for the conveyance of the cotton to the seaboard! Cotton is the Englishman's strength, yet he looks to foreigners for his supply when he might have it from his own provinces. One of these days America will play the Dalilah and cut off Sampson's hair. Some great moral convulsion, or a failure of crops, will stop the supplies, and the spindles and looms of Manchester will cease to work. Then the government of India will sit on the stool of repentance—a little too late." The old soldier was an inspired prophet. Twenty years later the Southern States seceded from the Union. The Northerners blockaded Charleston, Savannah, and New Orleans, and the receipts at the ports fell from 3,656,086 bales in 1861 to 1,950,000 in 1866. That great rebellion was India's opportunity, but the scantiness of the means of communication with the seabord prevented her seizing it at the critical moment. Governments, like individuals, are only taught by bitter experience. The lesson was not lost upon the rulers of India, for we find that the exports of cotton to England, which amounted in 1830 to only 30,810 bales, and had reached no higher than 350,833 in 1858, absolutely attained in 1869 to double that number of bales. This could not have been the case if there had not been some diligent road-making. It is within my own recollection—now dating forty years back—that there were only three or four cotton screws or presses in Bombay. At this moment there are actually 19 cotton press companies in the district and in Deccan and Guzerat, with presses at work, besides several spinning associations, 170 with 220,000 spindles in operation; and nearly all these companies pay good dividends. These facts sufficiently indicate the presence of raw cotton; and the logical deduction is that carriage had been provided for it. But the government did not stop short in 1869. The construction of roads continued, coevally with agricultural improvement, and by the latest returns the exports from India amounted to 117,696.128 pounds of raw cotton.

In spite of all this manifest effort in a right direction, however, the government is alive to the necessity of energetically pushing forward the means of transport. With a deficit of direct revenue from the ordinary sources it is difficult to provide for all the great undertakings planned and in course of execution, but expenditure is the inevitable condition precedent of profit, and England and India must patiently bear with the immediate sacrifice. America, with her wonted elasticity, has recovered herself. The estimate of her receipts of raw cotton at the different ports for the current year amounts to 3,700,000 bales—more than was produced in 1860—a striking proof, by the way, of the fallacy of all the arguments in favour of negro slavery. The "coloured man" works more bravely in a state of freedom than he could possibly have laboured in his shackled condition. With such a competitor we must nerve us for a mighty task. But we need not despair; albeit the relative distances from these shores of America and India will always give the former an advantage in the markets, let alone the better quality of the staple.

Let us now take a retrospective glance at the operations of road-making during the past 14 years, and on the exertions used in that period found our hopes of the future.

In 1858 there were 4,690 miles of first-class roads, and 24,715 miles of second-class roads opened in India for traffic. At that time the principal railways had not reached 500 miles in length. As I stated in my former paper, there are now over 5,000 miles of railway in actual working order, and nearly 3,000 miles in course of completion. This has, of course, in some measure interfered with the structure of ordinary roads—they have become less necessary—but it must not be deemed a retrogression, or even a delay, in the progress of internal communication. We have now, or shall have in a year or two, actually thirty-eight thousand miles of road, in one form or another, traversable by passengers or traffic in every direction. It has been pleasantly said—"*mauvaise plaisanterie*" would more appropriately designate the assertion—that the convenience of the military has been considered at the expense of cotton and other produce. I maintain that the law of self-preservation justifies any measure that would accelerate military movements at a great crisis. Of what avail would be all the endeavours to promote science, agriculture, and commerce, and advance civilisation, if we exposed ourselves to the risks of another rebellion or to foreign aggression from any quarter? Of what use would be all the means adopted for carrying produce to the markets, whether in India or Europe, if our armies were not brought promptly to threatened points to repress disorder, prevent wholesale plunder, or check invasion?

I have spoken only of land transport and travel. Let us see what has been done in respect to water carriage. And in speaking of this we shall necessarily touch upon another great subject—the irrigation of the land. In a paper recently read before the Institution of Civil Engineers, Colonel Greathed, of the Royal Engineers, treated of irrigation in India so exhaustively that I could say little which has not been anticipated by that distinguished officer, if I were to attempt to enter into minute details.

Nature has done something for India in supplying her with noble rivers, the Ganges (the Holy Gunga of the Hindus), the Jumna, the Nerbudda, the Godavery, the Kistna, the Brahmapootra, the Irrawaddy, and others, which run in every direction of the wide continent, but they have been insufficient, even with the addition of hundreds of large tanks and wells which receive the annual falls of rain, to supply the wants of the people and protect them from the consequences of occasional droughts. At a very early period of the history of the country, canals were dug by the native rulers, but from neglect or indifferent architecture they appear to have become choked up or to have fallen into desuetude. Engineer talent has been employed in cleansing and reopening many of these canals with excellent effect. The greatest works under the Mogul princes would seem to have been contemptible when compared with what has been accomplished by the English. The first of these latter great works are the Ganges Canal. It was projected by Colonel Colvin, of the Bengal Engineers, and the project was by him bequeathed to the late Sir Proby Cautley. This was in 1836. Sir Proby Cautley saw the advantage of the scheme, and it was brought under the consideration of the government for the time being, but the ordinary official delays, coupled with unforseen difficulties, retarded the execution of the work, and it was not until 1848 that the operations of the spade and the pick commenced. In 1854 the canal was opened, and at the expiration of the year 1866-67 the Ganges Canal consisted of 653 miles of main canal and 2,968 miles of distributing channels. That canal cost the state £2,195,576, but in 1867 it yielded an income of £ 5,250, which exceeded the receipts of the previous year by 11¾ per cent. The distributories are now 3,071 miles in length, and water 767,000 acres, in upwards of 5,000 villages. Further improvements are in progress, and Colonel Greathed computes that after an expenditure of five millions sterling, the canal, in conjunction with that of another, called the Eastern Jumna, will yield 13 per cent. The yield is nearly that per centage at this moment. Numerous works of lesser magnitude have followed upon the construction of the great Ganges Canal. The main object of all these canals and their distributories has been the irrigation of the surrounding country, in view to the acceleration of production, and the protection of the people from the famines consequent upon droughts. An examination of the works thus planned, either carried out, or in course of execution, would scarcely be acceptable, seeing that Colonel Greathed has presented a very complete *résumé* of the whole affair. Suffice to say, that the entire scope of the operations of the government in utilising the old and constructing new canals, in applying the waters of lakes to purposes of irrigation, in assisting public companies to complete enterprises for which their own capital was found insufficient, in widening and improving harbours (especially that of Kurrachee), in clearing channels, such as the Paumbaum, establishing lighthouses, and extending the usefulness of the electric telegraph, the government of India has triumphantly vindicated its claim to be considered the earnest friend of commerce, and the promoter of the general interests of the millions of human beings committed to its charge.

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* Report of Colonel J. P. Kennedy on Railway Gauge, considered in relation to the bulk and weight of goods to be conveyed.

DISCUSSION.

Mr. **Edwin Chadwick** said—I am glad to find that the justice of the representations contained in my letter, read at the last conference, has met with acknowledgment—viz., that any account of the general progress of India would be incomplete which omitted to notice the progress already made, and still to be made, in sanitary improvement; and that the great importance of this subject has been recognised. I now beg to adduce some additional facts in support of the position I took in my letter read at the last conference, as to the possibility of the preservation of the health and strength of the children of European parents, and as to there being sanitary conditions in which the settlement of British families would be possible in India. I also feel myself called upon to say something on the foundation of the complaints made of the general want of due recognition and encouragement to zealous sanitary service, now more than ever needed for the conservation of infant and family life, to induce a higher quality of volunteering, urgently required for subordinate civil as well as military service, and to counteract the attractions of more healthy climes. The proof I adduced of the better preservation of infantine life being practicable, from the fact of its being done, as shown by the complete example given by Dr. Fayrer, appears to have surprised some old Indians, and not to have been accepted by them, because it was not in accordance with their observation. It is not to be conceded that their observations limit the applications of sanitary science. I might, if there were time and opportunity for its collection, adduce much further evidence on this point. I now submit, however, some obtained from the very extensive practical experience of Dr. Mouat, in Bengal, In answer to an inquiry of mine, he writes as follows:—

"Dear Mr. Chadwick,—You ask me for information of the health of children in the plains of Bengal, and of the mortality reduced in the prisons of the same presidency.

"Regarding the former, I am sorry not to have the facts and figures available for immediate reference, and I have no time to hunt for them among the mass of papers and observations which I accumulated during my lengthened official career in India.

"I was for some years a manager or governor of the great Military Orphan Schools at Alipore and Kidderpore, and of the Free School in Calcutta. In all of these institutions there were children of European parentage, pure blood, and children of mixed parentage, the latter class predominating. My experience, writing from memory, fully bears out the conclusions arrived at by Dr. Fayrer, from the more limited field of observation presented by the European Orphan Asylum, to which his remarks apply.

"In my paper on the British soldier in India, read before the Royal United Service Institution, and in my rough notes of a trip to Réunion and Mauritius, I have mentioned the conditions in which European life in the tropics may be maintained at a high standard, and health be preserved in circumstances apparently inimical to both children of European parentage born in India if they are sent from the plains to the hills, or to Europe for education, during the interval between infancy and dolescence, when they are among the healthiest and most vigorous of their race, mentally and physically; and if this be done—succession from generation to generation may be maintained without a break.

"With regard to gaols in Bengal, I am able to give you the exact figures. At Monghyr, with an average prison population of 564, a mean mortality of 93 per 1,000 in a quarter of a century was reduced, in 1871, to 27 per 1,000. At Bhaugulpore, with a daily average of 441, the mean mortality of the quarter of a century, from 1844 to 1868 inclusive, was 161 per 1,000. In 1868 it had been reduced to 19 per 1,000. In the presidency gaol of Calcutta the average death-rate among European prisoners in 1871 was 22 per 1,000, and among native prisoners 9·3 per 1000. The reduction in the latter rate was from an average of 51 per 1000 in the previous 14 years. The detailed figures for each year are full of instruction. In the 14 years from June, 1855 to 1868, there were 21 deaths from cholera, and but 26 from all other diseases, among an annual average of 115 prisoners, most of them dissipated and depraved."

I expect that, by those conversant with sanitary science, the proofs that even in climates to some extent malarial, the children of British subjects may be conserved, at all events to be brought home in large proportions, will be considered conclusive. But besides removal to suitable hill districts, as Dr. Mouat suggests, I may present the alternative of removal for permanent settlement for productive industry to plains and open country, under sanitary conditions, analogous to one of which I beg to present an instance. You may be aware that in Algeria the death-rates amongst the French soldiers were, and in many places are yet, about the same as the old Indian military death-rates—sixty, eighty, a hundred and more per thousand of mean force, and that the invaliding is in the like proportion. I was assured by a French medical officer that a most devastating fever-nest in Algeria had been destroyed, and the death-rate amongst the soldiers reduced to less than one-fourth of what it had previously been. I represented the case as one to be examined for the sake of our Indian army; but the statement was received by the old military authorities with the same incredulity with which we have seen the statement of the preservation of the European children in India received here. It was not in accordance with their experience, and they did not believe it, and, although it was attested by the Minister of War in France, they would have it that the statistics must be incorrect. Lord Ripon, who was then Minister of War, however, considered the case to be one that ought to be examined, and he directed a committee, consisting of Dr. J. Sutherland, of the Indian Army Sanitary Commission, Mr. Robert Ellis, president of the Sanitary Commission of Madras, Colonel Ewart, of the Engineers, and Dr. Logan, to inquire into it. The place was a district near Bona, called Boufarik. For strategic reasons it was thought necessary to occupy it in some force, but three bodies of soldiers and three sets of colonists had been swept away by malignant fevers. Even the Arabs could not live in it. It fell to an engineer, with some light of sanitary science, to deal with it. He subsoil-drained it, and put it in a state for cultivation, and newly planted it. A fresh water supply was brought in for the inhabitants, and drainage on correct principles was provided for their habitations. The result of this sanitation was, that the death-rate of the French soldiers was reduced to twelve in a thousand, or one-third lower than the death-rate prevalent amongst the French army of occupation at Rome; and the improvement was extended in like proportion to the civil population, and settlement was well ensured. But what, for our present question, was the effect in the rearing of children? The commissioners state in their report:—"The first thing that struck us on entering the town was the healthy aspect of the people, and especially of the children. Indeed, we did not see a single person bearing the marks of malaria; and some we saw would have been a credit to the healthiest spots in England, so far as appearances went." The main condition achieved for settlement was this; that the children's birth-rates now exceeded the children's death-rates; whereas before the improvement the children's death-rates greatly exceeded the birth-rates, a condition in which settlement and succession is impossible. Mr. Ellis and others acquainted with India declared, as I anticipated, that the example was of a very general application for India, and that it is not enough there to drain the immediate sites of barracks, and camps, and cantonments, but that, even for military occupation, the principles of sanitation must be applied to the improvement of the surrounding land, as was done in this instance, by opening it up in such manner as to avoid injury to the cultivator, and plant it with such vegetation as will remove from the soil the excessive products of decomposition. On this point the example is connected for particular examination and extended application with the important achievment, which I have cited, by Lord Mark Kerr, in getting rid of the old Delhi sore by an improved culture. I now beg leave to advert to the common obstructions to sanitary progress occasioned by the official apathy and discouragement of zeal for the work. I may observe, with regard to Algeria, as illustrative of the obstructive state of some official minds, especially of old military minds, that in that dependency, where there is no settlement to speak of, and which was in former days the granary of Europe, the country now is only a great field of military exercise—and failure, as proved in the last war—maintained at an expense of upwards of three millions per annum from the resources of France. It might be imagined that the example in proof of the means of colonisation and relief would have been officially regarded with the interest of the discovery of a new gold mine—that the governor would have gone in state to see it, that all France would have heard of it, that the official departments in Algeria would have been put in action, and the engineer corps have been required to go in for earthworks, for culture and against the incursions of epidemics more destructive than hostile Arabs, and that capital and commercial enterprise would be invited to the advantages of extended and secure seats of settlement, culture, and produce. Nothing of the sort. The achievement applicable to some of the most important parts of Algeria appears to have fallen dead, and to be sterile of benefit, except for the immediate occupants of the small space which had been rendered habitable and cultivatable. Whether the field marshal of the line, the governor general, was slow in seeing merit in the work of any officer of the *Génie*, or whether he had only the common notion that the only object of government was the old military one of rule by the sword, I cannot say; but the great practical demonstration there, has been little, if at all, known in France, and it yet remains unheeded for any extended action. The late Emperor had visited Algeria, and had written a paper on the means of improving its condition by new settlements, and singularly he recommended settlement chiefly by Irish and by Germans—settlement by Frenchmen having entirely failed. I saw him at the last meeting of the British Association at Brighton, and had some conversation with him there, on points of sanitary progress in which he had taken particular interest, and on which I had very satisfactory communications with him whilst serving on the jury of hygiene at the International Exhibition in 1856. I referred to this great sanitary case of Boufarik, and ascertained that he was cognisant of it. It was not meet for me to inquire, and it was only to be pondered over, how, by so high an intelligence, distinctions, crosses, and honours should be exclusively reserved for perpetual conflicts with barbarous and unsettled populations, and no notice be taken of the conquest of disease and of the soil, and of the achievement of a brilliant demonstration of the practicability of successful settlement by Frenchmen. I beg to state a parallel instance, in some respects, of operations in India, which, though not conducted directly for sanitary results, displayed means of obtaining them. Major Dixon, of the artillery, was sent with a brigade of force to keep in check some robber tribes of a hill district called the Manwarrah, of about the size of the Highlands of Scotland, and he found that this robber population, like the Highlanders, was impelled to make forays on the lowlands, for want of food, and, at certain seasons, for want of water and means of cultivation. He borrowed money, and employed the people in making storage reservoirs, in clearing jungles, and in cultivation. He founded nearly 130 villages, in which he settled the robber population in conditions of production, in which they could no longer afford to thieve. For the sale of their produce a market was necessary, and he founded a town. Instead of expending a revenue upon the people, he raised one; and instead of occupying a brigade of force, he raised a brigade of force from the people there, and that brigade was loyal to us during the mutiny. It might have been expected that it would have received the particular attention of a Governor-General, as a feat of administration and that attention would be directed to it throughout the presidencies as a subject for study and imitation, and, amongst other objects, for giving productive occupation to much of the force kept rotting in barracks, much better occupation than idleness even at hill stations. It is improbable that any member of the Indian Council ever heard of the work. It was told to me by my friend and sanitary correspondent, the late Col. Baird Smith, of the Engineers. Whilst Major Dixon was alive I gave my mite of private effort to bring his achievement under notice in an influential quarter, for distinction, without success. Major Dixon passed away without due notice or any distinction given to him, or his great work of sanitation, as well as production and civilisation. That example, like that of Boufarik, too, remains sterile, except for the population of the particular district, in whose memory he will live. Let me mention another subsequent instance of a sanitary achievement. The sea-side city of Masulipatam, about as large as Brighton, was submerged, one afternoon, by an irruption of the sea, when thirty thousand of the population were drowned in about two hours. The native chiefs and authorities were howling helplessly over the ruins and the unburied dead, when Mr. Robert Ellis—the chairman of the Sanitary Commission for Madras, without waiting for orders, took a steamer and got with all speed to the spot, took command, had all the dead burned—as was according to custom, and the most eligible for the occasion—brought in a supply of fresh water—had the whole city more thoroughly cleansed than ever it was in its life before, and put it in so good a sanitary condition that it had an immunity from a severe visitation of cholera that ravaged other cities. But there was no home or other governmental notice of this exploit, the moral influence of which was calculated to be far greater amongst the native population than of battles gained against them;

no distinction was given for the preservation of a city, such as would have been given of the destruction of a city by bombardment, and storm, and sack. Mr. Ellis, after two other feats in staying accustomed outbreaks of disease at great native fairs, left the new sanitary service in which he ought to have been carefully retained and advanced, for some other branch of service of obscure benefit, in which there is doubtless better attention and treatment. I may recite other recent instances of unnoticed sanitary exploits, in addition to those of children preserved. What more complete than that of the sanitary improvement of the prison administration of Madras, where a mean death-rate of 100 per thousand has been reduced to less than 20! In the central gaols, with an average population of 4,356, there were no deaths from cholera or small pox, and only two deaths from malarial fever, while during the same year there were 17,668 deaths from cholera, 20,483 deaths from small pox, and 192,467 deaths from fevers amongst 26 millions of the civil population outside. What is wanted is, that the protection given by sanitation to the population of the prisons, should be extended to the civil population, with which there are only rude and halting beginnings, coupled with much obstructive discouragement. I have been led to allude particularly to the subject by the dissatisfaction which I am assured exists in India, as here, with regard to the manner in which the new distinctions for distinguished civil service have been given. How they have been given there I do not pretend to know; I must assume in the best manner; but how they have not been given is clear and patent from such instances as I have adduced. None have been given there or here for distinguished sanitary service. It was noted that in the Crimean war distinctions were given to many of those under whose service our first army was lost, whilst none were given to those by whose sanitary science and art, according to the declaration of the Minister of War in the House of Lords, the second army was saved. Burke said that ordinary service must be secured by motives to ordinary integrity, that the state which laid its foundation in the heroic virtues would have its superstructure in profligacy and corruption. We know in our comparatively small way at the Society of Arts—as at academies—the beneficial stimulus to zeal given by the distinctions of medals and prizes we are accustomed to distribute. Factitious honours, however, unless they are manifestly well and truly administered, do more harm than good. When an honour, provided for distinguished service, is given to routine, it is made an affront to those who have rendered service which is overlooked. Officers who have rendered distinguished service would never have thought of such honours if they did not exist, but they feel aggrieved at being passed over, and the example has a depressing influence. "Why do you waste yourself on such work? You will get no thanks for it," is the expression with which zealous overworkers are assailed. In India such distinctions are peculiarly important for their effect on the minds of the natives who see in them the disposition and character of their rulers. What must be the effect on the native minds when they observe that such services as that of Masulipatam and others of the beneficient character I have recited, disregarded, and only those of war or undue exactions upon them, as they conceive, honoured? Must they not believe that they are all under the rule of a war caste, whose worship is of Siva the destroyer? Should not representations be made of the need of raising a belief amongst them of a new avatar—that of Vishnu the preserver?

Dr. Fayrer, C.S.I. (Medical College, Calcutta), not having heard the previous paper, was not clearly acquainted with the object in view, but he took it as mainly to be whether the European child could be educated and trained and developed in India—that is to say, whether it could be maintained in a standard of health equal to children in Europe. Some reference had been made to a brief report he wrote a few years ago upon an exceedingly interesting institution, which well deserved the support it received, and was well entitled to more, the European Orphan Asylum in Calcutta, founded, he believed, in 1815. Its object was to provide for the orphan children of European soldiers, who were then chiefly the representatives of the lower classes of Europeans in India. Since then the working classes had largely increased. But the Female Orphan Asylum never confined itself to the children of soldiers until they attained the age of ten years; and in some cases, he believed, after that the object was to train them and protect them from evil influences, and bring them up for domestic service, giving them a good physical and moral education; and in this respect they were most eminently successful. The institution was under the care of English ladies in Calcutta. It trained and educated generally 70 to 80 children, and that was the average constantly in the school—and they either came to Europe or, as in the case of the majority, went into domestic service, or became nursery governesses. Statistics enabled him to say that European children would live and thrive tolerably satisfactorily; but whether the European race could be established there, whether, in fact, it could colonise India, he had nothing to show. He was in possession of facts that seemed to prove the existence of a third generation, but he believed such cases were so exceedingly rare that they might be counted on the fingers. These children enjoy a remarkably immunity from disease, and a very fair standard of health. He believed they were nearly as healthy, physically and mentally, and rather more precocious than Europeans, and that all the functions of life might be fulfilled until a tolerably late period. And these remarks not merely applied to the hills, but to residence in the plains in an almost tropical region, for it was only just outside the tropics. It must not, however, be assumed from anything he had said that the European or the English race could ever colonise India. He believed they never could do so. If you placed a certain number of Europeans in India, and left them entirely to themselves, and without communication with Europe, whether the third, fourth, or fifth generation would be the last he did not attempt to predicate. It was purely speculative. He knew that the third generation existed, but he knew of nothing to make him believe, rather the reverse, that the European could ever colonise India. He could live there, and maintain health at a very fair standard. That insurance offices put an unnaturally high value, and made people pay more than they need do, he had no doubt. The standard of life, as far as years go, was as good, but the standard of health was not so good, not so physically vigorous; you were not able to do so much work, although you were called upon to do a great deal more; mentally you were quite equal; but sooner or later the European breaks down, and finds it to be absolutely necessary to return to this country. Such was his experience, gained during 23 years' residence in India, 13 of which were spent in Calcutta. He believed there was an erroneous impression about the danger of the climate. People think that if they go there they run the risk of suddenly losing their lives. But such cases were comparatively rare; the fixed European population enjoy good health in Calcutta. On the other hand, nothing was worse or more dangerous to what he might call the floating population of India, the men who come and go at the beginning of the year, such as soldiers. Their lives are exceedingly precarious. The hospitals were full. But then it must not be forgotton they are exposed to all sorts of dangers to which the fixed population are not. He believed any young person going out to India had a fair prospect of living. He might not live so satisfactory a life; it takes more out of him, and he would sooner be an older man, but there was not the danger to life which was generally supposed. He knew of no more crucial test than that of the orphan asylum he had mentioned, because the condition of admission to the institution was that the child should be of pure European blood, and no admixture with the native race; and if these children can live and thrive as they do, he maintained that it was possible, without reference to any ulterior purpose, for children in India to live and thrive, and gain, far better than was supposed, a physical, moral, and mental education.

Mr. Chadwick said Dr. Fayrer's observations applied to children. Could he give them any information regarding the condition of adults in the hill stations?

Dr. Fayrer replied he had seen most of the hill stations, but he was not so well prepared to give information on the subject as Dr. Townsend, whom he was glad to see present. But he thought he could safely appeal to the appearance of several adult old Indians present as to the possibility of preserving health in India.

Mr. S. Ward said he had heard that when people suffered from fever they went up to the hill stations, where they recovered for a time, but as soon as they returned they again suffered from the old complaint. Was that so?

Dr. Fayrer replied that Calcutta was an alluvial delta, and, therefore, was under the influence of what was called malaria, which was a mere expression of ignorance. What it was he did not know, but he knew its effects. People suffering from it, if they go to the hills, improve for a time, but when they return they suffer from it again; they suffer from it also when they go to sea. The result of his experience was that though people living in Calcutta can live and keep their health, India must be continually supplied with fresh health and fresh people from Europe.

The Chairman said he was sure they must have been much interested with the valuable information which Mr. Stocqueler had placed before them in his two lectures, and the statistics, which showed great power of analysis, and must have cost him much labour and research, for which he was entitled to their warmest thanks. He had only recently returned from India, after a sojourn there of over 35 years, with a brief interval of one year. In that time he had resided at Benares, Mooltan, and Lahore, and had visited the Himalayas and Cashmere, besides having passed 21 years of his service in Arracan, Burmah, Assam, Cachar, and Munnipore. He had, therefore, had ample opportunities of watching all the vast changes which had been effected in the moral, intellectual, and material improvement of that great country, and he must say the transformation had been wonderful. It had, indeed, been from that of a child in all the nakedness of its infancy to the development into manhood, well clothed, well educated, with plenty of money in its pocket, and an anxious parent still watching to promote its advancement. Although this development had taken place in the period to which Mr. Stocqueler had alluded, that is, since the transfer of India to the crown, and had been accomplished by three great statesmen, Lords Canning, Lawrence, and Mayo, nevertheless he was sure it would in no wise detract from their renown when he said that the foundation was laid before the period in question, and it was due to the memory of Lord Dalhousie that this fact should not be lost sight of. The period of his administration extended from 1848 to 1856. During these eight years he introduced comprehensive reforms into every branch of the public service. The Board of Customs, Salt and Opium, the Revenue Board, and the Military Board, all underwent remodelling. From the latter he withdrew the control of the army and ordnance, remodelled the stud department and the department of public works, and gave to each a chief of its own, imparting to them the unity of control and responsibility which is found so beneficial in the present day, on the principle, he supposed, "that too many cooks spoil the broth." The cause of education received special encouragement from him. Vernacular schools were established throughout the land, and government colleges and a university in each presidency, besides grants in aid of all schools, without reference to creed or caste. And above all, he officially announced, in the teeth of native prejudice, that the education of native females was considered by the British government to be an object of national importance, and on the death of Mr. Bethune, the Legislative member of Council who had devoted his time and his money to female education, he took upon himself the support of the female school supported by that gentleman. The revenue of India was considerably augmented during Lord Dalhousie's administration; the commerce of Bombay was developed to an extraordinary extent, and that of Calcutta was doubled; the coasting trade from Kurrachee to Calcutta, and Calcutta to Rangoon, Singapore, and Penang, was liberated from every obstruction, and this gave birth to the establishment of the British-Indian Steam Navigation Company, a company second only in importance to the Peninsular and Oriental Company. Attention was equally bestowed on the improvement of the internal navigation, and steamers were placed on the Indus and on the Irrawaddy, from which the commerce of the countries through which these rivers run had derived considerable expansion. He gave to India the boon of a cheap and uniform rate of postage, and likewise procured a reduction in the rate of postage between England and India. Roads and canals were also pushed forward with great vigour in his time, and two roads of great magnitude were devised and completed. He alluded to the roads across the Arracan mountains, from Dacca to Pegu, and the road across the Himalaya from Kalko to China. The Ganges Canal was also pushed forward with a spirit proportioned to its importance, and the main stream was for the first time opened on the 8th April, 1854. The system of railways, which is working a greater and more beneficial change in the social, political, and commercial condition of India than had been known at any former period, was due, also, to the indefatigable exertions of Lord Dalhousie. Another benefit conferred on the commercial and political interests of India by Lord Dalhousie was the electric telegraph. It was a well known fact, that in the days of Lord Wellesley the Government of India was seven months without intelligence from England; the same number of minutes now suffice to place the two countries *en rapport*. The above facts will all be found at length in Marshman's "History of India"—a couple of volumes which he strongly recommended to the notice of those who wished for a general and accurate knowledge of the progress of India down to 1867. He was a great admirer of Lord Dalhousie's government, and he hoped he should therefore be excused for concluding with the following quotation from that work:—"His administration marks a new and important era of civilisation in India. The principle of uninterrupted progression which has since characterised the movements of government is due to the impulse which he communicated to it. To his genius is to be ascribed the grateful fact that the India of 1867, or rather of this day, presents so pre-eminent a contrast to the India of 1747." "He grasped the largest projects for the improvement of the country, and his views of policy were of Imperial magnitude. In all his measures he exhibited a clear intellect, sound judgment, and deep sagacity, while his firmness of purpose and resolution of character turned all these qualities to the highest account." "He communicated vigour to the administration by exacting a rigid performance of duty from all under him, and he set them the example of his own intense application to public business, to which, by a noble devotion, he sacrificed leisure, ease, comfort, and health. He investigated every question that came before him with patience and diligence, and with a scrupulous desire to do right. He marshalled all the arguments which could be adduced on both sides, and always recorded weighty reasons for whatever decision he formed, the soundness of which was seldom questioned, either by his colleagues or by the public in India. If he had little imagination for the sensitive feelings of princes who represented ancient and effete dynasties, its absence was in some degree compensated by his compassion for their misgoverned subjects; and his administration was distinguished throughout by incessant efforts to benefit the people, whether in our own territories or in dependent states." He had endeavoured to show them that the foundation of the progress which had taken place in India during the last 14 years was laid in previous years. Upon the broad foundation thus laid by Lord Dalhousie his successors have raised a noble superstructure; and he was sure they would all agree that if there was anything which should encourage and cheer on those upon whom the government of that magnificent empire had devolved, it would be found in the results which Mr. Stocqueler had so clearly placed before them.

Dr. Townshend said his experience enabled him to concur with the remarks made by Dr. Fayrer, and fully to bear out all he had said.

Mr. Espinasse proposed a vote of thanks to the lecturer, which was duly acknowledged.

Dr. Boycott proposed, and **General Vaughan, C.B.**, seconded, a vote of thanks to the chairman for presiding, and the proceedings closed.

Colonel Lawrie sends the following:—"As Mr Stocqueler has alluded to the American mission in Burmah, with reference to the Karens, that wonderful tribe of deists, chiefly inhabiting the hills of our northern boundary (though found in other parts) of Pegu, I would remark for a moment, from some knowledge of the subject, on the continued success in the golden land, of Karen female schools, under European female superintendence. The Karens have yet to play an important part in the civilisation of the world. They are not the aborigines, but probably were the last people to enter Burmah. They regard themselves as wanderers from the north. The country of Caride is the south-east point of Thibet, and Teen, a word signifying Heaven, but used by some of the Chinese to signify God, is used in Karen poetry as the name of the god of a people with whom they were formerly connected. The Karen language also indicates, says Dr. Mason, "a connection with tribes on the borders of Thibet." The Karens have traditions of the creation, the temptation, the fall, and the dispersion of nations, in prose and verse, nearly as accurate as they are found in the Bible. Here, then, there is a wonderful people to educate. The energy of the American ladies in this particular, as regards Karen women, has been remarkable, and throughout Burmah they have been the true friends of woman's elevation from the days of Mrs. Judson, after the first Burmese war, in 1826, down to those of Mrs. Mason, at the conclusion of the second war and conquest of Pegu, in 1852. I was inspector of government and aided schools in the new province in 1865-66, but among the various Burmese and Karen schools inspected there was nothing to equal as a bold success Mrs. Mason's Karen Female Institute, at Tarngoo, for the instruction of the daughters of Karen mountaineers. In January, 1866, Karen mountain chieftains sat, for the first time, as judges, and awarded prizes to Karen young women for attainments in scholarship. There were present also nine other chiefs from beyond the eastern boundary and two Gaiko chiefs from near the northern. No less than 41 chiefs were present to witness what good educational work had been accomplished—in the face of many trials—by Mrs. Mason, one of the most gifted American ladies who ever came to Burmah, and whose labours are fully mentioned in the annals of our Indian administration. As in India, so in Burmah, the greatest hindrance to the conversion of the men is the women. For the last ten or twelve years, however, through American ladies like Mrs. Mason devoting themselves to the good work with untiring zeal and ability, the opposition of the natives themselves to female education—particularly of the Karens—has been subdued, and various schools have at length been constructed, and are supported by voluntary offerings. The people are even beginning to show an interest in our arts, manufactures, and commerce; and doubtless, when the trade of Western China is opened up to the world by means of Burmah's noble river, the Irrawaddi, the Karens will be among the foremost tribes to wheel into the ranks of civilisation. From America have been sent forth Woman's Union Mission bands and auxiliaries to India and Burmah. Mrs. Mason's success among the Karens would appear to be an earnest call to the ladies of England to go and do likewise, which work would give them far greater glory than aiming to win political distinction through female suffrage at home. I observe that a meeting was held recently at the Hon. Mr. Kinnaird's, in support of a new missionary college in Asia Minor. Through Turkey the agents of the American Board of Missions have been the most successful. Mr. McCoam, in a recent letter to the papers, praises them highly. It will surely, then, not be to our credit if the Americans—chiefly ladies—are allowed to carry off the educational palm in Asia Minor as well as in Burmah. We must all agree with Mr. Stocqueler that whole troops of the fair sex from England would greatly facilitate the progress of education in India and the East."

TWELFTH ORDINARY MEETING.

Wednesday, February 26th, 1873, Vice-Admiral Erasmus Ommanney, C.B., F.R.S., Member of Council, in the chair.

The following Candidates were proposed for election as Members of the Society:—

Barbour, William Boyle (Messrs. Barbour, Barclay, and Co.), Manchester.
Baynes, Alfred Henry, F.R.G.S., F.S.S., Fairlight, Harrow-on-the-Hill, Middlesex.
Brown, Alexander Marshall (Messrs. James Finlay and Co.), Glasgow.
Cowan, John George, 4, Cullum-street, E.C.
Dehesghues, Leon, 51, Hatton-garden, E.C.
Garnham, J. B., 34, Stoke Newington-green, N.
Porges, Jules, 17, Conduit-street, W.
Rodger, John Pickersgill, 49, Harley-street, W.

The following Candidates were balloted for and duly elected Members of the Society:—

Baker, John Marcombe Bromley, Hortensia-villa, Southsea.
Parr, Henry, Beoley, near Redditch.
Roberts, Benjamin, Cornwall-lodge, Anerley, S.E.

The discussion upon Lieut.-Col. A. Strange's paper, "On Ships for the Channel Passage," adjourned from the 12th inst., was resumed.

Mr. T. Webster, Q.C., in opening the adjourned discussion, said there were one or two questions which had as yet received very little attention, although they had an important bearing on the subject. In the first place, the height of the waves—it was remarkable how little was really known on that point. Colonel Strange had referred to the experiments of Admiral Scoresby, which had led him to the opinion that the waves in the Atlantic seldom exceeded twenty-eight feet in height. The Astronomer-Royal, in an article in the "Encyclopedia Metropolitana," expressed his belief that they rarely exceeded thirty or forty feet; but there was a recorded observation by Admiral Fitzroy, on board the *Thetis*, showing that in a very extreme case waves ran to a height of sixty feet. This was about the state of scientific knowledge on this subject, and it was somewhat remarkable that more information had not been obtained, especially considering there were Cunard steamers crossing the Atlantic under circumstances which would allow of these facts being ascertained. Amongst other good results from the present discussion, he hoped attention would be called to this point, and suggested that it might be advantageously taken up by the British Association. In the next place, there was very little doubt that size was a great element of stability, and, *ceteris paribus*, the larger the vessel was the more stable she would be. Still, there were certain conditions of stability which were all essential, and those acquainted with the paper written by Canon Mozeley, in the "Philosophical Transactions" were aware that it was there conclusively shown that a circular section of a vessel was the one most stable of all. He was surprised, therefore, that there should have been so few observations made on this point, but he believed an elaborate series of experiments had been conducted in America, by Messrs. Winan, on a form of vessel in which every section was a circle. Then, again, there was the commercial element to be considered. Many years ago, at a meeting of the British Association, this matter was very much discussed, and what was called the *plus* resistance at the head and the *minus* resistance at the stern, were shown to be comparatively insignificant as compared to the area of the wetted section with reference to the displacement. That principle had since been thoroughly acknowledged, both by mathematicians and practical men. There, if the commercial element was to be considered, though it might be worth while to obtain stability at any price, yet this must not be lost sight of—that the area of the wetted section with regard to the displacement should be a minimum. Now, whatever might be the advantages of the doubled-hulled vessels, models of which had been shown, no one could deny that they sinned against the principle in a most extreme manner; in fact, it would hardly be possible to have a greater wetted section in comparison with the displacement than they disclosed. Applying these general principles to Mr. Bessemer's vessel, she came under a totally different category. Mr. Bessemer availed himself of the best known form for constructing his vessel, and there was no reason why he should not. He might have every section a circle, or might adopt any other particular form which he thought best, but, having taken that, and, having thus arrived at the best sea-going vessel, he applied his own invention to that, for the purpose of getting rid of one particular motion, viz., that of rolling, which, no doubt, was most distressing to the majority of travellers. They were much indebted to Col. Strange for having set forward so plainly the different kinds of motion to which vessels were subject—for, speaking generally, the public had no idea of the distinction existing between these various motions—though, no doubt, mathematicians knew they might all be regulated by certain formulæ. The pitching motion was not provided for, but it was a question whether it was worth attempting to do so, and that involved the question of the height of the waves, to which he had already referred. In conclusion, he expressed his satisfaction that the restrictions formerly imposed by Parliament on the form in which vessels should be constructed were now removed, so that there was no obstacle to the greatest freedom in this matter.

Mr. Arthur Paget said that about eight years ago his attention was specially directed to the subject of double-hulled vessels, as they were then called, and having a very long empty room at his disposal, he constructed in it a long tank, and provided a hauling apparatus, so constructed that he could propel vessels along this tank at a certain speed. He then constructed a good many models of double-hulled vessels, in order to ascertain the form which would give the least resistance, not being aware at that time that any one else was engaged on the subject. His experiments, in one respect, would not be of much value with respect to the Sedley-Dicey system, because his experiments were confined to models of sailing boats, and his propelling power was applied at a point representing the centre of the area of the sail to be carried, which would be about one-third the height of the masts. Of course, the power being applied at that height would tend to make the vessel plough, and therefore, to some extent, his experiments were not reliable for steam power. Still, they gave results which, in some measure, bore on the point in question, and he would state the results. He found that hauling a double vessel in the way described and then closing her together, so as to make her a single-hulled vessel of the same form, the least increased resistance in any case on an average was ten per cent., speaking roughly. It then occurred to him that as such vessels must require a deck, in any sea the resistance would be enormously increased, and he, therefore, managed to introduce into his tank waves as nearly as possible in proportion to the size of the model. He then found the ten per cent. increased resistance rose to from 25 to 50 per cent.; in other words, the speed was reduced to about half what it would be if the two hulls were brought together, and propelled as a single vessel. He, therefore, at once decided in his own mind that for any other method of propulsion except sails, a double-hulled vessel had no advantage except increased stability. Since that he had built seven different practical working models of double-hulled vessels, and had sailed with them in all weathers and all waters, when he found that his previous experiments obtained a singular verification. In racing his double-hulled craft against others in still waters, he could beat a certain vessel, say at two to one, very often; whilst racing the same vessel in a rough sea he would be beaten himself. From that he deduced this conclusion, that unless Capt. Dicey and Mr. Sedley had tried their vessels in very rough sea they would be disappointed in the speed. In a smooth sea the speed would be very easily diminished, but in rough weather the loss would be very great. He had been much surprised at the statement of one speaker, who said he had been in a double-hulled vessel which rolled, for he had worked his craft in all kinds of weather, so rough, in fact, that he had blown three sets of masts overboard, and he must say he had never experienced the slightest degree of rolling. Of course, he used the word "rolling" in the seaman sense, not that the vessel never inclined, for, of course, she would incline to the wind when a gust came. The difference was this, in an ordinary single-hulled vessel, when a puff of wind came, she would incline to one side, and then oscillate backwards and forwards until she steadied; but the double-hulled craft would incline about one-sixth as much, in the first place, and when she came back she would not go beyond the horizontal. The double-hulled system, however, would give an immense motion of translation. In rising to the top of a wave it was usual, if you were sailing close-hauled, nearly in the teeth of the wind—especially if you had friends on board who were rather delicate—in going down a wave to ease the tiller, and let her down gently; whereas if you jammed the tiller hard up and kept her in the teeth of the wind, she would go down with a bang. He had been out in rough weather where an ordinary yacht would have buried herself one-sixth of her length in pitching. He had jammed his tiller up as hard as he could, kept her head to the wind, and brought her down with a smack on the water, which made a report like a cannon, which could be heard a mile off, but he never succeeded in getting her head under, and never shipped a green sea, whilst alongside might be a yacht six times her length shipping green seas freely. At the same time he must say that if his vessel were watched from the yacht, it would be seen that she would rise say twelve feet while the yacht rose only four, because his vessel, having a flat deck underneath, when the wave came under her she must go up, unless the deck broke to pieces. Therefore, for the same reason that the yacht was wet all over the deck while his deck was dry, his vessel rose three times as much by the waves as the yacht did. Therefore the Sedley-Dicey ship in rough weather, unless her decks were of such a height that the waves would not touch it—which, if the figures Mr Webster had given were correct, seemed impracticable—must yet have much more motion of translation up and down. He must say, however, that though he was sometimes sea-sick, it was only when he was rolling—never when the vessel rose up and down. That rolling motion he believed the Sedley-Dicey ship would prevent, and also the Bessemer. The Sedley-Dicey would be the liveliest and the driest. The Bessemer must be a wet ship, from her low edge; and, from the want of height in the bow, when the wave came she must plough. But there was another matter to be considered. One great difficulty in all these large ships was this, that any large ship must be enormously difficult to get in and out of any of the existing harbours on the French coast. If you are starting straight for the harbour, and had your bearings perfectly right for a certain wind, a gust of wind would come which threw you out entirely, unless you went at such a speed that if you did strike, it would be sudden death to all on board. From practical experience with small vessels and small harbours he was prepared to say that it was no easy matter to hit the harbour's mouth, and, comparing the two kinds of ships, he thought in this respect the Bessemer would have an enormous advantage. It was not the strength of the tide which interfered, because every Channel captain knew that that might easily be allowed for, being pretty constant. But the wind might vary 300 per cent. in two minutes, and having made allowance for the wind, if it dropped you would hit the pier on the windward side, whereas if it increased in strength you would hit it on the other side. All these vessels, therefore, with the saloon-cabins, would find enormous difficulty in hitting the harbour. He had not seen the Sedley-Dicey last model, but the old one had cabins at both ends, and—though a high cabin in the middle of a vessel would not affect her steering, and the longer she was, providing the cabin was short, the greater hold she would have on the water and the greater certainty you would have of hitting the harbour mouth—on the other hand, if you had high cabins on each end, the wind would have enormous power on them, and there would be great difficulty in hitting the harbour-mouth at such speed as was requisite to enable her to do it. Summing up the results of his experience they appeared to be this, that the Sedley-Dicey would be the most comfortable ship; though she would have most motion of translation, she would have very little rolling, in fact, less rolling altogether than the Bessemer, except in the cabin, because the mere fact of the cabin not rolling would give the rest of the ship more power of rolling. In the Sedley-Dicey you would have greater difficulty in hitting the harbour-mouth; and as to the speed, in fair weather she would have nearly the same, with equal proportionate expenditure of coal and engine power—that was to say, not more than ten per cent. less than the Bessemer, but in a gale she would only attain half the speed.

Mr. Edwin Chadwick, C.B., said he would interpose in the reasoning from the more abstract and hypothetical data some reference to direct practical experience. Sir James Anderson, who had commanded twelve Cunard ships, and who had twice commanded the *Great Eastern*, and had the largest nautical experience, had stated to him that, as a rule, sea-sickness had under all conditions a considerable reference to size. Whilst he commanded her he had never seen any one sick to the extent of vomiting on board the *Great Eastern*. Size was the first condition to be regarded in a ship for the purpose in question. Sir James declared that, having examined Mr. Reed's plan, he (Sir James) would—had he been at liberty to do so—have gone into the commercial enterprise of such vessels, as he expressed it, "with a header," as they were just what were now wanted. Mr. Grantham had objected to the plan of the large saloon ship as not being novel, for such ships had long been in use on the American rivers, and had been used on the coast on troubled sea-water, and were highly popular. That was the practical example on which he (Mr. Chadwick) very mainly relied for his support of the Bessemer ship. The American saloon vessel, fitted up with sleeping births and every accommodation, induced persons to go on board them for residence in pleasure excursions in preference to residence in hotels. The Bessemer in question would be largely improved in the saloon, and also largely improved in the construction of the ship on the successful American example. He had been told by the commander of one of them that, as a racing feat, he had gone at the rate of nearly twenty-two miles an hour. Mr. Reed expected that his vessel would go fully that speed, and was assured that for ordinary passage purposes it would be used at full twenty miles an hour. Was not that a great gain, a gain of a third upon the ordinary passage, a reduction by one-third of the anxieties and pains of that dreaded passage, even if those pains were to remain as they were? But assuredly they would not remain as they were. There were objectors who insisted that nothing was done unless everything was done according to their extreme suggestions. You will not prevent sea-sickness, they say, with an air of resentment at the attempt, and then they cite the instances of persons who were made sick by railway transit, and by going up hotel lifts. It was a misrepresentation that absolute and total prevention, even to the cases of the extremest susceptibility, was promised. The express promise of their prospectus for the Bessemer ship was that by it sea-sickness should be reduced to the minimum; and the two great conditions of increased size and greatly increased speed were alone sure data that more would be done by her than had yet been done, or than could be promised to be done on any plan yet advanced, for none would compete with her in speed. He had had in his time much to do with transport vessels for the transport of pauper emigrants, and for quarantines, and such vessels had to him been a sanitary study. Dr. Johnson had wondered that anybody would go on board a common ship if he could help it, for it was a bad prison with a chance of being drowned. He (Mr. Chadwick) regarded it as being an insanitary-conditioned cellar dwelling—ill-lighted, ill-ventilated, ill-warmed, and, above all, ill-drained, having cesspool matter, as bilge water, perpetually shaken up, and evolving pestilential gas, aggravated by the vitiation of air produced by overcrowding. They were frequently fever nests of the most dire description for animals and men, lowering health and strength, and attended by terrible outbursts of disease—generating disease of various sorts far out at sea, and at times far out of the reach of land importation, which contagionists assumed. He had recently crossed the Channel in one of the boats which a brutal ignorance and apathy to suffering provided and maintained, and though the crowding was not excessive, the alternative between the inclement weather on the deck, and the sickening atmosphere of the cabin beneath, was a severe one. With the large saloon there would be, at all events, the ventilation and the relief of increased space. He had found that both Mr. Bessemer and Mr. Reed fully appreciated the insanitary conditions of the common passage vessels, and were prepared to encounter them. With the faculties of one of the greatest and most successful mechanical geniuses of the age, and those of the chief and most successful nautical constructor of our time, the chosen president of the Association of Naval Architects, intently bent upon the object, with the recognised great nautical ability of the admiral, who had held with honour the highest executive position in our Royal Navy, and associated with eminent commercial men, the public might confidently expect an improvement in construction and action becoming the naval position of the empire.

Sir Spencer Robinson, K.C.B., F.R.S., desired to ask Mr. Paget whether his experience of double-hulled vessels, which he had described, was drawn in any way from such ships propelled by steam, or whether it was confined to sailing vessels; because every sailor knew that as long as a ship was propelled by canvas the force of the wind prevented rolling. If, however, Mr. Paget had had any experience of such a vessel under steam, his testimony would be very valuable, and would tend to show that such a ship would roll very little, or not at all.

Mr. Paget said his experience had been entirely on board a sailing vessel, but at the same time he must ask permission to state that he had been afloat in her under conditions which prevented any operation of sails to prevent rolling, viz., when from heavy weather she had been entirely dismasted, thus representing a steam vessel without the steam power in operation. Still he had experienced no rolling, as was proved by a trifling incident. On one occasion, while he was taking his luncheon, and was just about to drink a glass of beer, both masts went by the board. Of course he immediately put down the glass, and set to work to get in the wreck, which he did effectually, losing neither spar nor block, and then to his utter astonishment he found his glass of beer just as he had left it, not a drop having been spilled. That proved to him that if the Sedley-Dicey ship was so built that the beam between the hulls was properly proportioned to the beam of each she could not roll.

Sir Spencer Robinson, thanking Mr. Paget for his explanation, said it would follow that the Sedley-Dicey ship would probably roll less than any other form of vessel, but, even admitting that, he did not think the principles of the Bessemer ship were at all affected. The Sedley-Dicey ship was, in a certain sense, a raft, and the connection between the two portions must be extremely solid and strong, since Mr. Paget's description had shown that in the motion of translation it was the deck between the two hulls which lifted the vessel up and down, and it therefore had to bear the whole weight. Now in small vessels, of course, there would be no difficulty in constructing the deck and frame of sufficient strength to meet this strain with safety, but what strength and weight must be combined in a large ship of such a construction, intended to carry several hundred passengers and hundreds of tons of goods? If a small vessel had been found to jump from the top of a wave into the trough of the sea, with a noise like the report of a cannon, which could be heard a mile off, it appeared to him that with a ship large enough to convey passengers across the Channel the report of such concussions would probably be heard from Dover to Calais, if the vessel ever rose again after a shock so violent. The Bessemer ship, on the other hand, had been credited with very great ease of motion, and in particular with very little of that motion of translation which he believed was answerable for most of the horrors and miseries of sea-sickness, for as a sailor he had been accustomed to witness these things, though he had never suffered from sickness himself. He had seen the most audacious smokers and strutters about the deck come to grief after two or three of these motions, though they had been wholly unaffected by the rolling motion. Again, as remarked by Mr. Chadwick, the unpleasant odours arising from stinking bilge water and other matters, with the bad air and general neglect of ventilation, had much to do with sea-sickness, he believed far more than the rolling motion in many cases, and in the case of the Channel steamers, when crowded, the state of things in this respect was very often such as could not really be described. Mr. Paget admitted that there would not be anything like so much up-and-down motion in the Bessemer ship; indeed, from the well-calculated and well-designed lines which the constructor had prepared, from her size and the length between the crests of the waves, all of which had been most carefully and accurately ascertained, they were in a position to state, almost with certainty, that her motion of translation would be extremely small. He said advisedly, that there was no problem presented to the mechanical genius of this country—if presented by an observer who had accurately recorded the conditions of the phenomena—the difficulties of which could not be overcome and provided for if it were worth while to do so by the skill and genius of the mechanicians, engineers and mathematicians of this country. He was, therefore, not stating anything improbable, nay, almost certain to be borne out by the facts of the case, when he said that the problem of controlling the rolling motions of the saloon would be accomplished by the ingenuity and talent of Mr. Bessemer. Every mechanical difficulty which had presented itself had been one after the other surmounted, and he did not believe any difficulty would be found in controlling the rolling motion of this cabin. Under any circumstances this motion would be very small, for her form had been calculated and laid down by the most able naval architect in Europe, who was prepared to say that from her shape and dimensions alone this motion would be reduced to a minimum. But beyond this there was a saloon swung by its centre of gravity on points as nearly as possible coincident with the centre of gravity of the ship, and whatever inclination the movement of these points would give to the saloon swinging upon them would be controlled by the Bessemer engine. Some people did not accept this, saying there was something uncertain about it which needed inquiry and experiment before the result could be accepted. It was said the motion was very rapid, and that before the man at the hydraulic had got control over the saloon there would have been motion and consequent sickness. Now his answer to this—and the same thing would be said by any practical seaman—was that an experienced helmsman does not steer simply by the eye. There is a feeling which comes upon the rudder before any perceptible effect is produced upon the binnacle, so that a good helmsman steers more by the touch than by the eye. In the same way the man at the hydraulic would steer as much by the touch as by the eye. Before the ship could take any perceptible inclination the steersman will be aware of what is about to take place, and will be able at once to control it. One other point touched on by Mr. Paget was in reference to the effect of the wind and tide on the bows of the ship. The bows of the ship might be becalmed as she entered the harbour, and the action of the wind on the stern would bring the bows against the harbour. Instead of having a ship the same height the whole of her length, it was very wisely designed by Mr. Reed that the ship should be low at the ends. They are scarcely out of the water at all, and, therefore, you have nothing whatever that can catch the wind, and the steering of the ship would be relieved of that great difficulty of one end being becalmed and the other under the influence of the wind. The upper ends of the Bessemer ship so nearly balance each other that the difference is next to nothing. Mr. Paget also spoke of the extreme wetness of the ship. He would prove that the Bessemer would not be extremely wet. No passenger who was under the deck of the ship below the water would know anything about his being under the water so long as she was kept properly caulked. The passenger would not be affected in any way whatever by the waves of those parts of the ship that are of low freeboard, and over which the water will flow freely. The waves that meet the end of the ship can never flow over the deck beyond two or three feet, and the ship would probably be as dry as a ship could be when progressing at the rate of 20 miles an hour against the wind and sea. He concluded by expressing a hope that the efforts of Mr. Bessemer and all concerned, to mitigate the miseries of the Channel passage, would be crowned with success.

Mr. Paget, in answer to an observation of Sir S. Robinson, remarked that a wave to produce the result he spoke of would need to be 150 feet high.

Mr. G. B. Galloway remarked, in respect to the Bessemer plan, that for fifteen years he had paid some attention, and had something to do with naval architecture, and so far as it could be effected he thought the Bessemer plan would accomplish the desired object of preventing sea-sickness. Also, that, as regarded the ventilation and prevention of noxious vapours arising from the bilge-water, this plan would accomplish the desired effect. He did not, however, think that in applying the four paddle-wheels, and having the floats at right angles, would be as effective as they might be if the floats were placed at an angle of 33 degrees. The first pair of wheels, if they worked with the paddles at right angles, would throw the water against the succeeding pair; but with floats at the angle he described this would not be the case. Whatever might be the opinion about vessels not rolling, he had seen nearly all kinds of ships, but he had never seen a ship that would not roll; and whatever might be the opinion of gentlemen who claimed such high merit for the twin principle, he would say that in a few years, if the ship lived so long, she would be very crank, and be very likely to come in two.

The Chairman said it must not be forgotten that the ships were only experimental, and could only be looked upon as such, as they were so totally at variance to known principles; but there were a great many points which must not be lost sight of. He thought the power of the rudder, the light draught of water, and their enormous structure above the water, made it very doubtful whether in a gale they would be better or as good as the boats we now have; and he certainly would prefer having them without the saloons, that they might have a fine open deck. What had been done on the Dublin and Holyhead service might well be adopted. As for the Bessemer model, the saloon being between the two engines, he thought it would not be very comfortable in warm weather. You had heat at each extremity of the saloon; and with two engines at work, unless a similar pressure could be maintained, there would be a great vibration. He did not desire to raise any objections, for it was his duty rather to encourage the inventors, still these points must not be lost sight of. It was said it was not safe for any ship to exceed 240 feet in length, and unless the harbours were enlarged much could not be accomplished. If there were bigger harbours there would be plenty of good boats. He could not join in the tirade against those boats which had for twenty or thirty years done such good service, and which had done us national credit in the safety and speed with which the journey across the Channel was accomplished. In regard to the present service, he thought much evil was due to the boats being so overcrowded. If this were remedied by more boats being put on the service, much of the present evil would be removed.

The Secretary then read the following from Captain Mortleman:—

"I cannot refrain from saying that the remarks made by Lieut.-Colonel Strange on Wednesday last, as to the disgusting filth, &c., of our ships does not reflect much credit upon us, but happily the statement is not true, for we are continually being complimented on our attention and cleanliness. Of course I am speaking of the Folkestone steamers.

"But my object in writing to you, as a practical man, is to point out the most important feature that seems to be most completely ignored in these discussions, viz., the length of the proposed ships for the present harbours—Captain Dicey's 400 and Mr. Bessemer's 350 feet. The former proposes to steer at each end, as there would not be space to swing in the harbours; but I think he need not trouble himself much about that, for a vessel of such a length would certainly run aback of the piers in taking the present harbours in bad weather. The *Albert Edward* is about half that length, and I have, at times, entered the harbours with the greatest anxiety, on account of her length, whereas, in a shorter vessel, there would have been no danger.

"I have had twenty-seven years' experience in these harbours, and I can only say that if experiments are to be made how people can be drowned, the way to secure that end will be to have ships of the proposed length. The best and only practicable thing to be done is to improve the harbours, and larger ships are sure to follow.

"I contend, as a practical man—and I have been using these harbours many years, every day—that ships of the proposed length would certainly be lost taking the present harbours. We should have had longer ships when the *Victoria* and *Albert Edward* were built if safety had not been a consideration."

Mr. Bessemer, who was prevented by illness from being present, sent the following reply, which was read by the Secretary:—

"I was most desirous of correcting some erroneous views which were expressed by one or two persons in reference to my saloon ship; and if it is not contrary to the rules of the Society, I should esteem it a very great favour if you would read to the meeting the following brief observations in reference to the points to which I refer.

"Firstly, with reference to the opinions expressed by Mr. Grantham, I may remark that I deeply regret the absence from England at this moment of Mr. Reed, whose intimate knowledge with every branch of ship-building would have enabled him at once to remove the objections to his design which Mr. Grantham has made.

"In Mr. Reed's absence, however, I may be permitted to remark that Mr. Grantham's argument as to the sufficiency of deck accommodation in the saloon company's ship is wholly fallacious; he asserts that the whole useful deck space is destroyed for the use of passengers, because we occupy with the saloon some 70 feet out of the 250 feet of the deck's length. Is this gentleman not aware that we have, after deducting this 70 feet occupied by the saloon, all the ordinary deck accommodation of a vessel equal to 180 feet long by 40 feet beam; have we not in addition to it two spaces of 70 feet each in length by 7 feet wide, at the sides of the saloon; and have we not also two ranges of deck cabins, each about 100 feet in length, extending the whole way between the fore and aft paddle-boxes, in addition to which there are also two large second-class saloons below deck, which are in a more favourable position than the first-class saloon occupies in an ordinary ship? The whole of this accommodation is provided for second-class or deck passengers, who will be as quiet and well cared for, in this large and fast vessel, as they could be in the boats advocated by Mr. Grantham, for I take it for granted that provision for second-class passengers, with the advantage of a low fare, is as necessary by sea as on land, and we find no railway company has ever attempted to avoid the distinction.

"Now, with regard to first-class passengers, Mr. Grantham wholly ignores the fact that, with such a quiet, controlled saloon as I propose to construct, persons will not desire to lie down and occupy six feet in length of the sofas. It is well known that we propose to carry passengers in one hour and a quarter across the straits, and with about as little motion as they would experience in a quick railway train, and, therefore, we do not provide space for our passengers to lie at full length and be sea-sick; indeed, the whole scheme, as is well known, is based on the prevention of sea-sickness, and consequently there is no necessity whatever to provide space for persons to lie down at full length. Mr. Grantham might with equal justice deny the sufficiency of passenger accommodation in the next railway train he happens to travel in, by objecting that there are not carriages enough provided for every passenger to sprawl at full length on the seats, and thus reduce the available space in the train to one-third.

"Mr. Grantham will be good enough to remember that the quiet saloon has also four small and four large private rooms, for the express accommodation of the few very susceptible persons who might feel ill towards the end of this very rapid voyage. Into either of the four large apartments they may retire, and suffer in private, instead of exhibiting themselves at full length on the saloon sofas, basin in hand, as preferred by Mr. Grantham.

"In any case the mere question of how many persons a particular saloon will or will not hold has nothing whatever to do with the principle involved, and is no argument against the employment of a suspended saloon.

"Mr. Grantham says 'a vessel for the Channel passage should be able to take on deck all the passengers' luggage, and this requires a considerable area.' I do not agree with Mr. Grantham's views on this point, for I greatly object to encumbering the deck with passengers' baggage, and we have accordingly arranged a special mode of lowering the passengers' baggage in small wheeled crates, without concussion or injury to it in any way, into a space specially designed to receive it below deck, where it will be kept perfectly dry during the voyage, and from which our peculiar arrangements of hoisting tackle will enable it to be removed with great ease and rapidity.

"Mr. Grantham also expresses the opinion that the saloon would not be a cure for sea-sickness. Only imagine, says that gentleman, a saloon 60 feet long and 30 feet wide, suddenly sinking below one's feet, and rising again some six inches or six feet, by a translatory motion. Did Mr. Grantham ever imagine how extremely pleasant it would be for the passengers in one of his proposed ordinary steamers, when this translatory motion was supplemented by a pitch and a roll of eight or ten feet, while the cabin floor was continually presenting, in different directions, an angle of some ten or twelve degrees to the horizon? Surely if it is impossible to eliminate every conceivable motion of a ship at sea, it will be at least a great step to bring her rolling and pitching motions to a minimum, and to keep the floor of the saloon always horizontal, so that at least a passenger may be able to walk about if he desires, or be enabled to sit on a sofa without the dread of being suddenly ejected from it. If perfection is not attainable, let us at least have all the amelioration that modern science has to offer, and not blindly rush on, in the old rut, without first seeing what improvements are possible.

"In conclusion, Mr. Grantham further remarks that 'in his judgment there was no necessity for any of these new schemes, for a vessel built on acknowledged and recognised principles would answer every purpose.'

"I quite agree with Mr. Grantham that if what he calls 'answering every purpose' includes the rendering of almost every passenger utterly miserable, and disgusting every one with his neighbour, that the simple old form of sea-going ship, which he proposes to employ, is admirably adapted to effect this object, and perpetuate the reign of basins.

"I would next revert to some observations made by Captain Davis, who very modestly says, 'it would be presumption in him, in the presence of so many engineers and shipbuilders, to speak one way or the other as regards the engineering part of the question.' But notwithstanding this assumption of humility, he proceeds forthwith to say, in reference to my saloon, 'that it would not cure sea-sickness, he was sure.' Every sailor he had asked looked upon Mr. Bessemer's cabin as a sort of 'hobby, and a rather expensive one; they did not believe in it.' Perhaps Captain Davis does not consider this 'speaking one way or the other,' or giving an opinion on engineering questions; he at least would have given me an opportunity of changing or modifying this view of the case, had he given reasons for the very decided conclusions to which he and his friends have arrived. His remarks, as they stand, unsupported by any argument, forcibly remind me of the reasons given by a young lady on a particular occasion, as recorded in the old couplet,

> 'I do not like you, Dr. Fell,
> The reason why I cannot tell,
> But this indeed I know full well,
> I do not like you, Dr. Fell.'

It is equally evident that Captain Davis does not like my saloon, and, like the young lady, finds it difficult to assign any sufficient reason.

"And, further, Captain Davis takes exception to the position of my steersman, or controller. He remarks, 'The steersman is down below, and in ordinary steering the man at the helm watched the waves, and anticipating each wave, he moved the helm accordingly, but the steersman below, or leveller, or governor, or whatever he was called, could not see the waves, and if he were to attempt to act according to the movement of the cabin he might give his rudder a little turn the wrong way, and the wave might be coming the other, and so upset all his calculations.'

"Now all this is an entire mistake and total misapprehension on the part of Captain Davis, not only of the functions of the steersman but the whole mode by which he operates; in fact, the controller of the saloon could in no way be assisted in his duties by seeing the waves; they could furnish him with no useful indications, but would assuredly distract his attention from the one point only to which he has to attend. He has simply to watch the spirit level, which is placed on the quiet floor of the saloon before him, and to prevent, by the movement of the handle, the air-bubble moving far from the centre in either direction, and so long as he does this he knows that the saloon floor continues to be horizontal, and free from the rolling of the ship.

"Captain Davis evidently attaches great importance to the ease and comfort of the steersman, and at the last meeting propounded with much emphasis the following problem, 'What will you all do if a fly settles on the steersman's nose?' It is to be hoped, that if this calamity should happen, he would have sufficient presence of mind to knock it off, unless he preferred to let it 'bide a wee.'

"The real question which I presume Captain Davis intended to ask is, what provision (if any) have you made for continuing the control of the saloon in case accidentally the attendant is from any cause rendered for the time unable to attend to his duty. I would simply reply, that a complete set of valves in duplicate will be placed alongside each other, and two men will be stationed at them, so that one can at all times relieve the other when necessary, the double set of valves rendering the apparatus controllable even under the complete derangement of one set, and with one of the steersmen off duty.

"It is at least consoling to reflect that whatever adverse opinions may be given as to the possibility of lessening or preventing sea-sickness by the employment of suspended saloons, it is certain that the substitution of a large class of vessels, engined with immense power in proportion to their immersed mid-ship section, will considerably lessen the time of transit, and conduce greatly to the comfort of all who travel by them. Whether all the advantages that are anticipated from the employment of suspended saloons will be fully realised, time alone can show; but it is satisfactory to know that the interesting problem is in course of solution. The ship and engines are being constructed, and in a short time the results will be before the world; to that trial I look forward with the deepest interest, and with unbounded confidence."

Captain Dicey said Mr. Paget had left him little to say. The vessel that he had was always under sail, and in smooth water she went very well, and there was only a loss of about 10 per cent. He doubted whether there would be much more than that if propelled by steam. On one of the Indian rivers, which was three miles broad, one of these double vessels was propelled by steam, and she averaged nine knots an hour, and however hard the wind blew, and the sea there was very considerable, there was no diminution of speed more than in an ordinary single vessel. They had large vessels there of the flat type, with accommodation on deck something on the principle of the American vessels. These vessels were as steady as could be imagined. In these single flat-bottomed vessels, drawing three or four feet of water, the motion was so sudden that it made people sick on the rivers, and the difficulty of getting over this extraordinary motion had been his object all through. He had seen the difficulty there was in entering the harbours with very shallow water with flat-bottomed boats. The only way to get over the difficulty was to have flat-bottoms, with a girder between the two hulls, which would keep the vessel steady, on the principle of the Ceylon boat or the boat of the Pacific Islands. Another objection was about the wet skin and the excess of friction. That there were disadvantages attached to the double vessel no one could deny. But had it not advantages that would counteract the disadvantages? The double vessel was steady, and the loss of speed would be very slight compared with the great comfort that would be obtained by the steadiness. Whether the passage was ten minutes longer or shorter he thought made very little difference. Mr. Rawlinson had said that it would be very unpleasant to have the cabins so large, but he forgot that those cabins could be divided into any smaller number. Because it was 200 feet long it was not necessary that there should be only two saloons of 100 feet each. You could have any size you liked. Great objections had been urged against these long vessels entering the harbours of Calais and Boulogne. He thought that larger vessels might safely enter a harbour you would be afraid to go into with a smaller vessel. The new entrance into the North Sea Canal was only 250 feet wide, with stone piers on each side, and that was to take vessels of all sizes, while in these harbours there was a width of 300 feet between the piers. His argument was, the larger the vessel the more safely would you be able to enter the harbour.

Mr. Sedley asked Mr. Paget whether all the boats he had made the experiments with were 40 feet long, or under that length?

Mr. Paget replied that they were under that length most of them.

Mr. A. Sedley said a length of 40 feet did not convey any idea of what a boat would do. 50 feet would be the smallest length which would give you any idea. Mr. Paget had said that a twin boat would lose half its speed in troubled water or a rough sea. He differed with him on that. His experience in a trip he took the other day was that he went over the troubled water at a rather better speed than over the still. He ran the measured mile from Westminster to Vauxhall, against the tide, under 10 minutes, and returned, with the tide, in 7¼, and the water was pretty rough then. He thought Mr. Grantham's proposal was not a good one. Vessels of great capacity, such as 8,000 tons, were not wanted for the Channel passage. What was wanted was light boats, that would carry passengers, and not cargo; and it was not a question whether the boats were to be 150 feet long or 400 feet long, so long as they got the right thing. But from the experience on the river the long boat was the right thing to go straight, and fast, and surely. 400 feet may be too long, and 200 feet perhaps better, but the long boat must have a decided advantage. With regard to the tonnage of these different vessels, no one yet had told them what the respective tonnage was. He had had his calculated at from 1,000 to 2,000 tons. What the tonnage of the others was ought to be known, so that a comparison might be drawn between them. Vessels of 6,000, 7,000, and 8,000 tons were not required. Great tonnage involve great weight, and that required an enormous quantity of power to propel it.

Mr. S. J. Mackie, having seen that every vessel that had been put upon the Channel passage, since the old *Rob Roy*, had increased in size from 90 feet in length up to 240 feet, had yet to learn that any boat was going to be made too big to go into any of those harbours. There was no limit to length any more than size when iron was the material of which the ship was to be built. There were certain fundamental principles which the public were demanding in respect to vessels used in the Channel service. They involved three things:—they must be safe, they must be steady, and they must be speedy, as well as comfortable for the convenience of passengers. The first question to settle was that of steadiness. If you are to have a steady boat, you must have a boat proportioned in certain relations at any rate—at least long enough to cover three waves and broad enough to get a bearing upon two. Captain Dicey got this in one way; he got it in another. From the first he had set his mind to produce a vessel which should be essentially a ship in her character. The model upon the table was on quarter inch scale throughout, and therefore her proportions could be fully seen by everybody. With regard to steadiness, power or speed was an essential element. The momentum of a vessel of this class, driven at a high velocity, would be sufficient in itself to secure a very large amount of steadiness. That, as he understood it, did not mean that she was to lie like a rock on the water, but no seas would ever disrupt her. Every pound of iron going into that ship had been calculated. Safety was also a most essential element; and he would ask anybody to look into his vessel, divided longitudinally into three grand compartments, and see whether she was likely to be sunk, and come to serious damage. As to the saloon, he had gone to the extreme dimensions it was possible to take in a ship 300 feet by 60, and 12 feet in height. All round are private cabins, and the whole thing was designed to be fitted up for the comfort of all the passengers. The saloon alone could carry 1,000 passengers, with the comforts of a drawing-room, and if it was said that that was a large number, and not likely to be required he would only refer them to the report of Capt. Tyler to the Board of Trade in 1867 or 1868, that a freight as large as that could be got as well as carried. Mr. Reed drove his vessel with 4,600 horse-power. In his vessel he employed 7,000 horse-power, and if that were not enough he was prepared to put more into her. If he were asked for economy he gave it, and if he were asked for comfort he gave it, regardless of cost, and he could carry passengers at an expenditure of coal of ten tons per voyage per hour. So that the commercial question of his ship was not the least element of success. Then as to the objections about the harbour. He knew all that could be said on that question, for by his system he had the most powerful means of propulsion, and he would have no hesitation to send his ship in any weather into Boulogne or Calais. The question of propulsion in his vessel resolved itself into that one condition, which was inherent in Mr. Bessemer's plan, Captain Dicey's, and his own. That was the experimental portion of the work, and it was not likely, with the natural desire he had to state facts and things which could be proved or disproved, and which, so far as they could be estimated on a small scale and by experiment, had been done, that he would do otherwise. He would ask why water in a tube, driven out at high pressure from that tube, should not be as effectual a mode of propulsion as any other mode. The same objections were urged against the paddle-boat when it was first brought out, and more recently when the principle of the screw was invented. It was said in the one case, what was the use of having a mill-wheel to drive a boat? His intention was to avail himself of all the experience he could get. With regard to the pitching and rolling motion, he had endeavoured to counteract that upon this general principle. The vessel was flat bottomed, and buoyant from end to end. In an ordinary vessel the ship was buoyant only in the centre. He did not see how any very large amount of rolling or pitching could take place. He had spent a great deal of time in perfecting his model, and his only hope was that all the vessels might be upon the waters together, and then the best of the three would become the type ship of the future.

The Chairman called upon Colonel Strange to reply.

Col. Strange said his paper had been dealt with so tenderly and objected to so very little, that he really had nothing to reply to, nothing to defend, and nothing to explain. It was evident from all that had been heard on the subject that size was one of the indispensable requisites in these Channel ships. All these ships were large ships compared to those at present in use—though they were not really large ships. In one dimension they are all small ships. They all wanted depth, and he rather suspected that the absence of depth and the small draught of water was a disadvantageous feature, in regard to the chief object for which they were designed—the prevention of sea-sickness—because, as Mr. Paget, who spoke so cleverly and so clearly pointed out, a yacht, which has a considerable draught of water, was subject to far less motion of translation than a flatter bottomed vessel. It was inevitable that they should have that feature. They all had it in common. Then came the question of whether that motion of translation was increased by this small draught of water. On that subject they were still completely in the dark. That it was that motion which caused the sea-sickness was a mere matter of opinion, and, as he thought, not warranted by any theory or substantiated by any fact. Many who had expressed that opinion had possibly been misled by the complication of motions that took place, for the effect of the motion of translation on the human frame was simply to raise the body up and down vertically. But the same effect was produced by pitching. In these vessels, owing to their great length, and the character of the sea in which they will be, the motion of translation will be left as the residuum, and it will be very soon seen whether that is the motion which is so destructive to our comfort or not. The respect in which these inventions agreed was that they make almost any sacrifice, and exert any ingenuity, to prevent rolling. Only one of them pretended—he would say pretended for the present—to annihilate rolling, and that was Mr. Bessemer's. They all would diminish it, but only Mr. Bessemer's pretended to annihilate it. Sea-sickness might be caused by a complication of motions. Mr. Bessemer thought that if he could destroy one of the motions it would then be reduced to a simple one, exemplifying his view by alluding to the geometrical illustration. If you have absolutely only one motion, you then have a simple one. You have none of that twisting and twirling. His theory is that the up and down motion alone will not produce so great an effect upon the human frame as all the motions together, and he had this justification. A swing is a simple motion, and every one knew the effect of that. Another element in steadiness, besides size, was speed. How far this would have the effect could not be ascertained, for since Captain Hoseason had related the anecdote of a lady having been cured of her sea-sickness by an increase in the speed of the ship, another naval officer had expressed an opinion exactly the contrary. But it seemed to him that speed would most probably diminish motion. With respect to speed these gentlemen had been content to incur certain sacrifices to produce it, but he did not believe, if Captain Dicey or Mr. Mackie were called upon to design a ship to start in a race across the Atlantic, they would either of them design her according to these models. Captain Dicey candidly said he did not expect a maximum speed, but Mr. Mackie, on the contrary, insists that his ship will have great speed, but she would not have as great speed as if propelled in the usual way. He did not think it was a design calculated for speed, but it was calculated for steadiness. On the subject of harbours he would observe that there was at the present moment before Parliament a Bill, promoted by the Dover Harbour Board in conjunction with the South Eastern, and Chatham and Dover Railway companies, for the purpose of producing a harbour at Dover 600 yards long by about 300 wide, and it was a very great question whether that harbour would accommodate the traffic that these undertakings were likely to bring to it. He would, therefore, strongly advise all interested in the matter to watch the Bill closely, and endeavour to secure a larger amount of accommodation at Dover, for the railway companies were not likely to allow anybody to enter the harbour with boats of this class.

Mr. J. Grantham, C.E., sends the following:—Captain Dicey last night complained that I brought forward some plans of my own contrary to the regulations laid down by the chairman. This was hardly correct. I merely read a short extract from Captain Tyler's report to the Board of Trade on plans proposed by me some six years since. I did this, as I stated, to show that I had given much attention to the subject, and went on to complain that in a paper which, as I thought, professed to be a review of the whole question of steamers for the Channel, all the plans brought forward contained great and, in some respects, untried novelties. I thought that it should first be shown that proper vessels built on acknowledged principles could not be applied to that service. I hope elsewhere to show that this can be done. I believed that in such meetings fair and open criticism is invited, and Captain Dicey should not complain if plans thus brought forward publicly are sometimes "picked to pieces."

Models of ships proposed for the Channel passage were shown by Captain Peacock and by Mr. Coryton, as well as a number of models lent by the Royal United Service Institution illustrative of a great variety of forms of native boats used in the Indian Seas and in the Pacific Ocean. Captain Peacock's plan was on the model of a Peruvian "balsa," and had a double bottom or raft of iron tubes under the hull, which was supported above the raft on hollow vertical cylinders.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

The third meeting of the Committee on Scientific Inventions and New Discoveries was held on February 20th, at Gore-lodge, S.W. The following members were present:—Mr. C. B. Vignoles, F.R.S., in the chair; Mr. F. A. Abel, F.R.S.; Captain Hans Busk; Captain H. Colomb, R.N.; Major W. Crossman, R.E.; Dr. D. S. Price; Professor H. E. Roscoe; Mr. C. W. Siemens, F.R.S., D.C.L.; Mr. T. Sopwith, F.R.S.; Lieut.-Col. A. Strange, F.R.S.; and Sir Charles Wheatstone, F.R.S. The committee considered the numerous applications they had already received, and adjourned till Wednesday, the 19th March, when they would meet to inspect the scientific inventions and new discoveries, which are to be delivered on Wednesday, the 12th March.

H.R.H. the Prince of Wales presided, on February 22nd, at Marlborough-house, over a meeting of Her Majesty's Commissioners for the Exhibition of 1851. There were present:—H.R.H. the Duke of Edinburgh, H.R.H. the Prince Christian, H.R.H. the Duke of Cambridge, H.S.H. the Duke of Teck, the Marquis of Ripon, the Marquis of Lansdown, Earl Granville, Sir Thomas Bazley, Sir William Anderson, Sir T. M. Biddulph, Sir Francis Grant, Sir Francis Sandford, Mr. Edgar Bowring, Mr. Cole, Mr. Gibson, Mr. Hawksley, Dr. Playfair, Mr. Thring, and Major-General Scott, secretary.

The second meeting of the Committee for the Exhibition of "Wines, Spirits, Beer, and other Drinks, and Tobacco," was held on the 18th instant. There were present, Lord Skelmersdale, in the chair, Col. C. Baring, Mr. H. Matthiessen, Mr. C. Lombard de Luc, Mr. M. Yeatman, Mr. C. H. Frayser, Mr. H. Browning, Mr. J. Chambers, and Mr. T. J. Barstow, Lieut. H. H. Cole, R.E., also attended, and Mr. E. J. Craigie, deputy-commissioner, who acted as secretary.

The second meeting of the Committee on Steel was held on February 24th, in the Royal Commission Offices, Gore-lodge, S.W. There were present, Col. T. Inglis, in the chair, Mr. F. A. Abel, F.R.S., Mr. C. Asprey, Col. A. Lane-Fox, F.S.A., Mr. J. Latham, Mr. J. Gordon Smith, Captain A. C. Tupper, F.S.A., Mr. T. E. Vickers, and Mr. A. Vickers. The committee considered the applications which had already been received, and adjourned til Monday, the 17th proximo, the day for the reception of steel goods being Monday, the 10th March, 1873.

Mr. T. Oldham Barlow, the executor of John Phillip, R.A., is compiling a catalogue of his works, and wishes to make it complete, as it will assist in verifying the pictures. Many spurious paintings have been sold of late as his work. Mr. Barlow will be greatly obliged to owners of pictures by this artist if they will afford him any assistance, he having lost trace of some few of Mr. Phillip's works. He has already a list of upwards of 250 pictures by John Phillip. Mr. Barlow's address is St. Alban's-road, Kensington. This information will also greatly assist the exhibition of the works to take place this year at the annual International Exhibition.

Her Majesty's Commissioners have appointed Easter Monday as the day for opening the Exhibition to the public.

The following lately appeared in the daily papers:—"Sir,—I trust you will allow me to reply briefly through your columns to the numerous inquiries which I am receiving on the subject of the Army and Navy Amateur Fine Arts Exhibition. The works of intending exhibitors must be delivered at the Exhibition, free of charge, on the 24th March. The rules for the exhibitors, as well as the special labels to be attached to the works, may be obtained on application to the secretary, Annual International Exhibitions, Upper Kensington-gore, London. I should also mention that her Majesty's Commissioners have kindly undertaken to frame temporarily all works sent from abroad which may be accepted for exhibition.—I have the honour to be, Sir, your obedient servant, J. F. D. Donnelly, Major, R.E., and Hon. Sec. of Committee."

MINERS' SAFETY LAMP.

A new safety-lamp has been invented by Mr. William Yates, for which he has taken a patent. He has modified the old lamp in the following way:—He has removed the wire gauze from that part of it which surrounded the flame, and replaced it by a strong lens or bull's-eye glass on one side, and a silver reflector on the other. The result of this arrangement is, that his lamp gives a light which he estimates at twenty times that of the old "Davy," and sufficient for all necessary purposes. By this means the temptation to expose the flame to obtain more light is removed. He further provides a check against the practice of heating the lamp by means of the flame, for it is placed so low that it cannot be made to approach the gauze either by the breath or by tilting the apparatus. The lower portion of the apparatus, containing the oil reservoir and the wick, which is screwed to the part which consists of the gauze funnel, the bull's-eye, and the reflector, has a spring-bolt attached to it, which, by means of a serrated arrangement, permits the screw to be turned, locking the two parts of the lamp together. The bolt is easily withdrawn by another screw, but this cannot be done without at the same withdrawing the wick and extinguishing the flame, and it thus becomes impossible to get a light by opening the lamp. The inventor claims thus to remedy the chief defects. The apparatus is strong, little likely to get out of order, and altogether well adapted for the rough usuage to which a miner's lamp is likely to be exposed. It is more expensive than the forms of the lamp now in general use, but Mr. Yates states that the saving of oil effected by its use will in one year pay the additional cost.

CORRESPONDENCE.

GALVANIC BATTERIES.

Sir,—In my paper on "Galvanic Batteries," read last December, I find that, writing from memory, I inadvertently mentioned the name of M. Soret instead of M. Raoult.

M. Soret has published some very valuable experiments on the relations of electricity, heat, and mechanical force; but the particular experiments I was speaking of were not his, but those of M. Raoult.

To prevent mistakes, I think it right to correct the error into which I inadvertently fell.—Yours, &c.,

H. Highton.

Putney, Feb. 26, 1873.

GENERAL NOTES.

The Petroleum Trade.—It is proposed to form a company to lay a pipe from Petrolia to London, in the province of Ontario, Canada, for the conveyance of oil, in consequence of the difficulty experienced in obtaining prompt deliveries by railway. As the two places are on a level, pumps will have to be erected at intervals of about 10 miles to force the oil into the next pumping place. The distance to be overcome is about 60 miles, and the cost is estimated at 100,000 dollars.

Purifying Water in Condensers.—The steam condensed from engines always contains fat, resulting from the material used for lubricating. According to a French invention the water of condensation is collected in a common reservoir, and pumped into a receptacle provided with a powerful stirring apparatus, consisting of shovels, Archimedean screw, &c. This receptacle is three-fourths full, the remaining space being filled with petroleum; the apparatus is set in motion for five minutes, the water being allowed to settle for fifty-five minutes. Five minutes' time is sufficient to separate all the fat which is then contained in the oil, and the purified water can directly be used again. A hundred pounds of petroleum will absorb fifty pounds of fat; it has then a specific gravity of 0·840, but should be renewed when presenting a density of 0·810. It is subsequently regained by distillation.

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

REPORTS ON THE LONDON INTERNATIONAL EXHIBITION OF 1872.

The reports which appeared in the last volume of the *Journal* on the various sections of the above Exhibition, are now published complete, in a pamphlet form (price 2s.), and can be obtained at the office of the Society.

THE LIBRARY.

The following works have been presented to the Library:—

A Pamphlet on Yates' Patent Safety Lamp. Presented by the author.

Statistics of New Zealand for 1871, and the Agricultural Statistics of the Colony in February, 1872. Presented by the Government.

The Principles of Hydrostatics. By Thomas Webster, F.R.S. Presented by the author.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. The following meetings have been arranged:—

March 5.—"On Gas-lighting by Electricity, and Means for Lighting and Extinguishing Street and other Lamps." By W. Lloyd Wise, Esq., A.I.C.E., M.I.M. On this evening Capt. P. H. Colomb, R.N., will preside.

March 12.—"On Signalling at Sea, with special reference to Signals of Distress." By Capt. Colomb, R.N On this evening Thomas Brassey, Esq., M.P., will preside.

March 19.—"On Certain Improvements in the Manufacture of Printing Types." By J. R. Johnson, Esq.

March 26.—"On the Edible Starches of Commerce, their Production and Consumption." By P. L. Simmonds, Esq.

April 2.—"On Economy of Fuel for Domestic Purposes." By Capt. Douglas Galton, C.B., F.R.S.

April 9.—*No Meeting.*

April 16.—"On the Condensed Milk Manufacture." By L. P. Merriam, Esq.

INDIA COMMITTEE.

A Conference will be held this evening (Friday), 28th instant, at 8 p.m., when a paper will be read by T. Roger Smith, Esq., architect, on "Architectural Art in India." James Fergusson, Esq., D.C.L., F.R.S., will preside.

At the Conference which will be held on Friday, March 14th, Robert B. Shaw, Esq., will read a paper on "The Commercial Relations of England with Central Asia." Sir Henry Creswicke Rawlinson, F.R.S., F.R.G.S., will preside.

At the Conference which will be held on Friday, March 28th, W. T. Blanford, Esq., of the Indian Geological Survey, will read his paper on "The Mineral Resources of India." Sir Louis Mallet, C.B., Member of the Council of India, will preside.

CANTOR LECTURES.

The Second Course of these lectures is "On the Energies of the Imponderables, with especial reference to the Measurement and Utilisation of them," by the Rev. Arthur Rigg, M.A. The remaining lectures will be delivered on the following evenings, at eight o'clock:—

Lecture V.—Monday, March 3rd, 1873.

On the Energy of Electricity, with especial reference to the Measurement and Utilisation of it.

Lecture VI.—Monday, March 10th, 1873.

On the Energy of Light, with especial reference to the Measurement and Utilisation of it.

Lecture VII.—Monday, March 17th, 1873.

On the Energy of Heat, with especial reference to the Measurement and Utilisation of it.

The Third Course of Cantor Lectures for the present session will be "On Wines; their Production, Treatment, and Use," by J. L. W. Thudichum, Esq., M.D. The Course will consist of six lectures, the first of which will be given on Monday evening, the 21st of April, the remaining five on the Monday evenings succeeding.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...**SOCIETY OF ARTS, 8.** Cantor Lecture. Rev. A. Rigg, "On the Energies of the Imponderables."
Farmers' Club, 5½. Mr. H. M. Jenkins, "Some Comparative Results of Large and Small Farm Systems in Providing Food for the People." (Adjourned discussion.)
Society of Engineers, 7½. Mr. W. H. Fox, "Continuous Railway Brakes" (Atmospheric and Electric).
Law Amendment Society, 8. Mr. W. F. S. Daniel, "On the Second Report of the Judicature Commission."
Royal United Service Institution, 8½. 1. Mr. Nathaniel Barnaby, "Lesson from the Hotspur-Glatton Experiment." 2. Captain F. H. Poore, "Target for Eye-Training on board Ship."
London Institution, 4. Professor Duncan, "Physical Geography."
Royal Institution, 2. General Monthly Meeting.
Entomological, 7.
British Architects, 8.
Medical, 8.
Victoria Institute, 8. Rev. G. W. Weldon, "The Law of Creation—Unity of Plan, Variety of Form."

Tues. ...Royal Institution, 3. Prof. Rutherford, "Forces and Motions of the Body."
Civil Engineers, 8. Continued Discussion on "The Standard Gauge and of the Metre Gauge for the State Railways of India."
Pathological, 8.
Anthropological, 8.
Biblical Archæology, 8½. Rev. A. H. Sayce, "On the Synchronous History of Assyria and Babylonia, translated Cuneiform Inscriptions."
Zoological, 8½.
Royal Colonial Institute, 8. 1. Discussion on Mr. J. G. Bourinot's paper on "The Marine and Fisheries of Canada." 2. Mr. W. Walker, "On the Position and Prospects of the British West Indies."

Wed. ...**SOCIETY OF ARTS, 8.** Mr. W. Lloyd Wise, "On Gas-lighting by Electricity, and Means for Lighting and Extinguishing Street and other Lamps."
Microscopical, 8. Mr. E. J. Gayer, "Notes on the Micro-spectroscope and Microscope."
Pharmaceutical, 8.
Obstetrical, 8.
London Institution, 7. Lecture on "Music,"

Thurs...Royal, 8½.
Antiquaries, 8½.
Linnæan, 8. Mr. G. Bentham, "On the Perigynium of *Carex.*"
Chemical, 8. 1. Dr. C. R. A. Wright, "On the Action of Hydrochloric Acid on Codein." 2. Mr. P. Hannay, "New Processes for Mercury Estimation, with some Observations on Mercury Salts." 3. Dr. T. E. Thorpe, "On a Method of Estimating Nitric Acid." 4. Mr. F. Field, "Note on the Action of Acetates upon Solutions of Plumbic Salt), with Remarks upon the Solubility of Plumbic Chloride."
Royal Society Club, 6.
Royal Institution, 3. Mr. A. Vernon Harcourt, "On the Chemistry of Coal and its Products."
Royal United Service Institution, 8. Captain C. Jones, "The Construction and Manufacture of Rifled Guns."

Fri ......Geologists' Association, 8. 1. Mr. James Howell, "On the Geology of Brighton." 2. Mr. John William Wetherell, "On some Fossils from the Margate Chalk."
Philological, 8¼.
Archæological Institute, 4.
Royal Institution, 9. Mr. James Dewar, "On the Temperature of the Sun and the Work of Sunlight."
Architectural Association, 7½. Mr. E. C. Robins, "Middle-class Schools for Girls."

Sat ......Royal Botanic, 3¾.
Royal Institution, 3. Professor W. K. Clifford, "On the Philosophy of the Pure Sciences."

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FRIDAY, MARCH 7, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

TECHNOLOGICAL EXAMINATIONS.

The Programme of Examinations in the Technology of some of the Arts and Manufactures of the country is now ready for issue, and may be had on application to the Secretary.

The subjects selected for 1873 are Cotton, Paper, Silk, Steel, and Carriage-building. Candidates, in order to obtain certificates in any of these subjects, must pass the examinations of the Science and Art Department in certain sciences, which are specified in the programme; and in addition to these, special papers will be set in the technology of each manufacture by examiners appointed by the Society of Arts, and certificates of three grades will be awarded:—"Honours," "Advanced," and "Elementary."

The examinations of the Science and Art Department will be held during the first three weeks of May, the technological paper being worked on the evening of the 17th May. For the dates of the Science subjects candidates are referred to the Science Directory, published by the Science and Art Department.

The following Prizes are offered by the Society of Arts in each of the five subjects mentioned above:—

To the best candidate in Honours, £10.

To the best candidate in the Advanced Grade, £7.

To the best candidate in the Elementary Grade, £5.

In order that these Examinations may really be successful in promoting technical education in this country, it is desirable that encouragement should be given to candidates by the offer of additional prizes and scholarships. With this object the Council appeal to the Companies of the City of London, to merchants and manufacturers, and to members of the Society generally, to aid them by contributing to the Prize Fund.

The following special additional Prizes are offered:—

By Wyndham S. Portal, Esq., to the Second and Third best Candidates in the Elementary Grade, Paper Manufacture:—

A Prize of	£3
A Prize of	£2

By G. N. Hooper, Esq., to the Second and Third best Candidates in the Elementary Grade, Carriage Building:—

A Prize of	£3
A Prize of	£2

By the Worshipful Company of Spectacle Makers, to the Second-best Candidate in Honours, in the Advanced Grade and in the Elementary Grade, Manufacture of Steel:—

A Prize of	£5	5
A Prize of	£3	3
A Prize of	£2	2

A letter has been received from Colonel Akroyd, M.P., promising to contribute £5 in prizes whenever Examinations are held in the Technology of the Worsted Manufacture.

The Council beg to announce the following contributions to the Prize Fund:—

The Worshipful Company of Vintners	£10	10	0
Dr. Crace Calvert, F.R.S. (annual)	5	5	0
Sir Daniel Cooper, Bart.	5	0	0
R. L. Chance, Esq.	5	5	0

The Council invite the aid of masters and managers in promoting these examinations by encouraging their workmen to take advantage of them. An explanatory handbill, suitable for being suspended in factories and workshops, may be had on application to the Secretary of the Society of Arts, Adelphi, London, W.C.

PRIZE FOR STEEL.

1. The Council have resolved to award the Gold Medal of the Society to the manufacturer who shall produce and send to the London International Exhibition of 1873 the best collection of specimens of steel suitable for general engineering purposes.

2. The specimens exhibited must include a complete illustration of the applications of the varieties of steel submitted.

3. Each manufacturer should send with his specimens a statement of the nature of the tests he has applied to each kind of steel submitted, and give the results of such tests.

4. The samples tested are to be exhibited together with duplicate samples, or portions of the same samples; these will be submitted to tests should the Council consider it desirable.

5. All persons using steel for general engineering purposes, who are not manufacturers of such steel, are also invited to exhibit specimens on the above terms and conditions.

6. The Council reserve to themselves the right of withholding the premium, in the event of the specimens exhibited not being sufficiently meritorious.

COMMITTEE ON THE MEANS OF PROTECTING THE METROPOLIS AGAINST CONFLAGRATION.

The Committee met February 27th. Present—U. J. Kay-Shuttleworth, Esq., M.P., in the chair; Colonel the Earl of Mountcharles; Lord Alfred S. Churchill; Major-General F. Eardley-Wilmot, R.A., F.R.S.; Colonel F. Marcus Beresford, M.P.; Mr. Edwin Chadwick, C.B.; Mr. Seymour Teulon; and Mr. T. R. Tufnell. Mr. William Swanton, of the Metropolitan Salvage Corps, attended and gave information. Mr. Quick also attended and gave further evidence, which will appear in a future *Journal.*

PROCEEDINGS OF THE SOCIETY.

INDIA COMMITTEE

A Conference was held on Friday evening, 28th ult., at 8 p.m., JAMES FERGUSSON, Esq., D.C.L., F.R.S., in the chair. The paper read was—

ARCHITECTURAL ART IN INDIA.

By T. Roger Smith, F.R.I.B.A.

The subject of this evening's conference, and which I am to have the honour of introducing to your notice is, as has been announced, Architectural Art in India. The term Architectural Art has been adopted as embracing architecture viewed as a fine art; and with it painting and sculpture, when in the service of architecture—that is to say when employed in the decoration of buildings. Although the limiting epithet Modern was not added, yet it must be understood that the architectural art which has marked—or is to mark—the period of the British occupation of the Indian peninsula is the main subject of our investigation. Some reference to the ancient architecture of the country must necessarily be made, but it will be with the full recognition that I have little or no information on a subject which Mr. Fergusson has made his own, except that which has come to me through his publications, and with the equally full conviction that when your desire to have the ancient architecture of India described in this room, it will probably not be to myself that you will entrust the task.

Let us commence our inquiry by supposing for a moment that an accurate and critical European observer, with an eye trained by some study and some practice as an artist (especially if the art he had studied has been Architecture), were for the first time to come in contact with the architectural art of India, having not previously known it (such a case is possible); and that before him were placed a large collection of photographs, plans, and views, representing a selection of the prominent buildings from all parts of the country, from remote times down to the present year; and let us further suppose this critical observer to devote sufficient time to the study of the collection for him to be enabled to master the principal features of general design and of detail in all the buildings represented; we should find him, after his first burst of delight and astonishment—for such a man would be both delighted and astonished—forming some kind of classification of these works of art. It is not impossible that the criterion he would adopt might be the degree in which their aspect would be familiar to him; at any rate, such a criterion would be a very convenient one for our present purpose. On this basis three great groups would be formed—the buildings that were entirely new and strange, those with whose features the critic had a partial acquaintance—and those with which he had, I might almost say, a painful familiarity. These three groups may be very broadly classed as Hindu, Mahommedan, and European, and, as the names given to them show at a glance, they represent buildings erected under three different political conditions of the country.

The group of altogether unfamiliar buildings, to which we have given for convenience the title Hindu, would be a very large one; and would appear to any European observer full of novelty and full of variety. The truth is that several great groups and many smaller ones would readily appear were we to begin to classify these buildings on any other principle than that of their total unlikeness to anything with which Western experience is familiar.

Structures enough for example, bearing the aspect of petrified timber construction, would be found to form a group by themselves; and so on with other features, the groups being found to coincide with great divisions of race, territory, or creed, and the buildings which form them being of Jaina or Buddhist, or other origin, as the case may be. Almost universally, however, the absence of the arch, the prominent introduction of the bracket to some extent as a substitute for it, and the profuse employment of surface decoration, might be recognised as salient features.

These are the proper buildings of the country. Many different races have worked upon them, and, closely examined, they will yield plenty of traces of migrations, conquests, changes of style, and other marks of difference; but still, the group is marked by certain broad characteristics of an unmistakable character, and for our present purpose the architecture indigenous to the soil may be considered as one great style, which may conveniently be termed Hindu.

The second division of the photographs and views we have supposed our critic to examine, would probably delight him to a higher degree. He may have been filled with admiration at the hardy courage which has raised some of the domical structures of the first family, and he cannot have failed to wonder at the vastness of some of the works undertaken and carried out; but he will, as a European, have felt little sympathy with the designs; and the admiration which some of the details of decoration will have received will have been extorted almost in spite of himself. In the second group, features which recall Constantinople, Cairo, or Granada, features derived from the parent stem whence sprang the Gothic of Italy, France, and England, will meet his eye. The pointed arch, although not that of Western Europe, yet resembles it; the domes and traceried grilles of Arab architecture are combined with decorations entirely Indian, producing an aspect at once familiar and strange, and one which will charm the eye. Here we are on the traces of a conqueror.

This group consists of the buildings found in those provinces where Mahommedan invaders obtained and kept supremacy for a length of time, and where, bringing their art with them, they exercised it with a wise adaptation of their subsidiary forms to the requirements of the climate, and a clever adoption of much of the amazing skill for surface decoration which they found ready to their hands.

The Mahommedan buildings at Ahmedabad are the best known of the group, and probably the best worth knowing. They have been excellently illustrated by photography, and they include examples of grace and beauty which are hardly to be surpassed in the architecture of the West.

The remaining views of buildings, though of very familiar aspect, to say the least of it, will excite less admiration in the cultivated and impartial observer whom we have supposed, than the mosques and tombs of the believers in the prophet. They are motley, they are modern, they—many of them—make no pretention to architectural character, and when they do make such pretentions they more often than not fall short of the apparent aim of their designers. Need I say more to show that I am referring to the buildings dating from the European occupation of India?

There were many reasons why these buildings were unlikely to have much merit. For long there was little leisure and as little inclination to indulge in architecture at all. In the pressure of conquest and the hurry of newly-established trading, such forts and barracks as could shelter and secure the soldiery, and such rough buildings as would suffice to hold the goods, were all that was attempted. As time went on the Portuguese, the Dutch, and the English set such fashion as there was in the buildings of the country. Worse models than these nations were building at home could not be easily conceived—yet the European buildings in India were worse; and perhaps no words can better express the bathos to which architecture—if we may call it so—sank in India in the early times of the British occupation, than to say that it fell short even of our own eighteenth century work at home.

One circumstance especially militated against improvement, and prevented the fashions set by the Portuguese (who seem rather to have taken such lead as was taken) from being improved upon, a circumstance which still stands in the way of European improvement. No Englishman is a settler in India. We do not transport ourselves, our houses, and our modes of life to that country. We only go there for a term of years, and consequently, looking upon the whole thing as temporary, we put up with that which in a real colony would soon be superseded.

Better days, however, had to come; and the importance of the Viceroy and his court, and of the provincial governers, required that some permanent provision for state, for the administration of justice, and for public worship and public business, should be made. Accordingly, in the capital, and by degrees in other great stations, buildings began to rise for civil purposes, while those for military purposes were constantly being extended and improved. Before we consider what was done, or what might have been done, it may be worth while to give a moment's attention to the principles that ought to guide such work, and to throw a glance on the effects of conquest upon architecture, not only in the history of India, but in some other instances where the great building races have been concerned.

It may, I think, be fairly advanced, that in no country, where there were buildings of which we have remains, has there been a great political and social crisis such as an invasion, without a perceptible record being left on the architecture of the period immediately subsequent to the event. In Great Britain, for example, we have a sudden leap taken by the architectural works of the whole island at the time of the Norman Conquest, and the close similiarity of our eleventh-century churches to those of the North of France, would lead an observant man to guess that such an event as the Norman Conquest had taken place, even though he had never heard of it. The series of Edwardian castles in Wales is another familiar example of the same thing; but perhaps the most remarkable illustrations of what I mean are found in the traces of Roman invasion which are exhibited in Rome herself, and in every corner of Europe.

It is not always the conquering nation which imposes its architecture on the conquered. The arts of Greece were so infinitely superior to those of Rome, that when Greece was subdued, Roman art received its first great impulse, and took its first great lesson. Not so, however, in the case of nations inferior in civilisation to the Roman. Among them we can trace the footprints of the conquerors to the present hour. Just as the aspect of old moraines and ice-worn rocks enable us with certainty to point out spots in the valleys of Wales where glaciers once covered the now moss-grown rocks; so the straight roads and the intrenched camps of the Roman still remain deeply cut upon the face of the country, to bear witness to his military occupation of Germany, France, Britain; and his amphitheatre and forum, his temple and his aqueduct, indicate to this hour the spots where a more permanent colony tried to provide itself with the appliances inseparable from the Roman idea of civilised life. It needs nothing more than a visit to the existing ruins to display to us what was the nature of the Latin colony in such places as Nismes, Arles, or Orange in France; or Wroxeter, Dorchester, or Silchester in our own country.

Now more than one phase of the history of India has a permanent record in the aspect of her buildings and her monuments. The Mahommedan invaders made their mark, as has already been observed. We are ourselves busily engaged at the present hour in writing such a record on the length and breadth of the country; and were the British occupation of India to terminate to-morrow, the visible tokens of it would survive in our canals, and our railways, our ports, and our public buildings, or, at least, the remains of them for centuries to come. It may then prove worth our while to compare what has been done by other building races in analogous circumstances with what we are ourselves doing or about to do in India.

The custom of the Romans, in occupying comparatively barbarous countries, was to transport their architecture with very small variation, if any, to the new spot. The Mahommedan conquerors of

India did not pursue precisely the same course, the principal reason being that they settled among people of a high, and, to some extent, a kindred civilisation. To a highly artistic race the due design and suitable enrichment of such buildings as are devoted to public worship and public state, and very often to public burial, becomes a matter of great importance; and the elegance and adornment of their dwellings is attended to as a matter of course. In the Mahommedan races artistic instincts were very strong; and what I have called the architectural arts were, without doubt, forced into great activity among them by the circumstance that plastic and pictorial art were, to so large an extent, forbidden pleasures. Full as they were of artistic sympathies and powers, hindered by the prohibition of the Koran from indulging in the enjoyment of arts of which the representation of the human form is the highest development, architecture and that style of decoration which we do not call arabesque, but which has a better right to the title than the Italian work which is usually so designated, were to them the sole outlet for their imaginative and creative power. This, perhaps, is one reason why, from Spain to India, Saracenic architecture presents so much that is charming and powerful. When these people came to occupy large portions of India, however, they found existing an architecture, and a power of decorative carving, which were very far from contemptible, and they proceeded to incorporate many features of this national art with their own; and the very remarkable and beautiful buildings which resulted may be taken as an example of that which, under the circumstances of invasion and permanent occupation, not without proselytism, a highly developed artistic instinct was led to do.

The style of these works is essentially and unmistakably Saracenic; there is no room for doubt about this. Their detail varies, however, considerably from that displayed in Saracenic works in other countries, in Austria or in Spain, for example.

Now here we seem to have a guiding principle expressed very clearly. The leading features of the style of the conquering race have been retained; but at the same time its details have been largely modified to suit the materials, the designers and the workmen obtainable, and the circumstances of the climate or country.

It is hard to say what an English architect of the time when we first began to build in India would have had to fall back upon as the national English style; and difficult to see, therefore, what art, meriting the name, ought to have been transplanted to India had we from the first desired to establish there buildings of architectural pretension. In fact, we acted very much as the Romans acted; we built in India very much as we were building at home. And at the time when this work was begun we were building here, and consequently built there, in an entirely inartistic fashion; now, however, that attention has been pretty generally awakened here to the claims of architecture as a fine art, the question has presented itself for solution again—what sort of architecture ought we to employ in India?

In reply to this question I believe that the examples I have quoted will sufficiently indicate the natural course. We ought, like the Romans and the Mahommedans, to take our national style with us, but being strangers, as the Romans were, rather than semi-colonists like the Mahommedans, we shall be likely to succeed best if we are not too anxious to incorporate much of the art or style of the country with our own.

We are, however, met, if we strive to apply this principle to practice, by the difficulty of defining what our present national style really is; nay, at the present day it becomes dangerous to assert that we possess such a thing, and I, for one, am not going to venture far, at least within these walls, into a vexed controversy on this point. On a broad and general view of the aspect of Europe we may at least admit that there is a recognised modern European architecture about which we may be tolerably certain; and while it is difficult, and perhaps unnecessary, to lay down the rule that our work in India ought to be English, there could not, I should have thought, be much hesitation in admitting that it ought to be at least European, and in defining sufficiently for practical purposes what European architecture means. A different opinion has, however, been held, and the propriety of buildings for European use in India being even European in character is so far from commanding general assent, that I find in a report of a lecture on architecture, delivered by Lord Napier, the conclusion arrived at that the Government of India would do well to consider whether the Mussulman forms might not be adopted generally as the official style of architecture. This is a fundamental point of the utmost importance to the discussion of the whole question, and it is worth while to endeavour to arrive at a sound conclusion upon it, limiting our inquiry strictly to buildings which are intended for European purposes.

In occupying India we have not become colonists: we have remained conquerors. We have not sought to divest ourselves of our national habits, or manners, dress, or laws, even when convenience would have been consulted by so doing. The broadcloth of the civilian, and the gold lace and epaulettes of the soldier, are eminently unsuited to tropical climates, where the natives, when they dress at all, wear cotton or cambric. But it is because they are intimately associated with Englishmen, as such, that custom has decreed the retention of these things. We administer justice, not tyranny, in India; and yet, probably, a high-handed rule like that of an Oriental monarch would suit the difficulties of our case and the temper of the native mind better than our fair but foreign methods of dealing with government and law. Even our language is imposed by us on the courts of law; and European fashions, notions, and principles are stubbornly kept up in many cases, in which, if convenience alone were consulted, an entire change would be made. Now, why should our architecture be an exception to this rule? We go to India, Europeans with pale faces, a strange tongue, and unfamiliar customs; and our position as the foreign governing race, and as a race which does not settle in the country, and intermarry with the natives, but which has its home far away over the seas and retains all its personal relations with that home, makes such a course of conduct reasonable—in fact, inevitable. Let us, then, for consistency's sake, be European in our art; for art, if it be true, is an expression of national individuality more intense and more truthful than custom, fashion, or government. In the stubbornness with which we retain our nationality we resemble the Romans. They unquestionably not only cut their roads and pitched their camps in Roman fashion, but put up Roman buildings wherever they had occasion to build; and the remaining fragments of those buildings testify that the Roman governor of a province in Gaul or Britain continued to be as intensely Roman in his exile as the English collector remains British to the backbone in the heart of India.

The reasons advanced in favour of the adoption of the Mahommedan style, or of one of the phases of Hindu architecture, are, I think, these:—first, it is said that it is suited to the climate; secondly, that the natives can do it; and, lastly, that it is, or can be, very beautiful. The principal and a sufficient answer, of course, is, that it may be all these, but that it is not European, far less British. In addition to this, however, a good answer can be brought to each of the lines of argument which I have briefly summarised.

Of the three reasons alluded to, by far the most powerful is the one placed first, namely, that Indian architecture, whether Mahommedan or Hindu, is the offspring of the climate, and, as such, better fitted than anything we can import to the circumstances of the country. Very true, but so is Indian food, Indian dress, Indian living, Indian administration. They are all the offspring of the climate, yet we cling, and very naturally cling, to the food, the dress, the manners, and the principles of governing to which we are accustomed; although, while we retain them in principle, we are not unwilling to make such variations in detail as will tend to diminish some of the inconvenience experienced in consequence of the peculiarity of the climate, country, and *entourage*. Now, if it had turned out that no architecture to which we are accustomed in England, or, at least, no architecture which we should see in England without any sense of its being strange, could be employed in a tropical climate, the case would be a very difficult one to deal with; but if it can be not only argued but shown by experience that buildings which would not look out of place in England can be erected in India, and will be found perfectly suitable for us, then we may, without hesitation, allow the preponderating weight of the arguments in favour of giving a European aspect to our art to outweigh whatever can be urged in favour of Oriental architecture for Europeans on the score of its being the art of the country; leaving the question of encouraging the art of the country, in those cases where the building is to be devoted to the use of the natives of the country, to stand on its own merits.

The second reason for employing the styles of the country, namely, that the natives can design and build in them, is answered by the fact that the natives will not be employed. The buildings which are built for European use, and with European funds in India, have been invariably built under European superintendence and from European designs, and always will be; and, though the artificers employed may be natives, yet that does not make the buildings native works, any more than the printing in Calcutta of an English book by Hindu compositors and pressmen makes it a Hindu book. The designs of these buildings may, however, it is said, be furnished in the native style by European architects who are skilled enough to work in exotic European styles. It may be so, and I desire to use guarded language, because I know the attempt has been made by architects of skill; but I beg very respectfully, but most decidedly, to express my doubt as to the possibility of such a feat being often accomplished satisfactorily. To master a style of architecture so as to work in it respectably has hitherto not been accomplished by the unaided exertions of one or two minds, but by the concurrent power of many. Perhaps I may be met with a reference to Pugin as a man who accomplished a revival by his own personal powers. But Pugin was only the most conspicuous of a large school; but for the literary labours of Sir Walter Scott, the antiquarian labours of Rickman, and the concurrence of many other minds working with him and around him, Pugin would not have accomplished half of what he did; and in Pugin we only see the foremost man of an enthusiastic band, stimulated by religious and artistic zeal, and going along with a rising tide of public feeling. And, after all, the Gothic revival was but a restoration to use among us of models and principles which, if disused, had never passed out of sight or lost their hold upon the affections of Englishmen. It is a far harder intellectual and artistic feat when a European is asked to take such information as the labours of Mr. Fergusson have placed at our disposal, and such photographs and casts as have come to this country, and to make the attempt to imbue his Western mind with Oriental feeling as well as learning, and is told to work out under those conditions a building for European occupation which shall not be European. Believe me, gentlemen, the best artist at his best can but take the highest place among his peers; he is, in his taste, his sympathies, and his style, the exponent of the feelings of his race, his time, his school. Raffaelle was only the most noble Roman of the Roman school. Titian was the most intensely Venetian of the painters of Venice. Velasquez and Murillo are unmistakably Spanish; and Albert Durer as unmistakably German. True art is a very national affair, tinged most strongly by the national peculiarities of the time, the place, and the people among whom the artist learns his art and gets his inspiration; and though you may obtain a cold, formal, lifeless design, with horseshoe arches, and surface carving, and may carry it out, you will not easily get buildings possessing real merit in this way. It is difficult to speak critically of such experiments as have been tried in India without having seen them, which I have not, but the accounts which I have received of the results of the attempt fully well bear out what I have advanced, so far as they go; and if Mr. Emerson's attractive design for the Mahommedan university at Allahabad be quoted as an exception, I am inclined rather to claim it as *the* exception which proves the rule, than to admit that it destroys my position.

Lastly, the beauty of the best ancient examples is urged in favour of our adoption of some native style of architecture for our buildings in India. This agument would have great weight if it were impossible to provide anything beautiful that would also be European, or if we were permitted to hope that an Oriental building, designed even by the best European willing to undertake it, and carried out either by the Public Works Department of

India, or by any other agency, could hope to obtain a shred of that beauty which the Mahommedan, Jaina, and Hindu works—the offspring of Oriental minds, carried out by Oriental hands, under Oriental superintendence, and with an Oriental lavishness of expenditure and amplitude of leisure, undoubtedly possess. Though our buildings in India can never be cheap, there will never be unlimited funds at command for them, still less unlimited time. They are wanted promptly, and for a definite or an approximately definite cost; and this circumstance is quite sufficient to exclude those Eastern styles which could only be obtained in perfection by putting the work into the hands of an Eastern architect, and giving him his whole lifetime to work in, and a bottomless purse to draw from.

If, then, I have at all carried you with me, you will, I hope, be prepared to concede that the right thing in designing and executing our buildings is that they should be English if possible; or, if not, at any rate European in their aspect and general design, with such modifications as the climate, the materials, the power and training of the workmen, and other local circumstances render necessary.

This being so, we must frankly admit that the style native to England—English Gothic—is not fitted to be transferred to India without large modification. All its forms are designed to be seen by a horizontal and a faint light. It is essentially fitted to a cold, damp climate; and while on the one hand its characteristics would require many alterations in order to cope with the glare of Indian sunshine, on the other hand its provisions for carrying off the gentle showers, or even the steady downpour of an English wet day, would prove quite inadequate to cope with the torrential rains of a tropical storm.

We have a second style, which has become naturalised in England, and which has obtained a hold little, if at all, less strong than that of English Gothic—I refer to the architecture which is now often broadly termed classic, but for which Italian *renaissance* is a more appropriate and correct definition. This is the style of Wren's churches and cathedrals, of Whitehall-chapel, of Somerset-house, of the Pall-mall club-houses. This, as you of course know, is the architecture of the ancient Romans, revived and adapted to modern uses by the Italians of the 16th century. The Italian models were again modified to a certain limited extent by those architects who have best followed them in this country, in order to suit our climate and conditions of life. Now, in many respects the adoption for India of renaissance architecture, as practised in England, would be less impracticable than the adoption of English Gothic. The style took its rise in a sunshiny country, and though all the changes we have made in it have been introduced with a view to fit it for use in a colder climate than that of the land of its birth, still those changes have not been many nor great. Somerset-house might be copied in Calcutta without the attempt being wildly and utterly unsuitable.

The circumstance that the heat and the light are so intense in India will always occasion many variations in the buildings, either Gothic or classic, which we put up. The windows will invariably become smaller and fewer, or, if they remain large and open, must be screened by external shelter. The walls will become so thick as to occasion the disuse of the buttress in all Gothic structures, the roof will be flattened, and the exclusive use of the horizontal cornice will be encouraged.

The moment these changes are proposed in a Gothic structure, the Gothic of Italy and the south of France—countries whose sub-tropical heat is not unknown—is recalled to the memory; and when they are made in a classic design, the Italian renaissance architecture, as practised in the sunny streets of the cities whence it started to over-run Europe, presents itself as the true model.

This then is the point at which we have arrived. We can find in the south of Europe models which are essentially fitted for use as guides in designing buildings for hot climates, and these models are unmistakably European. Are they so different from English examples as to be unsuited for the purpose? I answer, unquestionably no. The Gothic buildings of the South are, it is true, different from our own Gothic in many particulars, but that circumstance has not prevented them from becoming the models on which in the present day a very large proportion of buildings in the pointed or Gothic style of architecture are based. An Englishman will, at least, recognise in Italian Gothic, or the Gothic of Southern France, the prototype of what he had seen in course of erection at his university or in his city; so that the very phase of Gothic most in use here at the present day borders closely upon that which most appropriately lends itself to the requirements of India.

In the case of renaissance work there is even less difference between the aspect of the buildings of South Italy and that with which we are familiar under the general name of classic, than between the two families of Gothic to which we have referred. The open loggia, a feature as fitted for use in India as in Italy, though almost unknown in England, is so essentially consistent with those features which we have adopted, that its use involves nothing startling to the English eye; and the method by which Italian architects sought to give dignity to their buildings, at the same time that they suited them to the climate by reducing the window-openings to a minimum, has been copied in our own metropolis by Barry, whose Reform Club has openings, the proportionate size of which is far better suited to a tropical glare than to London smoke and fog.

One feature which English architects left behind when they transported Italian renaissance to this country ought not to be neglected in transferring it to British India. This feature is the beautiful internal quadrangle or cortile, which is the direct lineal descendant of the atrium of a Roman house, and corresponds closely with the courtyard of the dwellings and palaces of almost all Oriental cities. Of the beauty, the coolness, and the comfort to be found in a cortile, Italy offers endless examples, perfectly worked out, and Anglo-Indian buildings afford not infrequent opportunities of making use of them; yet the cortile is rare, if not unknown, in the arrangement of those buildings.

If now, having arrived at some idea of what we might reasonably do in designing important buildings for India, we turn for a moment to what was done, we find that the fashions of building at home have been usually reflected, only in a distorting mirror, in India. To borrow a sentence or two from a lecture delivered by

Sir Bartle Frere, in 1870, at the Architectural Museum,* "It is difficult to describe the general character of our early Anglo-Indian architecture; its only characteristic was extreme broadness—an utter absence of anything like distinctive features. This is only to be accounted for by the fact that we sent forth our representatives to receive and acquire the Indian empire at about the same time as we were building Red Lion-square, and the acres and miles of featureless streets, roads, and squares, and the nightmare churches, so unlike anything which is dreamt of as a church, whether in a town or a country village. Our ancestors in consequence left no good architecture behind them in India. An ordinary Indian station"—I am still quoting Sir Bartle Frere; I should not have myself ventured on so irreverent a simile—"an ordinary Indian station is as nearly as possible like a nightmare of umbrellas in bricks and mortar. Be the materials bricks, stone, or timber, they are put together so as to afford shade and shelter, and nothing else." Of Calcutta, the so-called City of Palaces, which includes some buildings of which other writers speak with considerable respect, Sir Bartle Frere observes "the palaces of Calcutta are palaces of brick and stucco, built on a foundation very much resembling that of our own good town of Sheerness. A hundred years hence the English people will not look with great pride on the City of Palaces, for the materials employed are not such as any architect would use for architecture of a high order or intended for posterity." "The whole of what the English government has done for the adornment of the capital of India may be summed up," adds this experienced and cultivated observer, "by saying that very few public buildings have been erected which would be considered in any small seaport town in this country to be above ordinary merit."

This will be probably admitted to be a not overdrawn picture; and looking at the circumstances of England at the time when this work received its initiative, and, we must add, at the method which has been pursued in carrying it on, it is not easy to see how it should have been otherwise. Of the two national styles I have referred to, and which are now practised together, to the no small disturbance of our architectural peace, neither was at the moment available. Gothic, though not a forgotten, was a disused manner of building. Even at home those works of the end of the eighteenth and beginning of the nineteenth century which were called Gothic were extremely defective, and no means existed of providing anything better than a most rudimentary and imperfect attempt at a Gothic design for India, as Calcutta Cathedral can testify. Italian renaissance, though less completely disused, was under a cloud; the designs of the time in that style were very weak or very extreme, and such examples as were put up in the earlier days of building in India were no improvement on their prototypes. The healthiest architecture of the day was, perhaps, the lingering remnant of a manner of building which had produced lofty, square, brick-built country houses, full of tall windows, excellently well fitted for English use, but quite out of the question as Indian models.

The first artistic effort which emerged from the general low level to which architectural art in England had sunk in the eighteenth century, was what is termed the Greek revival. I am not going to ask you to travel over that chapter in our art history with me, though it is one not without interest at the proper time and place, and not without instruction; but it will suffice here to say that when the political independence of Greece became a prominent idea in European minds; when the Elgin marbles, and the labours of Stuart and Revett, and the Dilettante Society, woke all cultivated English taste to a sense of the exquisite beauty of Greek art, all our architecture; as well as our furniture and our decorations, became for a time, revived Greek. We built Greek churches, Greek opera houses, Greek museums, Greek banks, and even Greek taverns, and we built little else. It is not, therefore, surprising that the influence at work at home was felt in India, the more so that the Greek enthusiasm took very strong hold of the Scotch mind, and India was for long (if it be not still) a kind of suburb of Edinburgh.

Now, it is quite possible that the Greek movement might have prospered in India, and might have prospered at home. There is one living architect of genius, Mr. Thompson, who, by his works, is even now showing that Greek art, properly used, can be applied with success to the buildings required for ordinary use in Glasgow at the present day; but no one so practical as Mr. Thompson was at work on the problem in India, or indeed in England, and the result was that such buildings as were erected in the Anglo-Greek character were, so far as report and representations can guide us—for my own observation of them has been almost limited to the Town-Hall of Bombay—are as gloomy and inappropriate, and un-Greek (to coin a word for the occasion) as similar buildings at home, which is saying a good deal.

The mode in which public works were done was, it has been observed, very detrimental to their chances of obtaining artistic merit. All public works (and till lately most buildings of any pretension have been public works) have been designed and carried out by military men, whose education as engineers has, perhaps, required them, in addition to learning military engineering and regimental duty, to become acquainted with the rudiments of architectural drawing and of construction; but has seldom allowed them leisure to pursue those arts so energetically, or with such undivided attention, as to make them great architects. Far be it from me to assert that there are no engineer officers who have a claim to distinction as architects. The works of such men as Captain Fowke and General Scott in England, or Colonel Wilkins and Colonel Fuller in Bombay, are sufficient evidence to the contrary; but I do assert that these are exceptions, and that it is not the way to get good architecture when you select your architect, not because he has studied architecture as his principal pursuit, but because he has studied it as a supplementary study, and in subordination, after such difficult sciences as military engineering, artillery, and fortification. It must be admitted, looking fairly at the very great difficulties of the situation, that the works which have been designed and executed by engineer officers thrown on their own resources, far from books of reference, skilled assistants, or available examples, are infinitely creditable to their energy, skill, and resource; but the merit of these buildings as works of art has unquestionably suffered immensely from the fact that very few of their designers were architects.

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* *Building News*, June 7th, 1870.

With the great changes in India which followed upon a vastly accelerated speed of transit between India and Europe, the transfer of the government to the Crown, and the introduction of railways, an alteration began to be looked for, especially as a marked alteration was also taking place at home. The railway companies, in more than one instance, decided to send out an English architect to design and take charge of the erection of their stations. Works which English architects might advantageously take in hand began to arise in the large cities of India; and the spirit of church restoration and town-hall building, and general attention to architecture which had been growing in England, travelled rapidly enough to the Anglo-Indian community in the Peninsula; so that architecture began to be considered worth cultivating, and the government of India began to consider the advisability of obtaining designs for public buildings from architects in England.

The first church of good architectural character, St. John's Church, at Colaba, near Bombay, was erected, according to the authority from whom I have already quoted, by Mr. Conybeare. "This church, however," says Sir Bartle Frere, "owes some of its best features to G. G. Scott, who was applied to to give a design for a memorial church to those who fell in the Affghan war. He gave a very beautiful design, but one too elaborate to be carried out for the money available; therefore another design, by Mr. Conybeare, was substituted. The erection of this church gave, it is added, an immense impulse to the spread of good architecture in India." After a time the opportunity offered itself to Sir Bartle Frere himself to give a far more vigorous impulse in the same direction, and to carry out some portions of a great scheme of architectural improvement in the city of Bombay. This scheme was so fine and noble in its whole proportions that it well deserves description, and as those parts of it which have been carried into execution have consisted of buildings in the design of which the principles I have advocated have been adhered to more or less closely, Bombay may be appropriately referred to as offering a fitting illustration of the application of those principles to practical building.

When Sir Bartle Frere became Governor of Bombay, the fort or European and Parsee Town was inconveniently restricted within the old and massive fortifications with which it was begirt. Under his initiative it was decided to demolish the ramparts of the old fort, to lay out a large portion of the magnificent esplanade (a level expanse of grass-grown land skirting the fort) as building ground, to erect a series of public buildings on choice sites in this situation, and to obtain the funds for these buildings and works by the sale of sites to private purchasers. The American war stimulated the Bombay cotton trade to an extent well known to you all, and vast sums of money poured into the city. One result of this was that the sites I have spoken of were many of them purchased at very high prices; and, although the cost of building was enormously enhanced, still extensive operations might have been carried out had not the appropriation of the funds been largely diverted to the erection of forts in the harbour to supply the protection formerly afforded by the recently-demolished ramparts.

The whole scheme, in which the late Mr. Kinloch Forbes was an active coadjutor of Sir Bartle Frere, contemplated providing Bombay with one of the most complete series of public buildings which any city can boast; and though, from the cause to which I have alluded, and later from the commercial collapse which took place, much remains as yet unaccomplished, a great deal was actually done, and more is in progress.

What was proposed included grants of sites, and, in some cases, of partial aid in the erection of buildings for various public purposes; the erection of fountains and monuments; and grants of sites for ornamental fountains which private munificence was willing to put up. It was also proposed to exercise some supervision over the designs which private individuals proposed to carry out on the plots they purchased, and especially to encourage the use of arcades along the thoroughfares. This was in addition to provision for all the public buildings required for the purposes of the government. A complete scheme was prepared, and the various sites appropriated; a portion of the proposed buildings were erected; others are being erected now. Designs for others were obtained, which were not carried out, and most of which will probably be forgotten and superseded before the time comes for the erection of the buildings; and in some cases nothing more was done than to reserve a site; and though more has been left for the future than those who originated the scheme desired, still the whole thing has been started, a very substantial instalment of what was to be done has been built, and an excellent direction has been given to the efforts of private enterprise.

A tolerably complete list of the buildings for which sites were reserved, runs as follows:—Hospital, Elphinstone College, Post-office, Telegraph-office, Civil and Military Pay-offices, Government House, Official Residences, High Court of Judicature, Secretariat, University Hall, School of Art, Custom House, Police-court, Small Causes Court, Admiralty, enlargement of Cathedral, Markets, Public Fountains, Mechanics' Institution, Sailors' Home, several churches.

In the first instance, designs for some of the proposed public buildings were invited in public competition, and it is to the circumstance that a design of mine, submitted in that way for the European General Hospital was selected to be carried out, that I owe the opportunity of paying a visit to Bombay at the end of 1864. At that time the plan of laying out the new town, proposed by my friend, Mr. Trubshawe, the consulting architect to the government of Bombay, had been approved, and the Elphinstone College was in progress under him. I became associated with that gentleman in the preparation of plans for the Government House at Gunnesh Kind, and the Engineering College at Poonah. We also prepared plans for the Bombay Post-office, on a site different from that where it is now being built, and for some of the work done to Bombay

Cathedral, as well as designs for fountains, and for some other buildings which have never got in any shape beyond paper, including the High Court of Judicature and a large iron and glass Exhibition building.

Of other important buildings for which designs were commissioned, the university buildings were among the most prominent, and Sir Gilbert Scott furnished a very effective design for them. He also designed a fountain, which was erected at the cathedral. Mr. Cuthbert Brodrick was commissioned to supply a design for the Custom-house; and Mr. Burges to design a school of art, which commission he undertook with much spirit, and performed with remarkable completeness. Two able architects officially connected with the public works department, Mr. Paris, who was for some time consulting architect, and Mr. Molecey, who is still in Bombay, were of great service to the government in the conduct of its undertakings. Several engineer officers who had already shown ability in designing and erecting civil buildings, were commissioned to undertake some of the proposed government works. Lastly, some civil architects residing in Bombay who were not connected with government, received commissions. Thus, in addition to the names already mentioned, Colonel Wilkins, Colonel Fuller, Mr. Bedford, and some other architects received commissions.

The buildings proposed by private Europeans, by the municipality, and by public companies, were, many of them, of importance, and though the cloud which came over the fortunes of Bombay was of course felt most by these undertakings, yet the list of works claiming notice as possessed of architectural merit is very considerable. The first place among these is due to the Elphinstone circle, which was one of the earliest improvements in Bombay. It was designed and carried out by Messrs. Scott and McClelland, and consisted of a series of buildings of a bold Italian renaissance character for commercial purposes, greatly superior to anything existing in Bombay up to the time of its erection. These gentleman also designed and erected the Victoria Museum. The works designed and carried out by Mr. Emerson, including the new markets for the municipality, a very large block of commercial buildings for Messrs. Treacher, a fountain, and several churches, are well worth special mention. The same architect is carrying out a cathedral at Allahabad in a style of Southern Gothic, excellently, as I think, adapted to the requirements of the climate and circumstances of the English community.

It is not contended that the whole of these buildings or that any one of them are perfect models, but, taking them as a whole, it is not, I think, unreasonable to claim for them the merit of being architectural in their design, in the durable quality of the materials, and in the manner in which those materials are used. They are essentially European; they are strongly allied to the buildings with which an Englishman is familiar at home, and they are yet not, I believe, unsuited to the climate, for their types have been selected in the architecture of sunny countries; and while they include examples on the one hand of Italian renaissance, and on the other of Gothic, the two manners which divide between them the allegiance of Great Britain, they will be found, I hope, sufficiently distinctive to be recognisable as designed with a view to the circumstances and the climate under which they were to be built, and as being appropriate to the uses to which they were to be put.

I am not in a position to say anything from personal knowledge of the works going on in Calcutta, but I am able to produce photographs showing several important and characteristic buildings designed by Mr. Chisholm, practising there and in Madras. The name of Mr. Granville is also very favourably known; and I can speak from personal knowledge of the abilities of two of the young architects at work there—Mr. Bayne, who is acting on one of the railways, and Mr. White, both, I believe, in government service—while I have reason to believe that other men of talent and power are at work in that and other cities of India, though there can be no doubt that there is room for many professional architects in the Public Works Department of India, and that the engineers themselves would, in many cases, be glad to see such a reinforcement of the staff of the department.

Perhaps here I should stop, but it seems to me almost due to my colleagues in this work, and to those who may yet carry it on, that I should say one or two words about the difficulties which have to be encountered, and about the possible future course of Anglo-Indian architecture.

The difficulties which beset the designing and erection of buildings for India furnished the subject of a paper, which I had the honour to read elsewhere,* and they proved quite numerous enough to occupy an entire evening. The great difficulty in designing and contriving is, of course, to a large extent to cope satisfactorily with the heat and the glare, and to provide adequate protection against the monsoon. Artistic effect may, on the other hand, be constantly and naturally obtained by the use of simple and appropriate arcading for the verandah or wall-screen, which is required to ensure the coolness of the building within. The scarcity of good building materials, and of all the appliances and aids which can be ensured in England, gives rise to another difficulty, by rendering many features impossible, or at best extremely expensive, which are of constant occurrence here; and the architect must consider at every step that his building will be put up where manual labour is the only auxiliary that is plentiful. The resource of sending home to England for iron-work, brass-work, terra cotta, glass, and even carved stone, has been tried again and again, but there is great difficulty in obtaining exactly what is wanted; and probably in every case the less this sort of assistance is relied upon the better, for the risks of transit as well as other sources of disappointment largely interfere with its efficiency.

The workmanship ordinarily obtainable is again very rough to an English eye, and this is of some importance in the design of such work as masonry, where true surfaces are desirable both for structural security and for optical effect. All these difficulties are, however, small compared with the greater administrative difficulty—how to get the work done. Many of the Government works are carried out departmentally, as it is called—that is to say, by placing them in the hands of an officer of the Public Works Department, who buys materials and plant, engages labour, and overlooks and so erects the building. There are a certain number of cases where a European contractor is available. There have been some instances where European architects and engineers have successfully undertaken the laborious task of carrying out their own designs; and there have been not a few buildings erected by native contractors. Whatever plan is adopted, the difficulties are far in excess of what are found in this country; and in the case of buildings the designs of which come from men unfamiliar with India, they must often be aggravated, and the prospect of a successful result endangered, by the fact that large portions of the designs will be in danger of being omitted altogether or radically altered, as it will be found difficult, and believed to be impossible, to carry them out at all in the materials and with the appliances to hand, while to write home for new details will involve a delay of six or eight weeks at least, the result being that designs which depend for their effect upon their being carried out completely are in great danger of being mutilated and so spoiled, by the substitution of some feature more within reach, for parts which it is decided to omit. This, which s a constant cause of complaint in respect of idesigns thoroughly suited to the resources of the country, must occur even more frequently when the design is really difficult of execution.

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* Transactions of Royal Institute of British Architects.

It seems, from all this, likely that the designing of buildings for India will always be best left to men who know something of the country—chiefly to men resident in it; but it ought to be entrusted to educated and artistic architects. In the execution of them, a large amount of effect will probably in time be obtained by enlisting the skill of native artificers in decorative work, such as carving and pierced stone work; and in treating these subsidiary parts, a man of genius will often succeed in designing enrichments such as will be not inconsistent with his style, and yet not so strange to the native craftsman as to cramp him in his work and deprive it of that freedom of head and eye which the best decoration demands. And there is one more possibility to be kept in view—Indian interiors might easily be rich with carving and bright with colour-decoration. There is an infinite amount of scope open here to the decorative artist, and, among other things, he has the prospect of being able to train, if not to obtain, native painters and carvers to execute this part of his work. The schools of art have, of course, not done all that could be wished, but they have shown that some of the natives are apt students of colour-decoration, and there is no need of proof that they are apt at carving. The half-lights of an Indian interior would give wonderful charm to good enrichments; and in private houses and other buildings, where no great attempt at external architectural effect may be possible, or in cases where an existing building has to be dealt with, there is great scope for artistic treatment if only the attempt is made with judgment and taste.

In a country where no wall-paper can be used, and where plaster is the only building material that is almost uniformly good, fresco painting and distemper colouring seem to suggest themselves; and where natty manual labour is so cheap and abundant, mosaic might, it seems, be easily introduced into floors and panels, while a little of the carver's skill bestowed upon the familiar black wood furniture might be employed with very great success in adorning such wood-work as it is desirable or customary to leave visible.

To sum up the argument in a few words, most of our building work in the East has not been hitherto creditable to our taste, though it bears witness to our energy and vigour. The time has come when it ought to be held imperative, both for the Government and for private individuals, to render their buildings models of good taste. In order to do this, their design, and the design of such decoration as they receive, ought to be entrusted to men of cultivated architectural taste; and the style adopted for them ought to be, not a direct imitation of any Asiatic type, but an adaptation of those European styles which have grown up in sunshiny regions. Such styles are ancient Roman, or even Greek (when good enough materials and workmanship are procurable), or the Romanesque, Gothic, and renaissance of Southern Italy, Southern France, and perhaps Spain. In treating any of these styles, certain features of the architecture native to tropical countries will have to be incorporated. Among such features we may enumerate the following:—Walls of ample thickness, often covered with a profusion of delicate surface ornaments; an absence of vertical features of large projection, such as buttresses, and a constant preference for horizontal cornices; openings usually frequent and ample, and often filled with exquisite pierced patterns; a constant use of balconies and corbelled projections; roofs often low, sometimes flat, sometimes domical; piers and columns frequent and numerous; and an ample space allowed for the whole building and its surroundings.

There is but one limit to the degree to which these features of Eastern art may be appropriated; they must not be so freely used as to cause the edifice to lose its European style. Had we a distinctive English style we ought unquestionably to use it in our colonies, as Rome did in hers, with such changes as local circumstances made necessary. But though this is, unhappily, not possible to us, there are in existence familar European styles well suited to the purpose, and it appears only reasonable that as our administration exhibits European justice, order, law, energy, and honour—and that in no hesitating or feeble way—so our buildings ought to hold up a high standard of European art. They ought to be European both as a rallying point for ourselves, and as raising a distinctive symbol of our presence to be beheld with respect and even with admiration by the natives of the country.

DISCUSSION.

The Chairman then invited discussion upon the paper which had been read, observing that the question appeared to be whether native styles ought to be adopted or European styles. That was the main question, and then there was a subsidiary one, whether the style should be Gothic or Italian.

Mr. Emerson did not quite agree with the conclusion of the reader of the paper, that the conqueror should carry into the conquered nation a new style of architecture. He thought the course pursued by the Mahommedans was infinitely preferable. They adapted their architecture to that of the conquered country. European architecture would scarcely suit the requirements of the country. Indeed, it was impossible for the architecture of the west to be suitable to the natives of the east, and the Mahommedan buildings were found to work well.

Mr. Roger Smith said that Mr. Emerson's observations were not quite consistent with what might be seen in his design of the Elphinstone College at Bombay, and some other buildings.

The Chairman observed that the original difficulty in the matter was that when the Company went to India there were no architects there, and consequently every man built his own house, every clergyman his own church, and everyone did exactly as seemed good in his own eyes. The only architect sent out from Europe, he believed, was the one who built the government house at Calcutta, which was a good building in its way. The consequence of this state of things was, that people simply used the Italian orders, so as to meet the exigencies of the case. They did not know exactly how to use them, so they used pillars and so on, simply as blinds to keep out the sun and the excessive light. And the worst feature was that it was adopted by the natives too, and Lucknow, Travancore, Tanjore, and other places were instances of this, many of their buildings being in this wretched style. It was only in the last twenty years that any alteration had taken place. But the rebuilding of Bombay had given a great spur to the adoption of a better style of architecture all over India. There were no architects out there in his day. Now they had come to the time when really good architects went out there, and the question was what should be the style which would best suit the requirements of the country. For churches he thought the Gothic most suitable. Our churches ought to be distinguished from heathen temples or any other building. By the adoption of Gothic forms very good churches might be built in India; only he would suggest the using the aisles more as verandahs, and the nave as the congregational part of the church. The difficulty was that the pointed arch is a very inconvenient arch, because in India you want a screen down to about six or seven feet from the ground, to keep out the glare of the sun; and the tall pointed arch is very difficult to use in that way; and to fill it in with Venetian screens would spoil it. The low Tudor arch had been used with good effect in one or two of the university buildings, and was a capital form. It keeps the sun out very well; but his opinion was that a much freer style was requisite for public buildings, and that some modification of the Italian style would be the style to be used, and particularly a low arch. They did not want tall arches, but a low arch; and with modification the Italian style was the one allowing plenty of space for nailing up blinds and things of that sort, and the one which ought to be used. The solution of the difficulty would, he thought, be obtained, as iron came to be more used for verandahs and so on. The natives used stone very much as we use iron. They had the most marvellous pieces of stone in their buildings, cut so thin and made so light that it was really wonderful; and many valuable suggestions might, he thought, be got from the natives, and so a beautiful style might be produced by employing iron in screens and open work. However, it was one of those questions which could only be settled on the spot. If we settle the battle of the styles, all the rest could be easily settled. That was the important thing. Deep shade and large areas are a necessity for buildings in India, and whatever style was used they could hardly help being effective from that circumstance. He expected the result would be that they would soon have examples of great beauty and elegance in their buildings, and he looked forward with great pleasure to the changes which were being so rapidly effected. He was sure in India Mr. Smith's paper would have the effect of drawing attention to this all-important subject. It was exactly what was wanted, that the whole subject should be put before the people of India in a reasonable and tangible form; and he was quite sure if a few more of such papers were written, the people would turn their attention to it, and very soon we should have buildings of greater beauty, and more appropriate to the climate.

Mr. Roger Smith, in reply, thanked the meeting for the great attention they had bestowed on his paper, on a subject on which so much remained to be said, and for the countenance with which they had received the views he had enunciated. He did not know that anything had fallen from the Chairman calling for remark on his part, but he should like to say, with regard to Mr. Emerson's observation, that, to a certain extent, he thought Mr. Emerson's work partly contradicted him, some of his churches in Bombay, and the cathedral, which he was going to carry out, showing what his predilections were.

Mr. Hyde Clarke writes that the paper of Mr. Roger Smith is of great importance, because municipal institutions under the highest auspices are now attaining a great development, and consequently there is the opportunity for promoting the arts in India, for which the foundation has now been laid. With regard to the abandonment of everything in art to native style, it must be borne in mind that there is as much conflict as to style in India as there is in everything else. The Hindoo styles are not of one class, and are not universally prevalent, and the Mussulman styles are altogether foreign, and are not admitted by a majority of the population. The Mussulman styles, being introduced by conquering races (and not being indigenous, as Mr. Roger Smith assumes), are as much foreign as the European styles, and there is no valid reason against the introduction of the latter. Native architects and native workmen are already divided in style and practice, and they can and do adapt themselves to the construction of works in the European style, and with the necessary adaptations to the climate. If the English are not at this time a colonising race in India on a large scale, that is from neglect of the government, because the English have already shown that they can successfully establish themselves in the Himalayas and the other hills, and can, if supported, materially extend their populations. Considering that the Mussulman styles can be adapted to the cold winters of Thrace and the Bosphorus, so the styles once prevalent in Asia Minor, Syria, and the provinces of Africa can be extended to any part of India.

THIRTEENTH ORDINARY MEETING.

Wednesday, March 5th, 1873, Captain P. H. Columb, R.N., in the chair.

The following Candidates were proposed for election as Members of the Society:—

Beresford, Colonel Marcus, M.P., Sheen-house, East Sheen, S.W.
Danchell, Frederick Hahn, C.E., Vale-hall, Horwich, Lancashire.
Darby, Stephen, 140, Leadenhall-street, E.C.
Hargreave, James Sidney, 3, Victoria-street, Westminster, S.W.
Hollingsworth, William Thomas, jun., 106, Mile-end-road, E.
Imray, James Frederick, Foxgrove-road, Beckenham, Kent.
Kosloff, Stephen Alexandrovitch, 6, Winchester-street, E.C., and St. Petersburgh.
Pickersgill, William C., 30, Belgrave-road, Abbey-road, N.W.
Smith, Joseph, 6, Blenheim-mount, Bradford.
Stocqueler, Joachim Hayward, India Office, Downing-street, S.W.

The following Candidates were balloted for and duly elected Members of the Society:—

Barton, R. Harvey, 2, Great St. Helen's, E.C.
Booth, John Billington, J.P., Overleigh-house, Preston.
Burton, H., Newport, Monmouthshire.
Eckstein, Miss, 10, Prince's-square, Bayswater, W.
Messel, Louis, 34, Wiltshire-road, Brixton, S.W.
Munn, Major William Augustus, Churchill-house, Dover.
Nevill, Charles William, J.P., Llanelly Copper Works, Llanelly, and Westfa, Llanelly.

The Paper read was—

ON GAS-LIGHTING BY ELECTRICITY AND MEANS FOR LIGHTING AND EXTINGUISHING STREET AND OTHER LAMPS.

By W. Lloyd Wise, A.I.C.E., M.I.M.E.

Some curiosity having been excited by various newspaper paragraphs which recently appeared relative to experiments made first in Germany and subsequently at Preston, in lighting gas by electricity, on the plan invented by Professor Klinkerfues, director of the Royal Observatory a t Gottingen, it was suggested to me that a paper based upon the description originally communicated to me by that gentleman, might prove interesting, and lead to useful discussion at a meeting of this Society. Moreover, the Chairman of the Preston Gas Company, Mr. J. Billington Booth, by whom the English experiments were conducted, offered to lend the collection of apparatus now before you in illustration of the subject. Hence I was induced to undertake the preparation of this paper.

Without pretending to say what plan may ultimately prove the most successful, I may state that there are practical men who believe, and perhaps few persons will question that the art of lighting gas by electricity is as yet in its infancy, and has a great future, as applied not only to buildings, but also to the lighting up of large towns.

No doubt there will be scoffers at the idea, as there were people, deemed authorities in their time, who regarded George Stephenson as a lunatic when he spoke of locomotives travelling twice as fast as stage coaches, and proposed a railway over Chat Moss. Notwithstanding such people, however, we are making constant progress. Look at the wonders that have been wrought by electric telegraphy. Only a very few years ago the Atlantic cable, now uninterruptedly worked, was an unaccomplished project, fraught with apparently insurmountable difficulties, and that had been vainly attempted at a ruinous cost.

Seeing, then, such startling evidences of modern progress, sceptics may well hesitate to pronounce opinions too strongly condemnatory of any proposal which may seem to them impracticable because designed to go extensively beyond what has been already carried into general practice.

The subtle agent, electricity, by which such marvels as instantaneous communication between points thousands of miles apart have been rendered possible, would seem to be peculiarly adapted as a medium for enabling operations to be simultaneously performed at many distant points, from any given place, and, on this account, has commended itself to many inventive minds as the best means for rapidly lighting gas in towns and large buildings; with what success, remains to be seen.

The advantages to be derived from a practicable system of igniting gas, without the use of an exposed flame for the purpose, will be fully appreciated by those acquainted with the difficulties and dangers attending the ordinary methods of lighting gas, and the frequent accidents arising from the careless use of matches and negligent ignitions, not only in private houses, but also in warehouses, magazines, cotton mills, and workrooms, especially where the manufacture of inflammable materials is carried on. There is, also, considerable inconvenience and waste in connection with the lighting-up of turret clocks, and the ignition of gas in other places difficult of access, where, in some cases, to save the great trouble of lighting and extinguishing, the gas is kept constantly burning, instead of being extinguished during the daytime.

Then, as to street lamps, several important points claim attention.

The old-fashioned system of carrying a ladder with a lighted fuse from lamp to lamp, though still used, I believe, in many towns. has, nevertheless, been somewhat improved upon by the introduction of the lighting staff; notwithstanding the use of which, however, our present mode of street lamp-lighting is a tedious, wasteful, and expensive process.

Not only does it involve the employment in every considerable town of a large staff of lamplighters, but in order that all the lamps may be lighted by dusk, the lighting operation has to be commenced some time before any lights are really wanted, so that gas is consumed to no purpose. The same rule applies conversely to the extinguishing of the lights; hence the loss of gas night and morning from these causes alone in a large town must amount to something considerable in the course of a year, especially in these days of high-priced coal.

I have read that in Bristol, where they have about 3,600 lamps, one man is told off for every hundred, and in order to get the lamps lighted by a given time, the lighters must commence their duties an hour previously. In Preston, where there are sixteen lamp-lighters, the number of lamps being about sixteen hundred, it often happens that as soon as the men have completed lighting the lamps it is time to put them out, and frequently the outlying districts do not get lighted at all. Again, the hours during which gas light is required at any given time of the year, vary considerably according to the state of the weather, and under present arrangements, in order to be on the safe side, the lights have often to be kept up when they might be dispensed with.

In manufacturing towns where, to save gas, advantage is taken of the early moonlight, terminating perhaps an hour or two before daybreak, many operatives are left to grope their way to work during the interval through the dark streets, because, under existing circumstances, the special lighting of the lamps for so short a time would involve unwarrantable labour and expence.

Furthermore, lamp-lighters' strikes — though, happily, not of frequent occurrence—cause very serious inconvenience to the public when they do happen.

It is not, however, any mere wish to supplant the poor lamp-lighter, but rather the want of those additional facilities for securing efficiency and economy inimical to employing him in his present capacity, that calls for reform in the direction I have indicated.

I may, perhaps, be allowed here to introduce the following short quotation, not altogether inappropriate at this stage :—

> "Lamplighting, at the best, is only a prosaic calling, and one of the very last, it might well be imagined, to be rendered a scientific operation. There is certainly a considerable degree of personal credit attached to the occupation. If it were sought to express admiration at any display of unusual dexterity, the phrase, 'As sharp as a lamplighter,' offered at once a familiar and forcible illustration. Very few among us have not been brought into immediate companionship with this homely figure, skimming along the darkening streets with shouldered ladder, and lamp alight. At times, perhaps, the introduction has been effected rather more practically than pleasantly in the way of violent contact, on rounding a corner, with the projecting ladder, or in the shape of a violent scare at some demoniacal object executing a terrific descent from an unseen height overhead. The encounter, less these little *désagréments*, had always about it the flavour of pleasant familiarity; and although in these latter days the migratory lamp, dancing along the highways and byways, like some Will-o'-the-Wisp on the rampage, has given place to the economical lucifer match, we are not prepared to say that the banishment of the lamplighter will not do violence to an old friendship. His days, however, appear to be numbered, and science, with its universal meddling, bids fair ere long to consign him bodily, ladder, lamp, and match-box, to the limbo of worn-out and disused appliances."

Probably most persons know that many plans have been from time to time proposed for igniting gas by electricity, but even were I prepared to describe them it would clearly be impracticable to do so within the limits of a paper.

I will, however, allude very briefly to one or two, in the hope that some one acquainted with their details may come forward to explain them.

Many years ago Admiral Sheringham made experiments in Portsmouth Harbour with a view to the illuminating of buoys and beacons, &c., by gas ignited by electricity, but I have no particulars of his plan.

Some years later, Mr. Simon Petit proposed lighting several gas-jets simultaneously, or in very rapid succession, by providing each burner with a valve or cock, to be opened and closed by means of an electric current, acting directly upon it by means of an electro-magnet or coil, or indirectly, by a releasing detent, an electric spark being passed through the issuing gas at the moment of opening the valve or immediately afterwards.

At about the same time Mr. Isham Baggs proposed certain arrangements for instantaneously igniting gas by the use of frictional or high-tension electricity, as also means for turning on and off the gas when required.

The burner of each lamp was to be provided with a strip of glass, or other non-conducting material, placed horizontally, having a couple of wires passed through it, one at each side of the burner, the end of the two wires being brought close to each other at a short distance above the aperture of the burner. To the lower ends of these wires others were to be attached, suitably insulated from the metallic portion of the lamp, and joined to wires connecting it to the other lamps in a given circuit. Several plans were suggested for turning the gas on and off, one being to provide several burners with a common tap, to be turned on and off by air pressure and vacuum in a small cylinder containing a piston connected to the lever of the gas tap.

For effecting the ignition Mr. Baggs preferred to use an ordinary plate electrical machine and a Leyden jar, or combination of jars, for sending the requisite currents of electricity through the wires of each circuit.

Another plan, proposed by Mr. Denny Lane, was the use of a portable battery, to be carried from lamp to lamp, a piece or pieces of platinum wire being suitably placed in proximity to the orifice of each burner.

More recently Mr. Robert Cornelius brought out a plan for igniting gas, by an electric spark generated by frictional electricity, at the point of a wire bent over the top of a gas burner. A chain attached to this wire was carried to some accessible point, and upon being touched by a portable electric apparatus, or acted upon by a stationary battery fixed in any convenient position, a current of electricity was conveyed to the pointed wire over the burner, and the gas issuing from it thereby ignited. He proposed several kinds of small stationary frictional batteries suited to the purpose named, and also a small portable battery, in the form of a tube, with a metal rod, coated with vulcanite working loose in the inside. The tube was to be lined with lambs'-skin or other suitable material adapted for the purposes of frictional electricity, the depression or elevation of one end of the tube causing the metal rod to slide downwards by its own gravity, so as to excite sufficient electricity for lighting the gas issuing from the burner.

Mr. Barbarin subsequently proposed two plans, one involving the combined use of electricity and clockwork, a very complex arrangement; the other dispensing with the clockwork and electric currents, and employing a quicksilver closing and hydrogen gas, in conjunction with spongy platinum, for igniting the gas.

I am indebted to Mr. Ladd for the following information as to the lighting arrangements at the Royal Albert Hall, South Kensington :—

The lights are arranged in 30 clusters, of 5 stars each, each star containing 21 jets, or burners. A bichromate battery is made to work an inductorium, or induction coil, connected to which is a semicircular insulated arrangement. Attached to this are 30 wires, which lead off, one to each of the 30 clusters.

The burners are arranged in sets of three, somewhat like a three-pronged fork, and the ends of a couple of platinum wires, connected with the battery, are fixed within a short distance of each other, near the orifice of the centre burner of one set in each star, there being a special conducting wire from the battery to one of the stars in each cluster, or 30 wires in all. When the galvanic circuit is closed, by lowering the plates of the battery into the acid, a spark is caused to pass from the point of one platinum wire to the other, and thereby ignites the gas issuing from the burner. Since that burner is within lighting range of its neighbours at each side, they in turn with those next to them, and so on, the ignition of the gas proceeds from one to the other all round the star. The platinum wires are held by iron wires, attached by a small block of steatite to the stem of the burner, and are placed slightly below the horizontal line of the burner orifice, so that when the gas is alight the upward draught draws the flame away, and so prevents deposit of carbon upon them. The gas is turned on and off by stop-cocks in the mains in the ordinary way.

Professor Klinkerfues' arrangements are based upon the use of compact platinum, in connexion with a galvanic battery, without the intervention of any coil, by the movement of the plates or of the electro-motive liquid by mechanical means, or by gas pressure completing the galvanic circuit, the gas being at the same time brought into contact with the heated platinum wire, and thereby ignited. His experiments demonstrated that for this purpose less than a red heat was required, as a platinum wire inserted between the poles of a very small pair of zinc and graphite, without showing the slightest emission of light in a dark room, ignited a jet of gas almost instantaneously.

For opening and closing the gas passage leading to the burner, and lighting or extinguishing the gas as required, by simply altering the pressure in the main, he combines a bell-shaped compartment with the gas-pipe and the vessel containing the electro-motive liquid in such a way that when the gas is at its lowest pressure the liquid seals the gas-pipe. By increasing the gas pressure the passage to the burner is opened, and by a still further temporary augmentation of the gas pressure, the galvanic circuit is completed, so that the issuing gas, impinging upon the platinum wire between the poles of the battery, is ignited.

In its most simple form, his apparatus constitutes a hand-igniter, to be used in lieu of matches, spills, or tapers for lighting gas at any burner. It consists of a thin, hollow glass vessel, several inches high, closed at the bottom, and provided with a cover which screws into a mounting attached to the neck of the vessel, so as to hermetically close it. The cover has fixed to it, and carries beneath it, the galvanic pair, consisting of a perforated tubular piece of zinc, and a cylindrical piece of graphite or carbon. Above the cover are the electrodes, connected by a piece of platinum wire. The electrodes consist of two brass wires, one of them screwed into the metal cover, which is in direct contact with the zinc; the other passes to the carbon through the cover, from which it is insulated.

In order to light gas with this simple apparatus, it is only necessary to incline it sufficiently to bring the liquid into contact with the zinc and carbon pair, and at the same time to hold the platinum wire in contact with the jet of gas issuing from the burner. When the apparatus is placed in an upright position, the zinc and carbon do not touch the liquid, consequently no galvanic action takes place, and no material is consumed.

The street-lamp arrangement is designed to simultaneously light or extinguish a number of lamps from a single station. It being desirable that the gas supply should be shut off at points in close proximity to the burners, it is necessary that some means should be provided for opening and shutting off the supply from a distance. As we have already seen, it has been proposed to do this in various ways, one plan being to use stop-cocks in conjunction with electro-magnets worked by galvanic action from a common station. But Professor Klinkerfues, considering that galvanic batteries intended for the production of caloric should be of weak resistance, and, therefore, incompatible with great lengths of conducting wires and long duration of galvanic action, without frequent renovation of the liquid, decided to furnish each lamp-post with its own galvanic apparatus, and to make the galvanic pair touch the liquid only during the short time necessary for lighting up. In his apparatus for this purpose the vessel containing the liquid is provided with an internal tube leading to the burner, and having an enlargement at its lower part, as already mentioned. This tube is attached at its upper end to the cover. The gas-pipe enters the vessel at its lower part, and terminates within the tube. The carbon rests upon the enlargement of the tube leading to the burner; and the zinc, in the form of a ring, which is insulated from the tube, is attached to a screwed wire or rod, surrounded at its lower end by insulating material, and passing up through a suitable insulator in the cover to a connecting bar, upon which rests a nut, whereby the zinc is held and adjusted.

One of the electrodes is attached directly to the connecting bar, and the other is insulated from the bar and attached to the cover. The upper end of the gas-pipe, situated within the tube leading to the burner, is perforated, and a cap, adjustable by a screw, which screws into the pipe, fits easily over it, the lower end of the cap passing down below the level at which the liquid stands when the gas is at its lowest pressure. An annular space is thus left between the cap and the gas-pipe, and the interior of the latter communicates by the apertures at its upper end with the annular space.

The action of the apparatus is as follows:—When the gas is at its lowest pressure, and the surface of the liquid in the annular space between the gas-pipe and its cap is at or about its highest level, the liquid seals the lower part of that annular space, thereby preventing the passage of gas into the tube and thence to the burner. By slightly increasing the pressure of the gas, it will force the liquid down in the annular space, thereby raising the level in the main vessel until the gas is permitted to pass by the tube to the burner, and then, by a still further augmentation of the gas pressure for a few seconds, the liquid is temporarily forced up in the vessel into contact with the zinc, thereby completing the galvanic circle, and igniting the gas issuing from the burner as it comes in contact with the heated platinum wire. After this is effected, a slight remission of the gas pressure causes the level of the liquid in the vessel to fall below the zinc, thereby breaking the galvanic circuit in order to avoid unnecessary exposure, but without shutting off the supply of gas to the burner. The extinction of the light is effected by reducing the pressure, so that the level of the liquid rises up within the annular space between the pipe and its cap, and thereby shuts off the communication to the burner. The apparatus is accommodated to variations of pressure at different altitudes, by adjusting the position of its cap and the extent to which it dips in the liquid by means of the screw.

The practicability of this apparatus was first publicly demonstrated by a three months' test in Gottingen, where it was applied to forty street lamps in the principal thoroughfares; and the Gas Commission, of which the mayor was a member, certified on the 21st of March last that the apparatus had worked continuously to their satisfaction.

But I will come nearer home, and say a few words about the experiments more recently conducted at Preston before several members of the Corporation, including the mayor and the leading corporate officials.

The apparatus was fitted to a lamp near the Lady's Walk, Moor-park, a mile and a quarter distant from the gas works in Glover-street, whence the apparatus was to be operated. The times having been previously agreed upon at which the lamp should be lighted and the light extinguished, watches were carefully compared, so that the feasibility of at will almost instantaneously changing the gas pressure in the lamp apparatus to a definite extent, by means of a regulator at works far removed from the lamps, might be reliably demonstrated. The regulator in Glover-street being operated upon at the agreed times, the lamp a mile and a quarter distant was lighted with scarcely any perceptible lapse of time, left burning for five minutes, as had been previously arranged, and then was promptly extinguished. This process was repeated several times, much to the astonishment of a number of lookers-on who were not in the secret.

Similar experiments were tried on a lamp in Ribblesdale-place, and on another in Fishergate, the two being in sight of each other, about a quarter of a mile apart, and the same distance from the gas works. They were lighted simultaneously by one operation on the regulator at the agreed time, and both lights were extinguished promptly when the pressure was reduced.

The several lamps used for the trial were taken at haphazard, none of the service pipes having been tested for defects; nevertheless, the experiments were considered highly satisfactory.

For lighting sunlights the foregoing arrangement is modified, only one battery being used for each cluster of lights.

The vessel containing the liquid is placed in the middle, and is carried by a hollow centre-piece above it, from which the several arms or branches of the sunlight project radially. The centre-piece is screwed on to the gaspipe, whose enlarged lower end passes down into the vessel containing the liquid, the upper end of the pipe leading to the centre-piece above. The lower end of the pipe is closed by the liquid when the gas is at its minimum pressure and opened by increasing the pressure, the galvanic circuit being completed for igniting the gas by a temporary augmentation of pressure, as in the street-lamp apparatus. The electrodes are situated at each side of one burner only, across which the platinum wire passes, and all the burners being within lighting range of each other, the whole of the gas jets are rapidly ignited.

The dip of the pipe into the liquid may be varied, as required, by simply turning the centre-piece.

The requisite changes in the gas pressure are effected by means of a suitable regulator, as well understood.

The office desk, or table apparatus, is an ingenious modification, in which the battery resembles those of the street and sunlight arrangements, except that instead of there being a hydrostatic tap, and the electro-motive liquid being brought into contact with the zinc by the pressure of the gas, the zinc is lowered into the acid by a mechanical arrangement operated by hand pressure upon a suitable knob, by which at the same time an ordinary gas tap is opened, the platinum is moved over, and ignites the issuing gas. A spring returns the zinc and platinum wire to their original positions on the removal of the pressure from the knob.

Professor Klinkerfues' invention is evidently susceptible of other applications than those I have alluded to.

The length this paper has attained bids me to conclude. In doing so, while acknowledging your kind attention, I crave indulgence for the very imperfect manner in which my subject has been brought before you, knowing as I do that it would have gained much additional interest in the hands of one qualified by special experience to elucidate its practical details.

DISCUSSION.

Mr. Ladd said he had gone very little into these arrangements, yet he had had a great deal to do with lighting gas by electricity. He had always adopted the induction spark for the purpose. He had fitted up the Royal Albert Hall, which was the largest building to which electricity had been applied for the purpose. The apparatus there was of far greater power than was wanted. It was originally intended to light five jets at a time. The same principle had been carried out in the east laboratories of the Royal Arsenal, where the combustible materials are compounded, and consequently no such thing as a light or a match of any kind is allowed to be brought into the building. He had adopted the same principle there by applying the electric spark and the two wires. Two platinum wires were set in a small block of steatite, and these were fixed immediately below the burner. The wires were connected with a coil, and as the spark passed, the gas was turned on and ignited. The draught then carried the flame upwards and away from the apparatus, so that it was not possible to have a deposit of carbon upon the wire. After a great deal of practice he found there was really little or nothing left to be desired to perfect the arrangement. In the east laboratory there are 24 houses to be lit, all protected by glass underneath the burners; a man goes down with a little battery and coil, and puts it against the two wires outside the door, turns on the gas, and so lights it, and no possible danger can ensue. There is some little difficulty in lighting the gas if it was enclosed in a glass vessel. Unless the electricity was applied very quickly, the gas and air mixed, and you got an explosive compound, and might blow the lamp to pieces. A very pretty arrangement came over from America a few years ago, which he believed was presented to Mr. Faraday. A little ebonite plug, lined with silk, fitted in a cup, and the wires were brought up to the burner. All you had to do was to lift the plug out of the cup, and the gas lit. It was a pretty little arrangement for a single light. He thought there might be some difficulty in carrying these arrangements out, and some objections to them in their present state. One was as to evaporation. In hot weather it would be rather difficult to keep the liquids from evaporating. Sulphuric acid absorbs moisture, but with diluted sulphuric acid, as this was, the absorption amounted to very little indeed. The great thing to guard against was evaporation, which in hot weather, he thought, would be difficult to prevent. Another question was as to the cold. If the winter were very severe, and the liquids froze there would be a stoppage to the gas. A separate main would also be wanted for the street lamps, because it would not do to tamper with the houses by increasing or lessening the pressure, as the case might be, to light or put out the lamps in the streets. In the arrangement for the sunlight the evaporation would be very great, from the excessive heat which would be brought to bear upon it.

Mr. W. Francis remarked that any plan which would enable the whole of the gas-jets to be lit at once would be a great boon, for it would prevent the escape of gas and the disagreeable odour arising therefrom. Also the effect would be very beneficial in preserving the clearness and brilliancy of the lustres of chandeliers, which frequently got soiled in lighting. He would also like to know the cost for the manner of its application to private houses.

Dr. Wallace had recently come from Glasgow, where about 130 men were employed, and where the saving would be very great if the plan could be adopted. But the subject was not yet thoroughly brought out, and there was still something to learn. One objection against its use for street lamps was the very deep shadow the glass vessels would cast. They were about five inches in diameter, and occupied a considerable space. He would ask, would it be possible to put these vessels in the pillar of the lamp, and not in the globe at all? It struck him the retention of the platinum wire diminished the illuminating power of the flame. He had not tried it photometrically, however. The use of separate mains was also an objection, but not an insuperable one, for doubtless it would be cheaper to erect separate mains than to spend, as was done in Glasgow, £5,000 or £6,000. a year. True the whole of the money would not be saved, because the lamp-lighters were also employed in cleaning the lamps. But if an hour's gas each night could by this means be saved, a large amount of money would thereby be economised. But they knew nothing of the cost of the apparatus, nor to what extent it was at present adopted.

Mr. Copland had made a few rough calculations in the room as to the saving of gas and labour. Taking Bristol as an example, with its 3,000 street lamps, these lamps took one hour, morning and evening, to light and extinguish. Taking the number of days at 300, and the cost of the gas at 4s. per 1,000 feet, the City of Bristol paid £1,000 a year more than was necessary if they employed this apparatus. The evaporation of the liquid, he thought, would not amount to much in the course of a week, and fresh liquid could easily be supplied by the lamp-lighter when cleaning the lamps, if it were necessary. The evaporation would be compensated for to a great extent by absorption by the sulphuric acid.

Colonel Goodenough inquired the cost of the apparatus, and if there was one of a smaller size, which offered less objection in regard to casting a shadow. He might say that a gentleman was about to visit this country from Vienna, for the purpose of introducing a plan for the lighting of street lamps, and when that scheme was before the public more information on this important subject would be forthcoming.

Mr. E. Lawrence was glad to see the method of putting a separate galvanic battery to each gas-lamp was introduced. He objected to the platinum wire remaining in the burner. The small apparatus for hand-lighting was the one which most commended itself to his mind, where the pressure upon a button brought forward a spark, and the gas ignited. The gas-lamps might be wholly separate from the battery, and the apparatus for lighting might be connected with it by a small tube, and this would obviate the difficulty of the platinum wire remaining in the flame.

Mr. W. H. Walenn, F.C.S., had paid some little attention to the history of these inventions and found they began as far back as 1812. In the Society's *Journal*, of July, 1859, there was an account of Professor Schilling's mode of igniting gunpowder by means of electricity. The heating power of electricity was at the bottom of this apparatus. But the heating power there was applied to carbon, and not platinum. The next invention was that of Mr. Roberts, in 1842, when he endeavoured to fire some fuses and to accomplish blasting by electricity. He used twenty-battery cells for that purpose. He found that a number of charges might be fired at once, but the increase of power was so great that he never attempted to fire more than one charge at one time. The next was that of Mr. Staite's, in 1847, the application of electricity to light lamps. He did it by means of platinum wire heated, and in the circuit there was an electro-magnet, and when the current ceased, the electro-magnet extinguished the light. The next was the one alluded to in the paper, Professor Sheringham's, which was similar to Mr. Staite's, and was by means of platinum wire. Then, in 1856, there was that of Mr. Simon Petit, alluded to in the paper. This invention was a very remarkable one. He united, by means of the spark or heated platinum wire, two distinct methods. He introduced the galvanic battery at each particular light—that was a local circuit, excited by a general circuit, and the lighting was in that case simultaneous, that is to say, the operation was, that during the time the light was extinguished the electric current was traversing the lamp wire, which was like our telegraph wire, and running from lamp to lamp. During that there was a constant current. The interruption of the current caused an apparatus to turn on the gas, and also actuated a further apparatus by which the gas was lighted. The fault in this was the constant action of the current in the circuit. Then there was Mr. Isham Baggs' plan. He used frictional electricity, and either pneumatic or hydraulic arrangements for turning the gas off. Whether he ever used the pressure of gas to accomplish his purpose he could not tell. This was not the first time galvanic batteries had been used in this way, for there were three plans for using them between 1858 and 1866, and several during the past few years. He did not attach much importance to the evaporation, because the liquid was not exposed to the air, and if it evaporated it must go into the gas tube, and that being small there could not be much loss.

Mr. Dipnall thought the apparatus might be lowered into the pillar of the lamp itself, instead of exposing it. He thought the commercial element was an important one; and it must not be forgotten, if a saving of £1,000 would be effected in Bristol, and there were 3,000 lamps, that would be only 6s. 8d. per lamp, and he doubted whether the cost of putting up the apparatus, cleaning, and so forth, would be covered by that, to say nothing of interest on the first cost. If it could be applied to turret-clocks, pier-heads, beacons, light-houses, and so forth, it would be a most valuable invention.

Mr. Fitzjames asked what would be the effect should there be a failure of electricity, or should damp get into the apparatus?

Mr. Botley said that considering the enormous number of street-lamps in use in London and its vicinity, and that they were generally lit in the winter at 3.45 in the afternoon, and not put out till half an hour or even one hour after the sun had risen, the saving would not be much less than £100,000 a year, if the lamps were only lit at sun-down and put out at once in the morning. When the high price of coal was taken into consideration such a plan as this was a great desideratum.

Mr. Pearsall would like to know what would be the effect of an alteration of pressure, as it was well known a sudden effect was caused by the extinguishing of the lights in churches and chapels and factories in large towns; the pressure on the lights burning was increased to a vast amount. He thought that even if the plan were not suitable for general purposes, it might be for particular uses, and that it would be invaluable in cases of collision and where individual lights were required, as in beacons.

Mr. James Brown said that the difference of pressure arising from the turning out of the lights in large buildings, and in certain parts of the town, would be entirely provided for by the fact that it required a separate main, which would run along the streets. There was an advantage in that, as they would be able to tell the exact amount of gas which was consumed. He thought the principle particularly applicable to the use of turret-clocks. In the town where he resided they had had considerable difficulty as to the lighting of a turret-clock, a ladder being found too cumbersome and a stick too long for a man to hold and carry about; and the only way they got over the difficulty was by keeping the clock alight night and day all the year round, and the gas cost some £15 to £20, whereas some £5 would have sufficed to pay for the gas really required. It might be said, "Turn the gas down." They did so, and the result was that the wind blew it out. The result was that a chemist of the town had brought forward a plan which seemed similar to the one before them to-night, by which he showed by experiment how easily the lighting could be accomplished. He would like to know whether the platinum could remain in the light without suffering any serious damage, and also how long it would remain without being spoilt.

Captain Lewis Munro said in some parts of France he had seen only the figures and hands of the clock illuminated, the face being plain, thus giving a much clearer light, and enabling the clock at the Custom-house at Havre to be seen many miles off.

Mr. Walter Smartt observed that, supposing it were not possible to obtain a sufficient pressure, would not the gas, continuing to pass through the tube, cause an explosion? It might not always be possible to get a sufficient pressure of gas, as had lately been the case, and London might be left in darkness. Another fact might be mentioned. In some conditions the atmosphere might be very dry and in others very moist. Now, it was well known that cold metal had an affinity for moisture, and the platinum might become frozen, and some time might be required to heat the platinum wire. When the atmosphere was dry near the gas-works the platinum would soon get heated, but where it was further off it might take a much longer time, and the gas authorities, seeing the lamps lit near the works, might stop the pressure necessary to light the further lamps.

Mr. Lloyd Wise, replying, said he did not think the principle of lighting the Albert-hall was applicable for street lamps. With regard to carbon being deposited on the platinum wire, the experiments of Professor Klinkerfues had not shown that any such deposit took place when the distance of the platinum wire from the burner was properly adjusted. As to the evaporation of the liquid, if the supply was found to be low when the man went to clean the lamps, it would be a simple thing to add a little. But, as a matter of fact, during the three months the experiment was tried at Gottingen, which was in the winter time, it was not found necessary to replenish the supply. In regard to the liability to freezing, a gentleman in the town had seen the apparatus at work with the thermometer at zero, and therefore it could be guarded against. Sulphuric acid itself does not readily freeze, and the quantity of sulphuric acid was proportioned so as to prevent freezing as far as possible. As to the form of the vessel, it was not absolutely necessary that it should be of glass. The difficulty which had been mentioned as arising from an increase of pressure in private houses had been satisfactorily overcome, and the apparatus could be applied to chandeliers. As to the shadow which might be thrown, that was simply a question of detail, and could easily be arranged. The platinum wire did not reduce the light, as was supposed. On the contrary, it increased it, but if it was found needful it could be kept out of the flame. The use of separate mains was partly obviated by the arrangement which was proposed. There was no connection between the works and lamps, save by the ordinary main—nothing whatever besides. The number of men required for attending to the lamps would be diminished. One quarter of the present number of men employed would do all that was necessary as to keeping the lamps clean and the apparatus in order. There was not only a saving as regards the light, but the power of lighting the gas simultaneously was the great advantage of the system. The gas could be lit instantly when necessary. He might say that there was a town where the apparatus was about to be applied to the lighting of 5,000 lamps. In conclusion, he would add there was nothing delicate about the apparatus, and it was not liable to get out of order. The augmentation of pressure for lighting was only momentary, and took scarcely any perceptible time. When there was gas enough in the works to light the town at all you could always get the necessary pressure. The question of cost he could not go into now, as he was not prepared to do so.

The Chairman, in proposing a vote of thanks to the lecturer, said, in a case of this kind, where a new invention comes before a general audience, first it was needful to look to the object sought to be accomplished, whether that was sufficiently important; secondly, at the principles involved in attaining the object proposed; and, lastly, to the detailed application of those principles. In the discussion the results he thought had been, first, that the subject was of very considerable importance; secondly, that the principle employed for dealing with it was sound; and lastly, that the details involved in carrying out the principles were not complicated. In discussing a new invention we must always bear in mind that what we have to consider is, not whether the thing is perfect in all its branches, but whether it is presented in a form sufficiently perfect to warrant further trial, and he thought the feeling of the meeting was that they had had the invention presented in that form. The speakers for and against balanced one another fairly, and where any answer was required it had been given by the lecturer in his reply. Of course, it was an action that could not be spoken about without a trial. It was a matter of experiment to ascertain whether the statements were borne out by the fact of continued trial. A trial of three months in Gottingen was only as far as the matter had yet gone. And the trial in England, as far as it went, was successful; but that was to be yet further extended. The illumination of outlying buoys and rocks was the most important matter to which the apparatus could be applied. That was a subject which had caused much thought and labour to many scientific men; but as yet only one plan had been adopted, and that was where they had arranged a series of reflectors on an outlying rock with a light on the shore throwing its rays on the reflectors on the rock, which were then transmitted to the spot in the sea where they were wanted. It would be a very simple matter to carry a gas tube to an outlying rock, and to place a beacon sufficiently high to be out of the water, and then to establish this apparatus, and so, by reducing or increasing your pressure, to obtain or extinguish the light. He hoped the matter would be laid before the proper authorities, and that something practical would be done.

Mr. J. B. Booth sends the following:—In reply to many questions asked last evening after the reading of the paper on gas igniting, I may briefly state that, from experiments which have been made, the liquid will not freeze with the English winter temperature; the cost of the application to street lamps is not expensive; the saving of gas is very considerable; the lamp-lighters may be reduced more than one-half; the apparatus is not liable to get out of order with proper usage. After a long discussion in Preston by practical persons, the calculations made have shown a saving of nearly 30 per cent. on the present cost of gas lighting. The apparatus is capable of application to all public and domestic purposes. I shall be glad to answer any further inquiries from correspondents.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

On Friday last, 1st March, 1873, a meeting of representatives of the Australian Colonies, proposing to occupy the Belgian Annexe as a Colonial Court, at South Kensington, was held at the Royal Commissioners' Offices, Gore-lodge. The following members were present:—Sir Daniel Cooper, Bart.; Sir James McCulloch, K.C.M.G.; Mr. F. Dutton, C.M.G.; and Major C. F. Roberts.

The fifth meeting of the Committee for Ancient Objects was held on the 3rd March, Mr. C. D. Fortnum in the chair. There were present—Mr. C. M. Campbell, Mr. J. Crace, Mr. H. Durlacher, Mr. Moody, Mr. Soden-Smith, Dr. Thudichum, and Mr. R. Thompson. The committee inspected an interesting collection of drinking implements and utensils for the table, and of silks and velvets. Offers of loans of valuable ancient objects connected with the classes of the Exhibition were communicated to the committee.

The issue of season tickets for 1873 commenced on 1st of March.

Her Majesty's Commissioners for the Exhibition have resolved that—

1. Season ticket holders shall have the following privileges of admission:—

(*a.*) To the Exhibition on all occasions when open to the public.

(*b.*) To the Royal Albert-hall, where concerts of a high standard, directed by Mr. Barnby, and performances on the organ, by Mr. Best and Dr. Stainer, will be given daily throughout the Exhibitton. (See special musical programme.)

(*c.*) To all private views.

(*d.*) To the galleries of the Exhibition two hours before the general public.

Visitors to the School of Cookery will pay extra. Admission for each hour's instruction on Mondays, Tuesdays, and Saturdays, 6d.; Wednesdays, Thursdays, and Fridays, 1s.

2. The charge for a season ticket, conferring the privileges mentioned above, lasting from the 14th April, 1873, to 31st October, 1873, will be one guinea.

3. The Exhibition will be open daily from 10 to 6.

4. The charge for admission to the general public will be:—From Easter Monday, the 14th April, to the 31st October, on Mondays, Tuesdays, Thursdays, Fridays, and Saturdays, 1s. each day; on Wednesdays, 2s. 6d. until 1st of August; afterwards, 1s. The picture galleries, and some other portions of the Exhibition will be lighted every Monday and Saturday evenings, and be open till 9 p.m. Admission, after 6 p.m., sixpence.

5. Her Majesty's Commissioners reserve the right of altering the prices of admission from time to time, as they may see fit, after giving public notice.

6. Season tickets may be had at the Royal Albert-hall, in Kensington-road, at the Office of the Society of Arts, Messrs. Novello's, No. 1, Berner's-street, and 25, Poultry; and at all the principal agents.

7. Season tickets must be signed before presentation. The owners must produce them each time they enter the Exhibition or the Hall, and, when required, must write their names in a book.

8. Season tickets are not transferable, and if presented by any other person than the registered owner, will be forfeited. Tickets lost cannot be replaced.

EXHIBITIONS.

Vienna Exhibition.—Advices from Cape Town state that the great diamond of 288 carats which has been exhibiting there is to be sent to the Vienna Exhibition.

CORRESPONDENCE.

CHANNEL PASSAGE.

Sir,—With reference to the ventilation of steam-ships, I desire to direct public attention to a letter in the *Lancet*, 22nd ult., written by Dr. Alexander Rattray, of her Majesty's ship *Britannia*. He has made observations during a voyage from the Cape of Good Hope to England, and he states that in the American navy a new plan of ventilation has been adopted recently which merits notice.

I believe it is difficult to ventilate steam-ships, especially during rough weather, so as to neutralise the close smell which prevails below, in small steamers generally. As to sea-sickness, I believe—judging from observation and in some measure from experience—that it prevails chiefly in shortly-built boats, and when they have a pitching motion, rather than when they roll. Mr. W. Froude, F.R.S., is preparing a report upon this subject, which, I hope, will be published. A recumbent position, assumed before the motion of the vessel commences, is desirable when possible; and I think that in the plan of Dr. J. Chapman, for applying ice to the spine in sea voyages, this position is necessary.

It has been stated recently that Calais is not accessible, except at the time of high tide, for the Channel steamers when the wind blows from the north or north-east quarter, causing delay and difficulty, as was the case with the Royal yacht in the year 1822.

In building ships it appears to me desirable that compartments should be used where it is possible, and that the American lake steamers, in which I have been a passenger, would be useful models for English shipbuilders to study. In America the canopy or awning plan is in vogue, and useful in fair weather certainly.

Sea-sickness, I believe, is constitutional, and depends much upon the health. I have heard that even Lord Nelson suffered considerably during his final voyage in 1805. The late Sir J. Herschel invented a plan for hanging hammocks, so as to regulate the oscillation, and I should be glad to know what has been the effect of the invention? It was, I think, partially successful.—I am, &c.,

Chr. Cooke.

London, 1st March, 1873.

Sir,—As Mr. Bessemer has been permitted to comment in writing on the few observations I made respecting the ships for the Channel passage, on the evening of the 12th February, I ask the courtesy of a brief reply to him.

I do not consider that I gave an "opinion on engineering questions." The case simply is this:—Mr. Bessemer invents a saloon for the sea. I do not question the ingenuity of the invention (Mr. Bessemer knows more about that than I do), but I do consider I know more of the sea, for which he invents the machine, than he does, and my opinion is just what I gave, namely, that from my knowledge of the former, the latter will not answer the purpose intended. The practical reason is obvious; it provides for one motion only out of several, and I expressed my doubts of that one motion being effectually controlled; and my comparison of the governor, who is to keep the cabin horizontal, with that of a man at the wheel, was merely to show that the governor had not the same facilities of anticipating the motion caused by the next wave; and I am borne out in the advantage of an anticipatory action by the remarks of Admiral Robinson, who—contrary to Mr. Bessemer—claims it for the man at the hydraulic. I also knew that for the purpose the lever must be one of great power and easy motion, and the illustration of the fly on the man's nose was apposite, if not very elegant—for I would defy a man to sneeze or even stand the bite of a sand-fly without a sudden motion of the hands, so that it was no mistake or misapprehension on my part. The double set of valves is a wise precaution, but has nothing to do with the subject.

I may as well have been considered giving an opinion on ship-building, when I said that I believed the Bessemer vessel would heel at times more than fourteen degrees, and also when I expressed an unfavourable opinion of Captain Dicey's ship.

Sailors may have a kind of "rule of thumb" way of giving an opinion, but it must be allowed they are not always wrong; and if the young lady quoted by Mr. Bessemer, in expressing her dislike to Dr. Fell, was lacking in argument, I suppose it was quite conclusive to the doctor himself; and I may be pardoned in hoping that Mr. Bessemer will be equally satisfied with the assurance that I, as a seaman (and many others who are better judges than myself), do not believe in the practical efficiency of his saloon in a Channel seaway.—I am, &c., H. DAVIS.

SIR,—On Wednesday evening, the 26th February, there was no mention made of one great peculiarity in the Mackie ship—namely, that the bow wave, after parting on either side from the stem, is taken almost immediately into the channels, and becomes the means of propulsion, the bow being thus relieved by almost all the water forming the torrents which propel the ship. I venture to call attention to this, as it appeared to me in the light of an omission.—I am, &c.,

EPSILON.

March 1, 1873.

PROGRESS IN INDIA.

SIR,—Having been unable to attend the meeting of the Society for the discussion of Mr. Stocqueler's paper on "Progress in India," I should be much obliged if you will afford me room for one or two remarks.

With reference to the observations on female agency in India, it seems to be spoken of as a thing very desirable, but not yet introduced. But there are at this time scores of ladies of good position in England who have given themselves up to this work, and, besides establishing training and other schools, have access to the families of the upper classes in a great number of zenanas in all the great cities of India, and the demand for such agency is rapidly extending, so that those who are employed are overwhelmed with work, and are constantly calling for further help. These ladies, of course, make themselves masters of the languages necessary for free communication with their pupils.

With respect to irrigation only one work is mentioned, but no attempt is made to show the progress of this system of improvement.

There are now, besides innumerable smaller works, five great systems of river irrigation in extensive and successful operation—viz., those of the Cauvery, the Kistna, the Godavery, the grand Ganges, and the Ranee works. Those have cost to this time nearly five millions, fully equal to the results of an expenditure of twenty millions in England. They are none of them yet completed, but they are irrigating about 2½ millions of acres, paying about one million per annum in direct returns to the treasury, and an increase of produce of about £1 10s. an acre, or an average of four millions a year, besides all the savings in water carriage and in other ways, certainly in all more than 100 per cent. benefit to the country. There are also two great systems of such works from the Toombudra and the Mahanuddee, which have cost nearly three millions, but which are only just beginning to be in operation. Three other vast works from the Soane, the Sutlej, and the Jumna, are also now well advanced, and will probably be in operation this year, and five others have been fully planned and estimated, and will, it is hoped, be soon commenced. All these works are estimated to cost about £35,000,000 when completed, will irrigate probably about 15,000,000 acres, and secure food for about 40 millions of people, and provide about 12,000 miles of steam-boat canal. These are all entirely new works on a vast scale; there are, besides, thousands of minor works, some new, but mostly old native works, that have been improved and extended.

No particulars either are given in the paper respecting the progress of water-carriage.

It must be remembered that the power of India to contend with other countries absolutely depends upon this, which alone can provide cheap transit. In a paper lately the subject of supplying England with wheat from the north-west provinces was treated of. This will illustrate the state of the case in this respect. The whole depends entirely upon water transit. The sole reason why America pours wheat into England is that the former has water transit by the St. Lawrence and Erie canals. The wheat would not bear the expense of land carriage. Neither will the wheat from the north-west bear it, at a penny a ton a mile. When the above irrigation works are completed, and the wheat can be carried 1,000 miles for four rupees, or 2½d. a bushel, it will be available for the English market, and will be placed in a position of effective competition with America. And so with many other articles of commerce.

These navigation canals, fitted for steam power, cost nothing for transit, the interest being paid by the irrigation, but even if in any lines they were cut for transit only, the cost is so trifling (from one to three thousand pounds a mile) that the interest is a small charge upon the vast quantities carried where the transit is so cheap. Even the opening of the Upper Godavery, 220 miles, has only cost £2,500 a mile, and if the works at the third barrier are completed, 400 miles of navigation will be obtained at only £2,000 a mile.

If these first essentials of material improvement—irrigation to secure produce and greatly increase it, and steam-boat canals and improved rivers to give India transit at one-tenth of a penny a ton per mile—are kept out of sight, the progress of its material improvement cannot be at all correctly judged of. No land-carriage of one or 200,000 tons on main lines by land, at a penny a ton, can possibly enable India to contend with other countries. What she wants is the transit of two or three million tons on such lines at one-tenth or one-twentieth of a penny. When such provinces, instead of being under the necessity of growing everything they want, are enabled by cheap transit to give up the land almost entirely to those things for which it is best fitted, and to obtain other things from those provinces in which they can be grown most cheaply, just as the Isle of France is able to give herself up to growing sugar; there will then be a development of wealth and comfort far beyond anything now thought of. Thus the north-west, for instance, will be supplying England with wheat, and the central provinces will be providing immense supplies of their fine cotton, while both are supplied with a multitude of things from other provinces; but this cannot take place till they are provided with really cheap transit, which nothing but water can give them.—I am, &c., A. COTTON.

GENERAL NOTES.

A Society of Arts for Victoria.—We learn (says the *Australian Mechanic*) that a society is in course of formation, under the able auspices of Mr. J. G. Knight, founded on the basis of the "Society for the Encouragement of Arts, Manufactures, and Commerce," of London, established in 1754, and having for its objects the encouragement of the arts, manufactures, and commerce of the Australian colonies, by bestowing rewards for such productions, inventions, or improvements as tend to the employment of the industrial classes, and to the increase of trade; for meritorious works in the various departments of the fine arts; for discoveries, inventions, and improvements in agriculture, chemistry, mechanics, manufactures, and other useful arts; for the application of such natural and artificial products, whether of colonial, British, or foreign growth and manufacture, as may appear likely to afford fresh objects of industry, for extending the sphere of Victorian commerce, and generally for assisting in the advancement, development, and practical application of every branch of science in connection with the arts, commerce, and manufactures of the Australian colonies.

Chalk as Fuel on Railways.—With reference to a letter that recently appeared in our columns, we may notice that the London and South Western Railway Company, having tried the experiment of mixing chalk with coals for consumption in fire-grates at the offices, Waterloo, and finding it answer, have made arrangements for a regular supply to the various stations throughout the line for use in the several offices and waiting-rooms, and have issued an order for a truck load of chalk to be received at all the stations. The way in which the chalk is used appears to be as follows:—First light the fire as usual with wood and coals, then put on a layer of chalk, following with another layer of coals. A fire so made lasts a long time, and throws out a good heat. Experiments for using chalk in furnaces have been made, but it does not answer so well as in an open fire-grate. In the waiting-room at Guildford, chalk has been in use as fuel for over a week, and is said to have been found to answer very well.

NOTICES.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. The following meetings have been arranged:—

MARCH 12.—"On Signalling at Sea, with special reference to Signals of Distress." By Capt. P. H. COLOMB, R.N. On this evening Thomas Brassey, Esq., M.P., will preside.

MARCH 19.—"On Certain Improvements in the Manufacture of Printing Types." By J. R. JOHNSON, Esq.

MARCH 26.—"On the Edible Starches of Commerce, their Production and Consumption." By P. L. SIMMONDS, Esq.

APRIL 2.—"On Economy of Fuel for Domestic Purposes." By Capt. DOUGLAS GALTON, C.B., F.R.S.

APRIL 9.—*No Meeting.*

APRIL 16.—"On the Condensed Milk Manufacture." By L. P. MERRIAM, Esq.

INDIA COMMITTEE.

A Conference will be held on Friday, 14th inst., at 8 p.m., when a paper will be read by ROBERT B. SHAW, Esq., on "England and Central Asia." Major-General Sir HENRY CRESWICKE RAWLINSON, F.R.S., F.R.G.S., will preside.

At the Conference which will be held on Friday, 28th instant, W. T. BLANFORD, Esq., of the Indian Geological Survey, will read a paper on "The Mineral Resources of India." Sir LOUIS MALLET, C.B., Member of the Council of India, will preside.

Members are entitled to attend these Conferences free, and to admit two friends to each of them.

CANTOR LECTURES.

The Second Course of these lectures is "On the Energies of the Imponderables, with especial reference to the Measurement and Utilisation of them," by the Rev. ARTHUR RIGG, M.A. The remaining lectures will be delivered on the following evenings, at eight o'clock:—

LECTURE VI.—MONDAY, MARCH 10TH, 1873.

On the Energy of Light, with especial reference to the Measurement and Utilisation of it.

LECTURE VII.—MONDAY, MARCH 17TH, 1873.

On the Energy of Heat, with especial reference to the Measurement and Utilisation of it.

The Third Course of Cantor Lectures for the present session will be "On Wines; their Production, Treatment, and Use," by J. L. W. THUDICHUM, Esq., M.D. The Course will consist of six lectures, the first of which will be given on Monday evening, the 21st of April, the remaining five on the Monday evenings succeeding.

MEETINGS FOR THE ENSUING WEEK.

MON. ...**SOCIETY OF ARTS, 8.** Cantor Lecture. Rev. A. Rigg, "On the Energies of the Imponderables."
Institution of Surveyors, 8. Adjourned Discussion on Mr. R. B. Grantham's paper on "Private Agricultural Railways."
London Institution, 4. Professor Duncan, "Physical Geography."
Royal Geographical, 8½. 1. Mr. J. Thomson, "Journey in Southern Formosa" (Adjourned Paper). 2. Mr. W. N. Thomas, "The Oil Rivers of Western Africa."
Society of Engineers, 7½. Discussion on Mr. W. H. Fox's paper, on "Continuous Railway Brakes" (Atmospheric and Electric).
Medical, 8.

TUES. ...Medical and Chirurgical, 8½.
Civil Engineers, 8. Continued Discussion on Mr. Thornton's paper on "The Indian Railway Gauge."
Photographic, 8.
Royal Institution, 3. Prof. Rutherford, "On the Forces and Motions of the Body."

WED. ...**SOCIETY OF ARTS, 8.** Capt. Colomb, R.N., "On Signalling at Sea, with special reference to Signals of Distress."
Geological, 8. 1. "Prof. Ansted, "On the Solfatara and some Sulphur-deposits at Kalamaki, near Corinth." 2. Mr. J. Lucas, "On the Origin of Clay-ironstone." 3. Dr. Dawson, "Note in Vindication of *Leptophlœum rhombicum* and *Lepidodendron gaspianum.*" 4. Capt. F. W. Hutton, "Synopsis of the younger formations of New Zealand."
Graphic, 8.
Royal Literary Fund, 3. Annual Meeting.
Royal Society of Literature, 4¼.
Archæological Association, 8.

THURS...Royal, 8½.
Antiquaries, 8½.
Royal Society Club, 6.
Mathematical, 8.
Royal United Service Institution, 8. Capt. J. P. Morgan, "The Causes of Inaccurate Shooting with Smooth-bore and Rifled Guns."
Royal Institution, 3. Mr. A. Vernon Harcourt, "On the Chemistry of Coal and its Products."

FRI ......**SOCIETY OF ARTS, 8.** India Conference. Mr. R. B. Shaw, "On the Commercial Relations of England with Central Asia."
Astronomical, 8.
Royal Institution, 9. Professor Allman, "On Coral Reefs and their Architects."
Quekett Club, 8.
Royal United Service Institution, 8½. Mr. E. J. Reed, C.B., "Iron clad Navies."

SAT ......Royal Institution, 3. Professor W. K. Clifford, M.A., "On the Philosophy of the Pure Sciences."

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FRIDAY, MARCH 14, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

TECHNOLOGICAL EXAMINATIONS.

The Programme of Examinations in the Technology of some of the Arts and Manufactures of the country is now ready, and may be had on application to the Secretary.

The subjects selected for 1873 are Cotton, Paper, Silk, Steel, and Carriage-building. Those desiring to become Candidates, should apply for the programme without delay, as all names must be sent in before the end of March.

The following Prizes are offered by the Society of Arts in each of the five subjects mentioned above:—

To the best candidate in Honours, £10.

To the best candidate in the Advanced Grade, £7.

To the best candidate in the Elementary Grade, £5.

In order that these Examinations may really be successful in promoting technical education in this country, it is desirable that encouragement should be given to candidates by the offer of additional prizes and scholarships. With this object the Council appeal to the Companies of the City of London, to merchants and manufacturers, and to members of the Society generally, to aid them by contributing to the Prize Fund.

The following special additional Prizes are offered:—

By Wyndham S. Portal, Esq., to the Second and Third best Candidates in the Elementary Grade, Paper Manufacture:—

A Prize of	£3
A Prize of	£2

By G. N. Hooper, Esq., to the Second and Third best Candidates in the Elementary Grade, Carriage Building:—

A Prize of	£3
A Prize of	£2

By the Worshipful Company of Spectacle Makers, to the Second-best Candidate in Honours, in the Advanced Grade and in the Elementary Grade respectively, in the Manufacture of Steel:—

A Prize of..........................	£5	5
A Prize of..........................	£3	3
A Prize of..........................	£2	2

The Council beg to announce the following contributions to the Prize Fund:—

The Worshipful Company of Vintners..	£10	10	0
The Worshipful Company of Salters (annual)........................	10	10	0
Dr. Crace Calvert, F.R.S. (annual).....	5	5	0
Sir Daniel Cooper, Bart...............	5	0	0
R. L. Chance, Esq.	5	5	0

The Council invite the aid of masters and managers in promoting these examinations by encouraging their workmen to take advantage of them. An explanatory handbill, suitable for being suspended in factories and workshops, may be had on application to the Secretary of the Society of Arts, Adelphi, London, W.C.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal early in May next. This medal was instituted to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty the Emperor of the French, "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

The Council invite members of the society to forward to the Secretary, on or before the 12th of April, the names of such men of high distinction as they may think worthy of this honour.

PRIZE FOR STEEL.

1. The Council have resolved to award the Gold Medal of the Society to the manufacturer who shall produce and send to the London International Exhibition of 1873 the best collection of specimens of steel suitable for general engineering purposes.

2. The specimens exhibited must include a complete illustration of the applications of the varieties of steel submitted.

3. Each manufacturer should send with his specimens a statement of the nature of the tests he has applied to each kind of steel submitted, and give the results of such tests.

4. The samples tested are to be exhibited together with duplicate samples, or portions of the same samples; these will be submitted to tests should the Council consider it desirable.

5. All persons using steel for general engineering purposes, who are not manufacturers of such steel, are also invited to exhibit specimens on the above terms and conditions.

6. The Council reserve to themselves the right of withholding the premium, in the event of the specimens exhibited not being sufficiently meritorious.

INDIA COMMITTEE.

A meeting of the Committee was held on Monday, 10th inst. Present:—Major-General F. EARDLEY-WILMOT, R.A., F.R.S., in the chair, Dr. Archibald Campbell, Messrs. Andrew Cassels, John Cheetham, Hyde Clarke, W. S. Fitzwilliam, F. Hendriks, Edwin Lawrence, W. Maitland, and J. B. Smith, M.P.

PROCEEDINGS OF THE SOCIETY.

FOURTEENTH ORDINARY MEETING.

Wednesday, March 12th, 1873, THOMAS BRASSEY, Esq., M.P., Vice-President of the Society, in the chair.

The following Candidates were proposed for election as Members of the Society:—

Colomb, Captain P. H., R.N., Harrow, N.W.
Hale, William Francis, 304, Goldhawk-road, Hammersmith, W.
Ricketts, Arthur, 12, Forbes-road, Penge, S.E.
Smith, Matthew (Messrs. Frederick Smith and Co.) Halifax, Yorkshire.
Wallace Sir Richard, Bart., M.P., 105, Piccadilly, W.
Whitehead, Charles, F.R.G.S., F.S.A., Barming House, Maidstone.

The following Candidates were balloted for and duly elected Members of the Society:—

Barbour, William Boyle (Messrs. Barbour, Barclay, and Co.), Manchester.
Baynes, Alfred Henry, F.R.G.S., F.S.S., Fairlight, Harrow-on-the-Hill, Middlesex.
Brown, Alexander Marshall (Messrs. James Finlay and Co.), Glasgow
Cowan, John George, 4, Cullum-street, E.C.
Dehesghues, Leon, 51, Hatton-garden, E.C.
Garnham, J. B., 34, Stoke Newington-green, N.
Porges, Jules, 17, Conduit-street, W.
Rodger, John Pickersgill, 49, Harley-street, W.

The Paper read was—

ON SIGNALLING AT SEA, WITH ESPECIAL REFERENCE TO SIGNALS OF DISTRESS.

By Captain Colomb, R.N.

Since I first applied myself to extending and improving our methods of signalling at sea, now fifteen years ago, I do not remember that public attention was ever so much directed to the matter as it is at this moment.

This is not to be wondered at. The subject takes a narrow range, and is one of the most technical which exists. It needed something like a great disaster, which could in some measure be traced to defective signalling arrangements, to turn general attention to them.

If the eyes of those in the steamer which ran the *Northfleet* down were not dazzled by the powerful rays of the electric light at Dungeness, then we may say that no material agency could have averted the collision. But there is a very general feeling that more lives might have been saved if the *Northfleet* had possessed the power of telling observers what had happened to her.

The last sentence is important. The fact is generally admitted, but we are not agreed as to inferences proper to be drawn from it.

I believe that when one wants to make a point which shall create a momentary but strong impression upon the minds of listeners or readers, the best policy is to employ a little exaggeration. When, however, we do not care for the momentary impression, but desire to awake a thought which shall take a permanent shape, I think all exaggeration should be rigidly excluded. Holding such views, I am justified in expressing my belief that no material agency, such as a system of signals, would, under the present condition of mercantile marine, have averted a considerable loss of life in the *Northfleet*. The time of night, the circumstances of the case, the customs of our marine respecting the use of boats, and even the way in which our ships are manned, with what may be called "scratch crews," would all have militated against full assistance being rendered in time, had the system of signals been never so perfect.

On the other hand, I cannot permit myself to doubt that the general public are right in supposing that some lives, at least, fell a sacrifice to defective signals.

While, however, everyone agrees that what the *Northfleet* really wanted was power to say, "We are sinking; send your boats," I observe that nearly all are agreed that it would have answered equally well had she been able to say, "There is something wrong with us;" or, at the furthest, "There is something very wrong with us."

The general and professional public are, I think, led away by the sound of words, and have forgotten that a "signal of distress" cannot mean more than is conveyed by the foregoing phrases.

The first branch of my argument will be to show that the *Northfleet's* signals were essentially signals of distress, and were so understood. If this is proved, it will follow that had there been a more precise signal, meaning "distress" only, the results would not have been very different.

It is perhaps singular that there should be such a general impression abroad that the *Northfleet's* signals were misinterpreted; for I cannot discover in the sworn testimony any distinct grounds for such a supposition; and the direct testimony of all but I think one witness goes as far as denial that they were misunderstood.

In drawing attention to what observers say on this matter, I must point out that where a man has omitted to do something, and afterwards has reason to regret the omission, he would not be human if he did not relieve his mind by throwing the blame of his inaction elsewhere.

The first witness that I shall call is the master of the steam-tug *City of London*. He says:—"I was on deck, and saw seven rockets thrown up. I counted seven within a minute, and blue lights were continually burning. Directly I saw the seven rockets I thought it must be a collision, and hove my anchor up directly, proceeding in the direction where they were firing."

This witness was cross-examined with the apparent intention of getting him to admit that he might have mistaken the signals to be merely for a pilot; but he had already shown by his actions that he thought differently, and would not now contradict them by his words.

The next witness is a pilot on board the cutter *Princess*. He saw some rockets, answered them by a "flare-up," and at first, supposing a pilot was wanted, stood towards the rockets. "As we were going west," he says, "we saw six rockets at one time, with another flight of six, and blue lights. I remarked at the time that there must be a collision."

The next witness is the master of the lugger *Mary*. He says, "I was called up, and found a vessel to leeward of us, throwing up rockets. She was distant from us about a mile. We at first thought it was a signal for a pilot, but when we saw the ship throwing up rockets so fast we thought there must have been a collision. . . . We at once hove up our anchor, and stood towards her."

The next witness is the chief boatman of the coast-guard station. He saw nothing, but he was called because a ship had been making unusual signals, which could only denote something unusually wrong with her. Inasmuch as he got out of his bed to see, he bears silent testimony that he thought the *Northfleet* distress was greater than the want of a pilot.

This witness repeats some hearsay evidence. He says the crew of the lugger *Pilgrim* told him next morning that their watch "had seen the rockets and blue lights in the night, but did not know what they meant." He further says that the captain of the *Corona*, the ship which was nearest to the *Northfleet*, told him his watch had not only seen the rockets, but had heard the screams, yet did not know what to make of it. He also states that the coast-guardsman who called him told him he did not know "whether it was a vessel wanting a pilot, or whether there had been a collision."

Such was the evidence given at the inquest, the earliest, and therefore perhaps the truest, testimony relative to the question with which we are dealing. There is a modification of it by one witness which must be quoted, although this also is hearsay evidence. The pilot on board the cutter *Princess* relates a conversation between himself and the master of the cutter. Just before the collision the two noticed a steamer passing, and the master observed that she was "a Bremen boat." The Bremen vessels are, it appears, in the habit of throwing up rockets on passing each other. When the *Northfleet's* rockets were observed, the pilot said, "Surely that must be a collision," but the master said, "No, no; I have had similar chases after Bremen boats, and no doubt they are up to the same thing again." The point I wish you to note is that, notwithstanding this very natural doubt in these men's minds, it did not stay there. The pilot continues, "In this case we were put off our guard for a matter of five minutes, but then, when we saw the rockets going up one after another, we thought there must be something wrong."

It appears on the whole that there was not a single witness called before the coroner who saw the *Northfleet's* signals and who did not know that something was wrong; or, in other words, that the ship using such signals was "in distress." Immediately after the news of this terrible disaster was published, there sprang up the idea that the loss of life was directly traceable—not to the want of signals in general, but to the want of a signal which should mean "distress" and nothing else. This idea grew, and is growing still.

Accordingly, although the evidence on the inquest did not prove it, enough was said to set those who do not habitually criticise such question thinking that a single signal of distress was the remedy to be sought for.

We can trace the growth of the idea in the minds of witnesses on the later inquiry before the Board of Trade officials; for we hear more there as to the necessity for a special distress signal than we had heard at the inquest; but it is not necessary to go closely into the evidence given, because, although a greater stress is laid on the possibility that a distress signal might have mitigated the calamity, I do not gather that any witness denies knowing that the signals made were essentially distress signals. The master of the cutter *Princess*, indeed, states that he thought a pilot was wanted when his attention was first attracted. We know from other witnesses that he did not continue in his belief.

As to the coastguard, we now have the statement of the commissioned boatman who called the chief boatman (whose evidence I spoke of before), and he, as might be surmised, states that "the rockets continuing, he concluded it was a ship in distress," and walked a mile and a quarter to call up his superior officer.

Then we have new evidence from the mate of the *Princess*, who states, just as the others did, that he recognised the *Northfleet* signals to be signals of distress.

On such evidence, and in spite of the prevalent belief, I must consider one point proved—namely, the *Northfleet's* signals were generally understood to be signals of distress.

I have next to show that rockets and blue-lights in any number are almost universally accepted as signals of great distress, although both are sometimes used in small numbers to express smaller distress. We need not go far in search of evidence. My professional brethren know very well that, though in the Royal Navy we use our rockets and blue lights simply to attract attention, and that they never have been, and are not now, especially distress signals, yet if any ships in our vicinity were, in the dead of night, to begin firing off rockets and blue-lights indiscriminately, we should immediately conclude that the ship using them was in distress, and we should at once take measures to ascertain the nature of the assistance required.

For those who are not content to take up the passing, and, it may be, superficial views of these questions without examination, a good deal of matter may be extracted from the columns of the *Shipping and Mercantile Gazette*. I shall here only mention one or two pieces of evidence which are quite recent.

A Captain Lash writes, on the 5th of February last, to say that as his ship was proceeding up the Gull-stream (near the Downs) he brought to mind that there were some rockets on board which could not be lawfully carried into the dock whither he was bound, he therefore directed his chief officer to dispose of them, and the latter fired them off as they proceeded through the Gull-stream on the night in question. Two Deal luggers immediately found their way alongside, to answer what was positively asserted by them to be "a signal of distress."

In the same column where Captain Lash's letter appears, there is another equally important. Captain Drury, master of the *Chloe* steamer, writes on the 6th of February to say that, being in his ship, five miles from the Tongue light-ship at the mouth of the Thames, he saw rockets thrown up in quick succession, also blue lights burning. It occurred to him that something was wrong. He ran his vessel off her course for half an hour to the eastward, and when he came up with the vessel which had fired the rockets, he found her to be a large steamer in want of a pilot. He is naturally not pleased that his praiseworthy exertions were thrown away; and when he proposes that some steps should be taken to avoid the same thing in future, we all sympathise with him.

I take a third case, which I find deposed to a few weeks ago, by the master of the *Outalpa*, a ship of 717 tons. Being on her voyage from Adelaide to London, and the weather threatening, she took a pilot off the Scilly Islands and anchored in St. Mary's Roads. In the night of February 1st, it began to blow hard, and ultimately, though the ship had two anchors down, she began to drag. The master then deposes thus:—"Hove port anchor off the ground with the hope of bettering my position. She suddenly struck heavily. Pilot said, 'She is lost!' I told him not to give up. She again struck, but more lightly. It was now 1 a.m., of the 2nd February. Fired rockets and blue lights for assistance, which were answered from various stations. At 2 a.m., a boat came alongside, which I sent for an anchor and chain, hoping therewith to heave ship off."

By a shift of wind this ship was able to make her escape from her dangerous position and to sail into safe anchorage.

Here we have a case where distress signals were intentionally used, where they were answered, and where they produced assistance, only—not the sort of assistance which was required.

These cases, taken quite at random, and without any search worthy of the name, are, I think, sufficient to complete the evidence one side, and to prove, in the absence of rebutting evidence, that the signals made by the *Northfleet* would be generally, if not universally, understood as signals of distress.

In order to complete the case, we must produce some evidence on the other side.

I shall take first the instance of the *Rangoon*. This ship, leaving Point de Galle harbour after dark, ran upon a rock, then cleared it, and was found to be in a sinking state in deep water. She fired off all the rockets and blue lights on board as signals of distress; they were seen from the shore, but were interpreted as being a friendly illumination in honour of some guests who had gone to sea with her and were about to return. No assistance left the harbour for this ship in consequence of her signals, which were, therefore, entirely misinterpreted.

Another case is that of the *Josephine Willis*, in the year 1855. This ship left the Thames in company with another, named the *Progress*. The captains of both ships were old school-fellows and friends, and the two kept company side by side until they were off Folkestone; there, during the hours of darkness, they separated in consequence of a change of wind. Twenty minutes later the *Josephine Willis* was run into by the *Mangerton* steamer, and was left in a sinking condition. She threw up the usual rockets, which the captain of the *Progress* saw, and, supposing them to mean a friendly farewell, sent up rockets in reply, and took no further notice. Meanwhile the *Josephine Willis* was sinking, and she ultimately carried down with her about 70 souls.

We have thus on the one side very general and satisfactory testimony that rockets and blue lights in numbers are generally understood by seamen to mean urgent distress, and two very remarkable cases where their purport was distinctly misunderstood.

If my endeavours were to prove that no change in the signalling arrangements of the mercantile marine was called for, there would of course be an end of the case here. Once I had shown that a signal of distress as at present arranged ran a risk of misinterpretation by intelligent observers, I had also shown the desirability of removing that risk by the establishment of a legal and generally recognised signal of distress, which should mean distress and nothing else.

My argument will convey us a good deal beyond this point, and will tend to show that however desirable the establishment of legal distress signals may be, it will only touch the outskirts of the question, and that we ought, in consistency, to make a much greater step in advance.

On the question of a distress signal, we have a very anomalous state of opinion to deal with. On the one side we have to deal with the complaint—or the supposition—that signals of distress are generally taken as expressing the want of a pilot; on the other side we have the complaint of men who go out of the way to succour a distress which does not extend beyond the want of a pilot. Both these complaints cannot possibly be generally true. It cannot be that signals of distress are generally interpreted as signals for a pilot, and, at the same time, signals for a pilot are generally accepted as signals of distress.

The fact I take to be this: "Want," and "Distress," are synonymous terms. When a ship is recognised as being "in distress" she is also recognised as possessing some want. The common wants, and, therefore, the common distresses vary with the locality. In and about the Downs, for instance, ships commonly get into distress from running aground, from parting their cables, dragging their anchors, or fouling; also from want of steam power. Ships are not usually in distress for want of a pilot there, because it is customary for them to provide themselves with pilots before arriving at that point.

Far down the Channel, and at any distance from land, ships rarely suffer distress from want of a pilot. But they spring leaks, catch fire, are run down by other ships, lose their masts, or break down in their engine power. Any unusual alarm signal, attracting general attention to the ships displaying it in these localities, would be interpreted according to the usual or probable causes of distress. The sort of assistance usually demanded in the locality in question would be usually forthcoming. If the locality were one where distress of any kind was unusual, all that could be hoped for would be a messenger by boat or ship to ascertain the nature of the distress and the required assistance.

On the other hand, we see by the instances of the *Josephine Willis* and the *Rangoon*, that if there is good reason to assume a cause other than distress for the use of alarm signals, and if the distress itself is very sudden and unexpected, observers will not accept as a distress signal that which they would, under other circumstances, have readily accepted as such.

On a case of this kind, the remedy seems at first sight a very simple one—namely, to establish an international signal of distress. Such a remedy appears in the second place very easy to administer. And I, for one, must acknowledge to thinking so for a time. But though I cannot yet see a positive objection to the establishment of such a thing, I am a little staggered by one or two considerations. In the first place, there is amongst sections of the shipping interest a very distinct and strong objection to "legalising" distress signals, and as the matter is a puzzle to me, I shall quote my authority in full. The Board of Trade, in the spring of 1871 and in the autumn of 1872, made some proposals about distress signals, apparently as a means of eliciting opinion. The following letter is published, as having been addressed to the Board of Trade, by the Local Marine Board of Newcastle:—

"Local Marine Board,
"Royal Arcade, Newcastle,
"November 18th, 1872.

"SIR,—Referring to Board of Trade letter of the 2nd October, forwarding a circular containing the draft of a set of rules intended to lead to the adoption of an uniform system of signals for ships in distress, and for ships wanting a pilot. The Local Marine Board desire me, in reply, to say that they are entirely opposed to the proposal in question. They have given the matter very careful consideration, and they desire to repeat all that they stated in their letter, dated April 13th, 1871, when this same question was under consideration. The Local Marine Board are opposed to any suggestion for legalising distress signals by embodying them in the Merchant Shipping Code.

"It is stated in the circular referred to, that all the public bodies, including the Admiralty and the Trinity-house, with whom the Board of Trade have corresponded in this matter, agree as to the necessity for authorised signals of distress. The Local Marine Board are much surprised at the statement. They have caused most careful inquiry to be made in this locality amongst the large shipowners and Underwriters' Associations, who have all, without exception, declared that no legislation whatever is required regarding distress and pilot signals.

"The Local Marine Board have before them a letter, stating that the underwriters in this locality representing insurances to the amount of four millions sterling, do not advocate any change as regards distress signals; and further, that if a distress signal were legalised, it would, in their opinion, be the subject for very great abuse by interested parties.

"The Local Marine Board are unanimous in their opposition to the proposal to legalise distress signals.

"Sailors of all nations know distress signals whenever and wherever they see the same exhibited, and distress signals are easily understood when seen by persons on the sea coasts. It is extremely undesirable to hamper persons in distress with exhibiting strictly legal signals. It is only interested parties on shore that can desire the signals to be legalised.—I am, &c.,

"S. W. STOREY WHITFIELD, Sec.

"To the Assistant Secretary Board of Trade, London."

I think the letter will be to my hearers, as it was to me, a very surprising one. I am not sufficiently versed in questions of the shipping trade to know where the real objection lies, and how legal distress signals could be applied to the disadvantage of others by "interested parties," but I think we shall all admit that it must be a very strong objection which could call forth such emphatic language.

Though I am unable to gather the thought which lies at the bottom of this protest, I can myself see a good many difficulties in the way of any purely legislative action as regards "signals of distress." It seems as though their use must be surrounded by penalties, and I have observed several writers in the public press look upon compulsory legislation and heavy penalties as likely to mitigate such evils as the loss of life in the *Northfleet.* My opinion is that usually, when a man has thought enough to see the necessity for compulsion and penalty, it only wants a little more thought to show him how to discard both and yet attain his object; and for this reason I generally dislike compulsion.

It seems, however, to be commonly understood that, side by side with a legal distress signal, must be a law making an unjustifiable use of the signal penal. It is argued that without such a law the masters of ships would speedily grow into the habit of using the signal to obtain the supply of trivial wants. I think the argument is sound within limits. I conceive, for instance, that a ship arriving off a port at night with a fair wind, and wishing only to land mails or passengers and be off to her destination, is very likely indeed to use any means at hand to get a boat to come off. And if she were provided with a very conspicuous "fire-work" or similar appliance which legally meant distress, it is not at all unlikely she would use it were she committing a moral offence only.

Supposing, however, it were made a misdemeanour to use the distress signal for a comparatively trivial purpose, some one must prosecute, if the law were not to become a dead letter; and I think our shipping legislation shows us too many dead letters of a similar character, to lead us to hope for much in that direction.

Damages might be recoverable in a civil suit by anyone who had been put to cost, inconvenience, or peril, by an improperly-used distress-signal, but I am afraid hard-headed Admiralty Court lawyers will tell us that such actions would not often be brought, and would be even less often won. As constantly happens in collision cases, the material witnesses would be scattered to the four quarters of the globe when the case came on, and there would be an end of it.

But, supposing it were possible to enforce penalties, we should be landed in some difficulty, for we must prescribe each set of circumstances which may be legally included under "distress," and as there is no real boundary between the character of the greatest and the least want, we should be likely to draw an artificial one too widely, and so fall back on our present trouble; or too narrowly, and so push our signal out of general use. If the use of a distress-signal is very rare, its meaning will possibly be forgotten at a critical juncture.

Lastly, there comes the dictum of an authority, Capt. Forster, of the Emigration Office, who tells us that "A signal for a pilot, with a prospect of pay, often brings more assistance than the simple white rocket signal, 'I want assistance.'"

I think I have said enough to show that the subject is surrounded with difficulties, although it is generally assumed to be so simple, that public departments are accused of supineness because they have not yet dealt with it completely. If there were no personal or moral difficulties in the establishment of a universal distress-signal by night, there need certainly be no physical ones. Any pyrotechnist will give us dozens of admirable distress-signals, using all the colours of the rainbow, and all we should require at his hands would be their distinctive character, their simple action, and their non-liability to spontaneous combustion —a liability which most *red* fires suffer under. For distress-signals in fog the maroon has been proposed, and here the pyrotechnist might easily be left to provide us.

In distress signals at night, as in all other signals at sea, certain conditions must be fulfilled. If the signals are visible, they should be displayed simultaneously, if not to all points of the compass, at least over a very large arc of the horizon, as it is impossible to say usually from what quarter the required assistance may be forthcoming. If the signals are not permanent, means must be adopted for their continual repetition so as to make them practically permanent. The distance at which the signals can be distinguished by the naked eye, should be as great as it is possible to have it—not necessarily to be read at that distance, but because a thick atmosphere, which it is necessary to pierce, so commonly intervenes between the observer and the signal.

It may be safely asserted that there is not in any merchant ships now afloat a permanent light which is visible all round the horizon at a greater distance than two miles in clear weather. The blue light, commonly used afloat, may, however, be seen ten miles—I have once seen a blue light fifteen miles. It is only this greater power which brings the rocket and the blue light into such favour.

I have seen a form of permanent lights with a contrast of colour suggested as a distress signal, but to this there are several very distinct objections. If two permanent lights be placed six feet apart, it cannot be determined at a mile distance by the naked eye, whether one or two lights are displayed. Any colouring shade before a white light, diminishes its power of penetration; a red shade by about one third, and a green shade by about one half. It follows that either the white lights used in combination with coloured lights must be reduced in power or that the coloured lights must be increased. If either of these things be not done the nature of the combination will be lost to observers, who will see the white lights only.

There is no question which has been more thoroughly tried and more absolutely condemned than the employment of coloured permanent lights for signal purposes at sea. The idea has been put into practice in every form, whether with one light and alternating colours, many lights, or few lights. The results have in every case proved valueless.

It is different with pyrotechnic colours. In many cases these have proved very successful, and where the attempt has only been to secure one or two clear and distinct signals, pyrotechnic colours have held their own in default of a better system.

The fog signal of distress must, of course, be a sound or sounds, and for these we have the gun, the maroon, the steam-whistle, and the fog-horn. If we consider the use of the fog-horn and steam-whistle already occupied, we have only the maroon and the gun, fired at some fixed interval or intervals of time; of course these intervals may be prescribed.

Now, as there are no physical difficulties in the way of providing an efficient distress signal, so the moral difficulties will not stand in the way when Government has made up its mind. I shall therefore suppose, for the sake of argument, that we are to have an established night and an established fog signal, which shall mean "distress," nothing more and nothing less. Let us see how we shall then stand.

If there be any truth in the evidence given in the case of the *Northfleet*, we cannot assume that a legal distress signal would have materially assisted her. All those who rendered aid to her state that they did so in consequence of her signals, and we have no evidence to show that anyone withheld his aid because he did not believe she was in distress.

On the other hand we have abundant evidence to show that no one knew or guessed that the ship was sinking until they saw her with their eyes. Her real want was power to say, "I am sinking," not to say, "I am in distress."

Let us take another case, which I have before quoted—that of the *Outalpa*. You may recollect how she made the usual distress signal, bringing a boat alongside, which she at once sent back for an anchor and cable. This ship's signals succeeded as well as any merely distress signals could, but they did not produce the assistance she wanted, and she might have been lost while the boat was making its useless journeys from and to the shore.

We now come to the case of the *Rangoon*, whose signals failed, and we have to consider whether she would have been much better off had they succeeded. She ran upon a rock, tore a rent in her skin, floated off again, and sank in deep water. It was equally possible that she might have remained on the rock in a comparatively uninjured state. The distress would have existed in both these cases, but the nature of the assistance required would have been quite different. In the real case she required boats, as many and as quickly as possible; in the supposed case, hawsers and anchors. Perhaps a second steam vessel would have been of more value than all the boats in the harbour.

A third thing, equally distressing, might have happened. Her engines might have broken down in close proximity to the rocks. The *Rangoon* might have been compelled to anchor in such a position that, without the immediate assistance of a steamer—which we will suppose to be in the harbour—to tow her out of peril, she might have gone to pieces in a few hours.

In all cases such as these time is the all-important element. Had the *Rangoon's* signals been at once understood to be distress signals, the authorities on shore would have only done earlier that which they did later, namely, send off to see what was the matter. Once this was ascertained, the particular wants might have been supplied as far as the resources of the place went; but before it was ascertained, what could be done? It did not follow that because the *Rangoon* made a signal of distress she therefore wanted all the boats in the harbour as fast as possible. Nay, when it was known that she was in distress, it was not known that she was sinking. Here, therefore, we have a case where the simple distress signal would not have produced the assistance required.

Next comes the case of the *Josephine Willis*, which is one where probably a single distress signal would have answered, because the *Progress* being at hand possessed perhaps the only means of assistance available, and it may be supposed she would have used them. But I shall revert to the case, as there is a fair inference in favour of my future argument to be drawn from it.

I suppose that the nature of this argument is now sufficiently apparent. I believe that it is not in providing a particular signal which shall mean "distress," and another particular signal which shall mean "wanting a pilot," that we shall succeed in averting such losses as those in the *Northfleet* in future. I rather believe we should struggle to enable merchant ships to express to one another and to the shore their actual wants, and no such vague idea as being "in distress."

I have no objection to an alarm signal, the more distinct and startling the better; but if we have an alarm signal to get attention, and when we have got it are further able to say what we want and why we display the alarm signal, I consider we make real progress. But if the signal expressive of our particular wants is itself an alarm signal, then I think we have made a further advance.

Twelve or thirteen years ago we in the navy were nearly in the same condition as regards signals of distress as the mercantile marine now finds itself. It was then said by all our authorities, and also believed by me, that what we wanted were a few distinct, simple signals to express the most likely orders of the admiral, the most probable wants of any ships.

I believe nearly the same idea might be expressed by many who have thought over the *Northfleet* disaster. No naval officer, however, who is personally acquainted with what goes on afloat, is likely to say this.

We cried out for a few simple signals because we had no idea that it was practically easier and simpler to extend to ships by night, the powers of signalling they already possessed by day, than to provide those few signals. So soon as the former was done, our cry ceased, and we are at least satisfied with what we now have.

The mercantile marine is as well provided as the navy for signalling by day. Her officers are taught the use of signal books and flags, and are placed in a position enabling them to express all their wants by signal, not only to ships of their own nation, but to those of nearly all others, by means of the key language found in the International Code.

In the early pages of the International Code there are set apart rather more than one hundred signals considered of urgent importance, and classed as "danger and distress" signals. None of the proposed "distress signal" arrangements by night intend to provide for more than two out of these—namely, the signals represented by the flags N.C., "In distress; want assistance," and that represented by the flags P.T., "Want a pilot;" and the question naturally arises, why, when the means are at hand and known, should not ships be enabled to express, by night and in fog, not only any of these hundred and odd wants, but any of the many thousand other questions, reports, and answers which the Code Book contains? Is it, in short, or is it not, possible to use this code at night as freely as in the day time?

I distinctly believe that it is, for the very simple and satisfactory reason that similar codes are now in use indifferently by day and by night in English, Russian, Austrian, German, Spanish, and probably Italian or French ships at sea. It is true all these ships are men-of-war, but I will presently show that merchant ships may just as easily employ the same means.

The question will now be asked, how is this done? and the answer is, that it is done by the means proposed many years ago by such far-sighted men as the late Mr. Babbage and Sir Goldsworthy Gurney, and which I and others have been able to carry out to a practical issue.

At its first introduction the progress of the system of signals, now known as the "flashing system," was baulked by its very simplicity. As it used for night signals only a single white light, provided with means to make it appear and disappear, it seemed absurd to suppose it could do what numbers of lights of several colours, guns, rockets, and blue lights had failed in doing. And it was only when it was found that no matter what was the state of the weather, and no matter how complicated the message, it was always quickly and correctly conveyed to any number of surrounding ships, that we became aware of the importance of the principle we dealt with. Since that date the growth of the system has been steady and continuous. Unless some method of signalling at sea now entirely hidden, be discovered, we may quite safely predict a future status for the flashing system at night, not below that of coloured flags in the day time.

The system is very easily explained and described.

Flashing signals are made by the motion of any single object. In most instances the object is made to appear and disappear; and in others it is made to change its position, so that one position shall represent the appearance, and the other the disappearance of the object. The symbols are determined by successive appearances and disappearances at regulated intervals, constantly recurring after a fixed pause, in a manner precisely similar to those of revolving or flashing lights in lighthouses. Signals made on these principles can therefore be scrutinised as long as may be necessary to make quite sure of their purport by comparison with the codes, before they are answered, in the same way as any series of flags hoisted together in the day-time may be fully examined before they are acknowledged.

Every signal—consisting of one or more signs, and representing a group of letters, figures, &c., according to the code in use—is made to recur once in every twenty or thirty seconds; so that an observer watching a signal for three minutes, may see it legibly repeated from six to nine times. This speed is found most suited to general service, and usually the observation of three repetitions is sufficient to make the signal understood without the possibility of mistake.

The appearances of the object are termed "flashes" and are of two lengths, termed respectively "short" and "long" flashes, which are used in combination to express the signs required. The long flash is about a second and a-half in duration, and the short flash about half a second.

At night these signals are in all cases made by the obscuration and exposure of a single light; in the day-time the different apparatuses suited to the varying circumstances of service.

The basis of the flashing system is numeral. First, because unlike flags, no repeaters are necessary; and secondly, because the signs are much more easily remembered, than when lettered, and as fewer signs are used, the system is simplified.

In fogs long and short sounds are used instead of long and short flashes.

The signs are given in the following:—

Table of Flashes for all Signal Books.

Numerals.

1	–	6	——
2	– –	7	– ——
3	– – –	8	—— –
4	– – – –	9	– – ——
5	– – – – –	0	—— – –

In the above, the long and short marks represent long and short flashes, showing their proportionate lengths; the proportionate interval which elapses between parts of a figure is shown by the spaces.

It is convenient, but by no means necessary, to use one or two additional signs, such as a sign for acknowledging a signal called the "stop" or "finish." But if it be more convenient to omit these auxiliary signs, then we have in the above ten symbols everything which is required to use international code by night.

You will observe, therefore, that practically the signs representing the figures from 6 to 0 are all which it is necessary to commit to memory, and as 8 is the reverse of 7, and 0 the reverse of 9, the whole system is really learnt while we are talking about it.

The method of applying this system to the International Code is perfectly simple. In the diagram given below, a portion of the code is shown with the required addition; it is simply to place side by side with the lettered column, which is used with flags in the day time, the *numbered* column to be used with flashing figures. There is nothing novel in the proposal, and nothing experimental, for it is what we did for our naval code book several years ago, and which has answered perfectly ever since.

Danger or Distress.

Assistance.

1	H B	Want immediate assistance.
2	H C	Vessel indicated wants immediate assistance.
3	H D	No assistance can be rendered.
4	H F	We are coming to your assistance.

Boats.

5	H J	Boat, or life-boat, cannot come.
6	H K	Boat in distress.
7	H L	Do not attempt to land in your own boats.
8	H M	Man overboard.

Assuming that the mercantile marine will follow the navy in the adoption of flashing signals, as it has already followed it in the matter of coloured flag signals, and thus possessed itself of the power on any distressing occasion, not of using a vague phrase, but of saying exactly what was the matter, or what was wanted, it is very easy to see the enormous advantages gained.

All the legislative difficulties vanish to begin with, for however a public body may object to establishing a "legal distress signal," when there is only one, no one would object to giving ships power to say they were on fire, they were sinking, they wanted an anchor and cable, they wanted to know their latitude and longitude, and so on. When the two signals were equally distinct, no captain of a ship would take it into his head to say he was "in distress and wanted assistance" when he really "wanted a pilot."

But chiefly we should gain this great advantage —a ship would be free to use any, and every known means of attracting attention, because all such means would merely emphasise the words she was uttering by signal.

Then, while we deal in the most complete manner with the distress signal question, by one and the same operation we throw open to the ships of the mercantile marine full powers to communicate by signal at all times, and under all circumstances.

As to distress signals, it is reasonable to suppose that copies of the early pages of the International Code, on an enlarged scale, might be placed on boards at all life-boat, look-out, and coastguard stations for public inspection; and we must assume that in this manner the boatmen, fishermen, pilots, coastguards, and all who might at different times be called on to render to ships different kinds of assistance, would become familiar with the numbers denoting these particular wants. They would soon carry in their minds the recollection that 14 meant "machinery disabled," that 91 meant "I am sinking," that 01 meant "I want an anchor and cable," or the 07 meant "I want a pilot." Most ships now carry the International Code, so they, in the same way, would gradually become familiar with the meaning of the different signals.

It is, of course, abundantly plain that we cannot revolutionise the mercantile marine, and make them all expert signallers at a moment's notice. But I see no reason why we should not begin. There are thousands of men in the navy and in the army of England, setting aside foreigners, who can both read and make these flashing signals, and the number is growing daily. Why should not the officers of the mercantile marine, who are now called on to read and make signals in the day time, be called on to undergo the very small additional labour of learning to read and make them at night and in fog? Something like this would soon make a beginning, and I have some hopes we may see it done before long.

I shall, of course, be asked what sort of apparatus I propose for the use of merchant ships with this flashing system, but if I have succeeded in conveying the nature of the plan to the minds of my audience, it will be seen that apparatus is a secondary condition. Anything which can be easily moved and easily seen; anything capable of making a long and a short sound will make flashing signals, and apparatus is only necessary to give us increased range or increased speed.

For a day signal apparatus there are few things better than a single flag, the halyards being worked in the right and left hands. I have read a flashing signal made by short and long puffs of steam, when I could hardly see the ship which used them. A collapsing and expanding drum is also found most satisfactory. A flag on a staff, such as is used in the army by a single man, will sometimes carry a message ten miles at great speed.

When we come to communicating from the shore to ships by the flashing system, we find that in the day-time a series of shutters, worked like a venetian blind, produces the most astounding results, and enables us to communicate to seaward at distances or speeds impossible with any other plan.

Coming to fogs, I know of nothing better for sound signals than the ordinary ship fog-horns. They are largely used in the Royal Navy for this purpose, and any improvement effected in them will extend the range of fog-signals beyond the mile or mile and a half at which it now stands in still weather.

At night, any light capable of rapid occultation is, of course, available, but as our view to-night is particularly directed to the question of night signals, and especially to signals of distress, I naturally produce to you the identical apparatus I propose.

To fulfil our wants in the mercantile marine, the flashing signal light must be very powerful, very simple, and very cheap. Long ago we christened such a light by the name of the "Chatham light," and this we have here in its simplest form. In outer character it is a simple anchor lantern, such as every ship is bound to carry now. In lieu of the usual oil-lamp, or candle, we have in the interior an ordinary spirit-lamp, and there is an arrangement by which I can, by blowing through an india-rubber tube, project a certain inflammable and brilliantly luminous powder into the flame. When I blow, the light appears, and when I cease to blow the light ceases. It is, therefore, all one whether I blow into the lamp or into a fog-horn—the signals produced are identical, except that one is conveyed by light and the other by sound.

Although this light has never been in extensive use, certain specimens have been working for some years past, so that we know a good deal about it. We know it is powerful; the light in the specimen before us is equal to 160 candles, and is visible ten miles. The common blue light is only equal to 60 candles. We know from its construction that it is as simple as a common lamp, and I have found, too, that when I have called suddenly on a lamp which had been years in use on board ship and elsewhere, it has never been found wanting. We know also that we might fill and trim the light now, and put it away for a year, and then if we wanted to make a signal it would be just as you have now seen it—ready in all respects. We know it is cheap—about £3 or £4 will provide such a light, and any ordinary signal will cost about twopence additional.

Let me now apply practically the lessons I have been endeavouring to draw from the cases of the *Northfleet*, the *Rangoon*, the *Josephine Willis*, and the *Outalpa*.

The *Northfleet* might have been expected, had matters been arranged as I propose they should, to have used her rockets and blue lights just as she did use them. She would then have got the attention she actually did get. She would, besides, have displayed by the more startling and powerful Chatham light, with which she was provided, either the figures 91, "I am sinking," or the figures 96, "I want boats immediately." Some one of the officers would have seized upon the fog-horn, and would have *sounded* these figures towards the nearest ship, the *Corona*. Those on watch in this ship would probably have been in ignorance of more than that a ship near them was saying something by means of a light and a fog-horn. As they could not assume what was said, they would probably have called the pilot; he would have been a man familiar at least with the figures 07, by sound or by light, and would have seen that whatever was said, it was *not* "I want a pilot." Inquiry would have been roused, the officers would have been called, and boats would have been sent.

The case of the *Rangoon* needs no comment; she would have got into communication as to her actual wants with the signal station on shore, and those needs would have been supplied as rapidly as circumstances allowed.

That of the *Josephine Willis* is more worth looking into. Nothing is far-fetched in supposing that the two friends, one in the *Progress* and the other in the *Josephine Willis*, should have amused themselves by carrying on those private conversations by flashing signals, with which our naval officers are so familiar. As they parted company, something like a farewell by signal would have passed between them. If, following on this, the captain of the *Progress* had seen the rockets, accompanied by the figures 91, is it to be supposed he would not have made the best of his way to his friend's relief?

Lastly, we have the case of the *Outalpa*. Her signal 01, meaning, "I want an anchor and cable," we know would have been answered from the shore, because the not more distinct signals she used actually were so. The difference would have been, that, instead of a boat coming off to know what she wanted, a boat would have come off *with* what she wanted, namely, an anchor and cable.

Such, then, are my views on the question of distress and other signals at sea. My object in reading this paper has not been to force them on the marine public, but I hope and believe that there is enough soundness and truth about them to justify at least some sort of inquiry as to whether we may not find in these views something which may assist in saving life at sea.

DISCUSSION.

Sir James Anderson said it was many years since he first became acquainted with Captain Colomb's system of signalling, the merits of which he both understood and appreciated, but at the same time there were practical difficulties in the way of carrying it into operation. In the Royal Navy, in the army, or in large and well-organised services, there would be no difficulty in adopting a system of this kind, and he had known whole columns of the *Times* signalled from one ship in the navy to another simply by flashing the hand across a common lantern, and the men learned to speak with each other in this way very well, not only at different ends of the same ship, but from one vessel to another, at the distance of half a-mile or a mile. The difficulty, however, was not the expense of the lamps, which was no object to any but the most wretchedly-found ships, but the fact that, at the end of each voyage, the crew were paid off, and very often the captain and officers also, so that all were new at the beginning of another voyage. Many cases of collision, he feared, arose in this way. A great deal was said about the rule of the road at sea, and so long as the pilot was on board it was all right, but when the newly-manned ship got outside the pilot ground, he believed many of the unfortunate collisions which took place were caused by the officers and crew being unknown to each other, and in some cases, perhaps, from there being a little too much grog aboard. If you sent a man to the helm, and gave him an order to port or starboard the helm, and he had not been accustomed to these directions, but probably to other terms more frequently used, ten to one but he would make a mistake, and do the wrong thing first. As a rule, men who had made long voyages to distant parts of the world were accustomed to two or three expressions, such as "keep her up," "keep her off," "luff a little more," "steady," and so on, and when they got into narrower waters, port and starboard was quite Greek to them. He had often, when in command of the *Great Eastern*, been alarmed at the near approach of a large sailing vessel, and had only felt secure by going to windward or astern of her. The same thing occurred with regard to signals; unless the men were accustomed to them they would be perfectly useless. Even with the signal flags, unless you were accustomed to the use of them, when they were very easily distinguished and picked out from a row on deck as wanted, to persons not constantly using them or drilled to the use of them, there was a great deal of difficulty and delay in working them. The difficulty lay not in the system, but in getting that acquaintance with it in the general run of the mercantile marine which existed in the Royal Navy. His own impression was that the *Northfleet* was lost from the causes above alluded to. No doubt both undermanning and overloading were great causes of disaster, but it would be easily understood that in a ship with a new crew, having just parted with the pilot, stowed her anchors, and got ready for sea, when the men were clearing away the many matters which encumber the deck, the look-out duty was not very efficiently performed. In the majority of cases there were not men enough to do justice to the look-out, and it was more than likely that some of the men had had a little too much grog, and, perhaps, some of the officers also. This would cause a little drowsiness, and then there was the desire for a smoke, and many other little matters, which would take the man off the forecastle, or the officer off the bridge for the moment. He could easily understand the *Northfleet* being so run into, because he had known instances to the like effect himself, though not under his own command. No doubt some one saw that the *Murillo's* engines were stopped, and backed, and in all probability the effect of the blow to the steamer was so small, that her captain, rushing out of his cabin, and hearing what had happened, had a vague hope that he had not done much damage, and that he could run away as he did, like a cur, without being recognised. No doubt he thought he had given the passengers a good fright, and that nothing more would be heard of it. In his early days at sea they used to be much afraid of the ships of a neighbouring nation, which were generally undermanned, as they were rather in the habit, if any accident happened, to make off and leave the sufferers in the lurch, acting upon the adage, "Dead men tell no tales." There was no doubt that was the reason in the mind of the captain of the steamer—that he had not done so very much damage, and that he might escape. It had been asked, why did shipowners object to the compulsory introduction of a danger signal? but the answer was sufficiently obvious. If anyone hoisted a danger-signal too hastily or inadvertently, and assistance put off, she would be liable for salvage, which the owners would not like. For instance, assuming the *Murillo* to be the steamer which caused the destruction of the *Northfleet*, the owner would be liable for the whole loss, which seemed rather hard, though he might be able to get a set-off. It was no wonder, therefore, that the last-mentioned class of persons should speak of danger-signals being too hastily used. He added that out of a crew of 500 men very few of the men knew the code of signals, or cared to learn it. It was most important, in his opinion, that in every large vessel there should be regular quarter-masters, thoroughly qualified to steer, who should be compelled to learn these signals.

Mr. Thomas Gray, without going into the history of the *Northfleet*, said the question seemed to be whether by some means or other the means of making the international code of signals available by night as well as by day could not be extended to the merchant service. In these times sailors could speak any language by means of flags and the signal book in the day-time, and if he understood Capt. Colomb rightly, he wished this to be brought into general use for signals at night, rather than have any special distress signal, to be known and acted on as meaning "I am sinking," or "I am in imminent danger." Now in this view he could not concur in the gallant gentleman's opinion. What was wanted was a signal which should draw immediate attention, and inevitably bring immediate help. If the flashing signals were understood by every man on every ship, and could be read by every boatman on the coast, they would no doubt be answered, but they never would be carried by every ship, or be understood by everyone on shore, and therefore they must sometimes fail. It was all very well to show a beautiful lamp, but the use of it required an immense amount of practice, and why should sailors be required to practice and to use such a thing as a signal of distress which they would never be perfect in, and which they might very easily muddle altogether when in danger by misplacing the long and short flashes. It had been said that rockets were generally understood as signals of distress, and in proof of this reference had been made to the three vessels which saw and answered the signals of the *Northfleet;* but the fact that only three out of the great number in the vicinity understood them to be such signals showed that they were not universally known and acted on as signals of distress. If that were so, the coastguardsmen would not have seen and disregarded the signals. When the news of the accident arrived a telegram was immediately sent to the spot—"Did you see these signals, and if so, why did you not go off?" The answer was, "We did see them, and thought they were signals for a pilot, so did not go off." Various instances were also given in which rockets had been sent up without any idea of indicating danger, but in some cases merely as a pyrotechnic display. The letter from the Newcastle Local Marine Board had been referred to, and he did not think it at all unnatural under the circumstances, seeing that any general compulsory system must include penalties for using signals of distress improperly and payment for salvage services. If this code of flashing signals system were introduced, masters and mates must be examined in it, and this would entail an immense deal of difficulty, and disqualify many excellent men from command. And what was it wanted for? For one purpose only—to signal distress. Now, a ship was not always in distress, not even on every voyage—at any rate not vessels belonging to respectable shipowners—and therefore all this signal apparatus (regarding it as a distress-signal) was to be constantly carried about simply on the chance that it might be wanted some day. Was it ever known that a thing not in general use, but only used occasionally, was in its place and fit for use when it was wanted? If it were laid down that a red rocket should be used as a signal of distress, that would throw upon owners the necessity of sending these red rockets, which deteriorated very rapidly, with every vessel. The same thing applied to the flashing-lanterns. But rockets were not intended to be the main or only signals of distress, as would be seen by the enclosure in the communication to which the Newcastle letter was a reply. It was as follows:—

Signals.—Pilotage and Distress.

1. *Signals to be made by Ships wanting a Pilot.*

In the Day-time.—The following signals, numbered 1 and 2, when used or displayed together or separately, shall be deemed to be signals for a pilot in the day-time, viz:—

1. To be hoisted at the fore, the Jack or other national colour usually worn by merchant ships, having round it a white border, one-fifth of the breadth of the flag; or

2. The International Code Pilotage Signal indicated by P.T.

At Night.—The following signals, numbered 1 and 2, when used or displayed together or separately, shall be deemed to be signals for a pilot at night, viz:—

1. A blue-light every 15 minutes; or

2. A bright white light, flashed or shown at short or frequent intervals, just above the bulwarks, for about a minute at a time.

2. *Signals of Distress.*

In the Day-time.—The following signals, numbered 1, 2, and 3, when used or displayed together or separately, shall be deemed to be signals of distress in the day-time:—

1. A gun fired at intervals of about a minute.

2. The International Code signal of distress indicated by N.C.

3. The distant signal, consisting of a square flag having either above or below it a ball or anything resembling a ball.

(The Ensign Union down has been advisedly omitted, because many foreign flags are the same whether right side or wrong side up; and because it is hoped that the signals now suggested may become international.)

At Night.—The following signals, numbered 1, 2, 3, and 4, when used or displayed together or separately, shall be deemed to be signals of distress at night:—

1. A gun fired at intervals of about a minute.

2. Flames on the ship (as from a burning tar barrel, oil barrel, &c.)

3. Rockets of any colour or description, fired one at a time at short intervals.

4. Blue-lights, burned one at a time at short intervals.

Board of Trade, 30th January, 1873.

Every large ship ought to have a gun, and every ship has also the means of making flames on deck, and a rocket of any colour or description fired one at a time would be a very simple signal. It was a very good thing to invent a system by which the international code could be used by night as well as by day, and if Capt. Colomb had accomplished this, he had done a great deal; but something more was wanted, viz., a signal of distress which shall be understood by everybody, independent of lanterns, lamps, and any particular invention or code of flashes—a signal such as any ship can make, and one which could be made by anybody without special instruction, and by means usually on board. He was glad to say that such a system had already been accepted by France, Italy, Austria, and Greece, and the United States also would adopt it. In conclusion, he must tender to Capt. Colomb every acknowledgement for the great services he has performed for the country in perfecting the flashing system.

Capt. Dawson, R.N., said he was called upon some years ago to report upon the various systems of signals in use in the navy, when he found there were eleven different systems of symbolising signals, though only two were generally known. As he understood it, Capt. Colomb did not mean to place these lights in place ot the rocket, or danger signal, but only as an additional means of communication. In the royal navy they had had more experience of signalling than any other people, and for the last ten years they had been able to communicate all their wants with the greatest ease by night as well as by day, a flashing lamp being used instead of a flag; and it was not expensive, as an ordinary lamp could be used. He quite concurred in the observations of Sir James Anderson with regard to the necessity of anything of the sort being in constant use; and that was his objection to Mr. Gray's proposal, that when the necessity arose, this very signal, which it was suggested should be insisted on by the Board of Trade, would not be forthcoming, or, if forthcoming, would be misunderstood. Capt. Colomb's idea was that attention should be attracted to the vessel by any means, no matter what, and then that her precise wants should be made known by means of the signals. No one proposed that this should be understood by every seaman; it was a question for the officers, and, as far as his knowledge of the merchant service went, it would be the duty of the second mate to attend to it. That officer would have only just passed an examination, and it would not be a very great extra burden upon him to require of him a knowledge of this system of signalling, which would not only be useful in case of emergency when the ship was in distress, but constantly throughout her career. The only point in which he disagreed with Captain Colomb was in the last sentence of the paper, for who cared anything about seamen's lives, and what consequence was it to anybody how many were sacrificed? If a man died suddenly or by violence or accident, on land, a coroner's inquest was held to investigate the matter, but the same principle did not at all hold good for sailors, and therefore he considered the proper way to bring forward the subject was with reference to its effect on property, because that was a matter of real importance. If signal stations were established at suitable spots, the arrival of vessels might be telegraphed as soon as they came in sight, and the news would sometimes be of great commercial importance. Some years ago he suggested, though he found that the same idea had previously occurred to others, that this system should be applied to lighthouses, each light having a distinct number, which it would continually repeat, so as to prevent the mistakes which sometimes occurred of one light being taken for another. If this were done it would have the additional good effect that every officer of a ship and every coastguardsman would of necessity become familiar with the system, and thus, in case of distress, there would be no delay in sending assistance.

Admiral Ommanney, C.B., F.R.S., thought that they had lost sight of a very important thing, viz., the minute gun. He quite agreed with Captain Colomb that in the case of the *Northfleet* the rapidity with which they burnt blue lights and sent up rockets must have been evidence, to seafaring men, of signals of distress; and that, if they could have fired their gun, it would have been answered. He considered that six-pounder guns were not large enough for vessels of her size, as they could not be heard far enough off, and that they ought to carry 24-pounders. He was in a vessel a few years ago, and one dark night wished to communicate with the Admiral, and had it not been for Captain Colomb's signals he could not have done so; but he was happy to say they answered admirably.

A Gentleman inquired what kind of lamp was used, and whether, supposing a vessel lost her signalling lamp, an ordinary lamp could be used for the same purpose.

Captain Ward said that, having held office for a great many years in the National Life-boat Institution, he had continually to deal with shipwrecks, and therefore looked at the question as one of preservation of life. He thought Captain Colomb's system was well suited for men-of-war; but simple as it was, it was not simple enough for the purpose of indicating danger to those on shore, nor did he think the men on shore would be able to keep in their memories even so short a system as this appeared to be. Another great objection to it was that in a gale of wind, looking from the shore, all lights seemed to be flashing, and that appearance would interfere with the long and short flashes. What they wanted was some signal which would at once show what was wanted, for very often their boats went out, at a cost of £15 or £20, in answer to signals of distress, and found that the signals were for a pilot, and that their assistance was not needed. Referring to what Mr. Gray had said, he considered it was very desirable that they should have some means for raising alarm, and that every signal should be as simple as possible, such as a red light to indicate danger to life, and a green light danger to property, so that if a red light was shown all the life-boats available would go off, and if a green light, other and larger boats. He then read a letter from the man in charge of the life-boat station near the spot where the *Northfleet* sank, in which it was stated that no gun was fired, that rockets were sent up, that two cutters answered the signals, and that it was supposed they were signalling for a pilot. He remembered one case where the captain of a vessel sent up 30 rockets in the space of half-an-hour, simply for a pilot and for the amusement of the passengers, and he thought that if their boats answered such signals they would have enough to do, thus showing that some special signal for danger was necessary.

Mr. Christopher Cook referred to several letters that had appeared in the *Times*, which he thought contained many valuable suggestions.

Capt. Goodenough, R.N., said it was supposed that the flashing lights might be mistaken for other lights, but it was not so, and he had never known such a mistake made. He considered that all officers should be made to pass an examination on this subject.

Captain Colomb, in reply, said that in the Navy, with one exception, where they used the Chatham light, they used a powerful oil-lamp, but this was more expensive. If the lamp broke down they used anything they could get. One captain had written to him telling him that they had lost their lamp overboard the first night, but they had got on very well with a common lamp and a bucket. With regard to Sir James Anderson's remarks, he thought that if that gentleman looked over his paper carefully he would see that he had stated in distinct terms that he quite understood the difficulty of dealing with the mercantile marine. His argument was that it was quite time to make a beginning, and if they could teach officers to use flags in the day-time, he saw no reason why they could not be taught to use the international code by night. He thought the more distinct and clear they made distress and alarm signals the better, but that they should supplement it by something to show what was the matter. He considered the feeling of the meeting would have answered most of Mr. Gray's remarks in his favour, and, therefore, it was unnecessary for him to add anything.

The Chairman said the recent disaster abundantly showed the urgent need for some effective signal of distress at sea. In a letter he had received that morning from Captain Shuttleworth, regretting his inability to be present, it was stated that there was a recognised distress signal, viz., a rocket; a blue light being the proper signal for a pilot. It appeared, however, quite evident that this distinction was by no means universally acknowledged, and the question arose whether some legislation was not called for on the matter to prevent confusion. A gun was a well-known signal of distress, and, if kept in order, appeared a very efficient one; but even with rockets or guns, or both, it would be a great advantage to have the additional means which had been described of communicating the exact nature of the distress. He had often heard of the system, but had never before seen it in operation. It certainly appeared marvellously simple, and, at the same time, effectual; though possibly it might require some degree of practice before it could be worked successfully. Nothing could be more simple than the mode of signalling with flags provided by the mercantile code, but when crossing the Atlantic last autumn in a yacht, and wishing to signal, he found it quite a business to find the right flags and arrange them properly. With regard to the mode of introducing this system into the merchant service, though it could not be expected that every seaman should learn it, he saw no difficulty in requiring an acquaintance with it from all officers; they were obliged to acquire a knowledge of the system of signalling by flags, and he did not anticipate any difficulty in requiring this very small addition to the qualification. He was sorry to see an apparent indifference to this important matter on the part of the Board of Trade, for he certainly thought a department which had under its charge the protection of life at sea, ought to welcome all suggestions of such a nature and offering as much promise as the one under discussion. No doubt the Board of Trade, like other departments of the public service, was besieged by inventors, but that was no reason why really valuable inventions should be rejected. Sir James Anderson desired him to say that in his opinion the duty of signalling should fall upon the quartermaster, who ought to be regularly appointed to all large vessels in the mercantile marine. There would be no difficulty in getting this class of men, or in teaching them the management of signals. In conclusion, he heartily wished success to the effort to introduce this valuable system; and, with reference to a remark of Captain Dawson, he did not think the apparent lack of public sympathy with the sufferings of sailors arose from anything but a want of information regarding them.

COMMITTEE ON THE MEANS OF PROTECTING THE METROPOLIS AGAINST CONFLAGRATION.

The Committee met on March 6th, 1873, at three o'clock. Present:—Mr. U. J. Kay-Shuttleworth, M.P., in the chair; Mr. E. Chadwick, C.B.; Lord Alfred Churchill; Major-General F. Eardley-Wilmot, R.A., F.R.S.; Mr. Robert Rawlinson, C.B.; Mr. Seymour Teulon; and Mr. T. R. Tufnell. Mr. Rawlinson, by permission of the President of the Local Government Board, was examined and gave evidence, which will appear in a subsequent *Journal.*

The following evidence was given at former meetings by Mr. W. P. Reynolds, manager of the London and Southwark Insurance Company:—

Q.—We are informed that you have, as a manager of fire insurance companies, studied the risks of fire to be provided against by measures of prevention, as well as to be insured?

A.—Yes, for twenty years, both in England and abroad.

Q.—Have you had the means for comparing a constant with an intermittent supply of water in putting out fires?

A.—I have been in Quebec, and especially at Montreal, where there is a constant supply of water, and there and at other places I have had opportunities of comparing the results with those in London, where the supply is limited or intermittent.

Q.—Have you considered the possibility of the occurrence of a conflagration in the metropolis, such as has occurred at Chicago and at Boston?

A.—Yes, I have; and I was one of a deputation of fire insurance managers to make a representation to the Metropolitan Board of Works—they being charged by Act of Parliament with the duty of protecting life and property in the metropolis from fire—as to the dangers to which we are exposed, and as to the means of meeting them.

Q.—Will you be so good as to state what are the dangers to which you consider the metropolis is exposed?

A.—The fire at Chicago occurred during a hurricane. It was intensified by the disablement of the water works. Now, it has appeared to me that, London being divided into several separate districts of supply, each of such districts may in that respect be deemed a Chicago. There is the possibility in London, as at Chicago, of the occurrence of a fire at the time of a hurricane, added to the concurrent possibility, under the existing conditions, of a failure or disablement of the sectional supply, and under those contingencies there might be a fire, commencing within the section, which would become a conflagration of vast magnitude.

Q.—Were all the deputations of the insurance companies of that opinion?

A.—Yes, we were.

Q.—Are the structural arrangements in London, then, not so different as to prevent a conflagration such as that at Chicago?

A—Modern London is unquestionably superior to Chicago as respects construction; but the extent of a conflagration depends very frequently on the elements—such as the wind and frost—and if they prevailed to a severe extent, and at the same time the water works were disabled, while a fire got a head, and raged in any closely-built locality, the advantages of construction might be greatly neutralised. The buildings at Boston, although not having the best roofs, were of good stone walls; and there, notwithstanding that there was a good water supply, the fact of a hurricane, added to an epidemic amongst the horses, which prevented the engines being brought to bear for half-an-hour, tended to a conflagration in which buildings covering sixty acres were laid waste. The Governor of Massachussetts has officially reported that the value of the property destroyed exceeded fifteen millions sterling.

Q.—What, then, upon these contingencies did you suggest?

A.—We suggested that the several water companies should be requested each to lay a main of communication with its next neighbouring company, such main only to be opened with the consent of the companies, and under an emergency; and that thus the whole power of the London water supply might, in a given emergency, be brought to bear upon a given point. We ascertained that this suggestion was mechanically feasible, and was not likely to be opposed by the water companies, the public being at the expense.

Q.—Why was not the suggestion carried out?

A.—The Board of Works saw a difficulty in making a requisition of the nature suggested.

Q.—We have dealt with the contingency of the possible failure of even a constant supply in separate sections. Have you any information to give us as to the intermittent supply, or of ordinary conditions of supply, that affect the occurrence and spread of fires?

A.—Yes. Fires frequently occur in streets through which a main runs that is not constantly charged with water. Most side-streets from main avenues are so situated, and the turncock has to be sought in order to turn the supply into the side-street. This delay frequently occurs before water can be obtained. Under a constant supply, branches as well as mains would be supplied with water. In December of 1871 a fire occurred at Camberwell, and, the turncock being an hour late in attending the fire, the house was destroyed. It is an evil defect of the present system, that the turncock must attend to give the companies' supply. There were, during 1872, fifty-eight cases where either the water supply was short, the turncocks failed to attend, or were late in attending, notwithstanding that rewards are given by the water companies and by the Fire Brigade in order to insure attendance.

Q.—Would not the telegraph serve to quicken the relief to be given in the occurrence of fires?

A.—Yes; and there is already communication between the fire-engine stations. Much additional aid would be derived by communications between the police-stations and the brigade stations, particularly in the outlying districts. A suggestion to this effect was made by the Fire Offices to the Metropolitan Board of Works, but it has not been carried out.

Q.—Is the present supply of water found to be sufficient in all cases?

A.—It is of the very nature of a system of trading water supply that it cannot be so, inasmuch as the supply will be only given where it is paid for. There are large masses of warehouses on the Surrey waterside, which may on the whole be said to be unsupplied with water to any effective extent for fire-extinction purposes. The warehouse keepers only require water for ordinary cleansing purposes—hands or face washing—and the pipes are correspondingly made. Thus, while these warehouses contain vast amounts of valuable merchandise, they are on the land side almost without water; and when the tide is low in the river, they are very much exposed to danger. An instance occurred when the King and Queen granary, at Rotherhithe, the largest in London, was destroyed, December, 1871. This building was situate near the extreme end of the Kent Company's district, and where that company approached an equally extreme point of the Southwark and Vauxhall Company's district. The pipes of each company being of a small bore, the pressure was thread-like, and the supply there given for an enormous building, containing one hundred and fifty thousand pounds worth of goods, was only a supply such as should be given to a £30 a-year house. The tide was out in the Thames, the nearest steam floating-engine was disabled, and by the time the larger floats attended, the fire was beyond control.

Q.—You speak of large masses of waterside warehouses, containing vast amounts of property, being almost without a supply of water. Can you state more specifically where those buildings are situate, and to what you refer when you allude to vast amounts of property?

A.—Taking a point on the Surrey side of the river bank, midway between Southwark and London bridges, and eastwards therefrom to Rotherhithe, there is an almost unbroken line of wharves having either one or several warehouses thereon. The water supply in the mains along this entire distance is of the ineffective nature I have already stated. When I speak of vast amounts of merchandise in these places, I have in mind wharves where the warehouses contain from £100,000 to £500,000 of value, and I know of one wharf where the value is nearly a million.

Q.—Does this condition of things exist elsewhere?

A.—Not to anything approaching the same extent, but it is always more or less open to arise when houses of trifling value are pulled down and are replaced by large warehouses. There were at the rear of Guy's Hospital, a few years ago, a number of little houses, worth, with contents, perhaps £300 a-piece. These are now replaced by large warehouses, often containing probably £30,000 each, but the water-supply is unchanged and unfit for the present property, so far as regards fire extinction.

Q.—Who is to blame for this?

A.—No individual or water company can be censured for a moment. It is the water-selling system sanctioned by Parliament that is faulty. So far from attaching blame to the water companies, I prefer giving expression to my experience that the companies generally give a most ready assistance to the fire brigade. The water companies, having invested sufficient capital for laying down pipes adequate for the wants of small householders, can have no temptation to take up those pipes and lay down large mains, simply to provide water to extinguish a fire in a newly-built warehouse; for, as a fact, the warehousekeepers sometimes refuse to pay their water-rent; they are without water, and the company is worse off than when the small householder occupied the ground.

Q.—Have you thought of any means whereby the evils you adduce may be remedied?

A.—I think the government should undertake the water-supply, after framing some equitable scheme of compensation to the water companies and all persons prejudiced by the change. The management should be in the hands of a commission, consisting of persons fitted by past experience for the office. The supply should be constant. As the companies now make a profit by selling water, I do not see why the government cannot sell it without making a loss, and give the public such additional advantages, without extra charge, as in their cost may be represented by such profit.

Q.—But the warehouses you have spoken of might not be any better off in consequence of the government supplying the water?

A.—I have no fear on that score. The warehousekeepers would make known their wants, and public opinion would operate on the government to comply with all needful requirements.

Q.—Will you state what, from your observation of the constant supply at Montreal, you believe might be done with a constant supply in London?

A.—A hose can be supplied to a hydrant, and the water, by its own pressure, may, without the intervention of a fire-engine, be most effectively used in the early stages of a fire. Many fires that, under the present system, become serious, would thus be checked at the outset under a constant supply. This more immediate application of means for stopping fires has the effect of deterring incendiarism, fires having been put out before they have obliterated the means whereby they have been caused.

Q.—You use the term hydrant; would you, then, discontinue the use of the water-plugs?

A.—Yes; the plugs are antiquated, inconvenient, and much less serviceable than the hydrant, which brings the water to the top of a hollowed iron post instead of—as with the plug—compelling you to probe into the ground for it. I would recommend that in the side of each hydrant there should be a small iron door; that every policeman and fireman have a key to open the door, inside which should be kept the key or tool for turning on the water; thus turncocks would not be required at a fire, and no delay could arise in the obtaining water.

Q.—I think you have previously stated that the metropolis was exposed to conflagrations from the occurrence of two or three events consentaneously. From your knowledge of incendiaries, would it not be liable to conflagration from a wilful act on such an occasion?

A.—A great depth of wickedness must be involved in burning down a city at such a time, but no doubt incendiaries do not always calculate on producing the dreadful results which arise from their designs. For instance, a man named William Anthony set fire to 120 places, merely for the sake of the shilling or two he received for giving intelligence to the Fire Brigade, and in some instances the fire he caused destroyed thousands of pounds worth of property, and lives were lost.

Q.—It was alleged, whether truly or not, that the commencement of the Chicago fire was the work of an incendiary?

A.—There are various representations on that subject. It was said to have been caused by a cow kicking over a lamp in the stable, but nothing authentic is known; still it is wonderful what slight causes will induce people to commit incendiarism. I knew of one case where the municipality offered a silk banner to the volunteer brigade which should be most frequently the first with its engine at fires in the course of the year. One astute member of the brigade made it a practice to have his horses always harnessed in readiness, and then went and set fire to some place, and of course got his engine there first.

Q.—With regard to the sectional supply; the mains of the different companies are not connected together?

A.—No; but I think they ought to be connected.

Q.—Are you aware, in the case of the gas companies, that before the impending strike, such a thing being anticipated, several of the companies united their mains in order that the deficiency of one might be supplied by the other?

A.—They did so in some instances.

Q.—Do you think a similar arrangement ought to be made by the water companies?

A.—The fire-offices have made that suggestion to the Board of Works, but they did not see their way to carrying it out.

Q.—It ought to be compulsory, of course?

A.—Yes; but compulsion would not be necessary, because I believe the companies would be perfectly willing to do so if it were not for the expense. They think, it being a matter for the public benefit, the expense ought not to be thrown upon them.

Q.—Was not there this further consideration, that the public is very much interested, not merely in the supply of water for the extinction of fires, but also in the purity of water for consumption, and that by uniting the mains the responsibility for impurities would be shifted, and offenders could not easily be detected?

A.—I do not know that.

Q.—Would it not be possible to have the mains so arranged as that the communication might not be constantly in operation, but brought into use in the event of a fire?

A.—That was the suggestion to the Board of Works.

Q.—Is it not the case that Montreal, and some other places, are supplied with water entirely from one source?

A.—Yes, it is so at Glasgow.

Q.—If the mains had to be connected at the time of the fire, would not the loss of time almost make that system as bad as the present one?

A.—It would not be required in the case of an ordinary fire; in such a case each water company would have a sufficient supply of its own. Where the system would be beneficial would be in the case of great conflagrations, such as those which occurred at Chicago or Boston.

Q.—You mentioned that the Board of Works saw a difficulty in making a requisition that the water companies should be connected; do you know what it was?

A.—It seemed to be almost a feeling of temerity in approaching the companies to ask a favour of them.

Q.—How many water companies are there in London?

A.—Eight; three on the south side of the river, and five on the upper side.

Q.—Were not many of the roofs of houses in Chicago made of shingle, or other very inflammable substances?

A.—Many of them were made of shingle, and many of what is called patent composition—a mixture of tar and gravel, forming a thin coating over a sheet of thick felt or paper. I should not call that a very inflammable substance, unless the sun has been acting on it for some years. Then it sometimes happens that the tar is melted, the gravel sinks to the bottom, and the more inflammable portions come to the surface.

Q.—Would not that be more liable to catch fire than a slate roof?

A.—Yes; and when the fire in the interior of a building raises the temperature to a high degree, the roof melts and falls into the building.

Q.—Assuming a very great fire to happen, would the same thing happen; the slates will not resist more than a certain temperature without splitting, and there would be wooden rafters underneath?

A.—Yes.

Q.—Is it not a fact that many of the mains on the south side of the river are very small, but that by coupling the Kent and Southwark companies together, a better supply would be afforded?

A.—There are some parts of the district where the mains do not lie contiguous. In some cases the trunk mains of two companies run side by side in the same road, and there is some point or other in most companies where the large mains approach tolerably close to each other.

Q.—The Kent companies' mains probably could not easily be connected with any other companies?

A.—They certainly occupy an extreme corner of land.

Q.—With regard to the fire at Chicago, was it not the fact that there was a good deal of Nicholson's pavement used there—a kind of preparation of asphalte—was that very inflammable?

A.—I am not sure about that; wood was used for the road and footways, but I do not think it added materially to the fire. The conflagration was of such a vast extent that these minor points were of very little importance. Where a conflagration takes place on such a very large scale it does not matter very much of what materials buildings are composed. During the great fire at Hamburg the steeples of churches, at some distance from the fire, were seen to burst suddenly into flame on account of the atmosphere being so intense, and it was mentioned by persons there that the draught caused by the flames was so intense that persons were almost drawn down the side streets towards it.

Q.—The great object in all fires is to check them as early as possible, so as to prevent them spreading?

A.—Yes.

Q.—For that purpose you propose that hydrants should be erected at short distances; might they not be fixed to the lamp-posts?

A.—Yes, that would do, provided you could have the gas and the water under Government control, but otherwise the gas company might remove or dispense with the lamp-post and the water also.

Q.—Mr. Bateman, before the House of Commons, on Metropolitan Water, No. 2 Bill, in 1871, gave this evidence. He was asked by the present Speaker of the House of Commons, "What is your objection to the word plug?" and he said, "Plug is a word meaning a piece of wood which is used for the purpose of being forced into the upright outlet from the main pipe which conveys the water, and that plugs the hole up. Every time the water has to be drawn from the main, that has to be loosened one way or another, not by way of a screw, but loosening it by a lever, and it flies out with a chance of hitting the man on the head; and when the water flows the men have to poke about with a long stand-pipe, always getting wet before they can get it into the plug. That is then drawn and fastened with pegs. As soon as that is fastened they attach the hose to the stand-pipe."

Q.—That apparatus in your opinion is not fitted for the purpose?

A.—It is a disgrace to a mechanical age that such a thing should exist. There are many improvements which have been introduced during the last 20 or 25 years much superior.

Q.—Is that a correct description of the present system of plugs?

A.—It is.

Q.—Will you explain what is a hydrant such as has been introduced into the various towns?

A.—A hydrant would be a hollow iron post, about four feet high. There would be a screw at the outside, which would be worked by a winch; then the water would flow out from the top. The hose of the Fire Brigade would be fitted to a worm, there being one universal worm for the hydrants and for the hose. The water would rise through the hydrant by its own pressure.

Q.—Is that the system enforced in most towns in England where there is a constant supply?

A.—No, I think not.

Q.—It is the system in Manchester, at all events?

A.—In Manchester, but they do not use it in Glasgow, and there is to some extent a constant supply in Liverpool, but they do not use it there. In Glasgow they use the plug; they could not use the same plug that Mr. Bateman has described in Glasgow, because the force of water, where there is a constant supply, would drive the plug sky high. It is the fact of having to probe into the ground and search for the water which is so objectionable.

Q.—Would the pressure in London be sufficient, without the use of fire-engines, if hydrants were used?

A.—Not in all cases. Fire-engines would still be required.

Q.—How do you account for the long delay in fitting hydrants instead of plugs?

A.—Because of the cost.

Q.—If there were hydrants introduced at all large wharves and warehouses, ought not there to be also high pressure hydrants on each floor?

A.—Those are not called hydrants. A hydrant is the thing fixed into the ground taking the place of the plug, now in use for the emission of water. A rising main is a very useful thing in warehouses, but in point of fact these appliances in case of fire are not of the use that is often supposed. Fire offices do not discourage it for a moment, but when a fire takes place, that being an event which only occurs probably once in a lifetime, the persons on the spot get in such a state of nervous excitement that they do not make use of the very means which have been provided.

Q.—How many hydrants would be required?

A.—Between 70,000 and 80,000. To have a perfect system every plug should be replaced by a hydrant. I should add that a perfect system means that the hydrant should be only so far apart that a hose could be attached to each two and brought to bear upon one point.

Q.—Are the present plugs sufficiently numerous for that purpose?

A.—I cannot say.

Q.—You think the government ought to undertake the water supply. Is that because there is no proper local authority in London?

A.—I propose government should have it, because the area of London is so different under different circumstances. There is the area covered by the Board of Works, and the Post Office area, and others, each of them different. If government had the supply it would extend to the whole of London, whatever it might be. The district served by the water companies at present considerably overlaps the area of the Board of Works.

Q.—When you say the government, do you mean the Board of Works?

A.—No. I should be very sorry to see it under the Board of Works. I do not think it would be beneficial to London that the water supply should be under that body.

Q.—What should you say if we had a municipal government covering the whole area?

A.—We had great hopes of the Board of Works before we saw it in operation, and I should like to defer my answer to that question until I saw what the municipal authority would be. My suggestion would be that it should be under some special commission.

Q.—Would there be any disposition on the part of the insurance companies to alter or modify their rates of insurance on warehouses which had large mains supplied to them?

A.—If a constantly-supplied main were found to be practically a preventive of disaster, competition would soon secure the lowering of the rates wherever it was introduced. But fires are found to increase year by year, and I do not look forward to such a thing.

Q.—Is it the fact that after Liverpool obtained a constant water supply the insurance charges were materially reduced?

A.—I do not think there was any connection between the two.

Q.—If the same result followed in London as did in Manchester, that 7 per cent. only was destroyed instead of 21, naturally the insurance companies would lower their rates?

A.—Rates for insurance can only be dealt with on an average of a long period of years. I am not aware that the reduced per centage prevailed over any long period.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

The 7th meeting of the Committee for Silk and Velvet was held on the 11th March. There were present—Sir D. Cooper, Bart., in the chair; Mr. W. Blakely, Mr. W. Bullock, Mr. A. Cassels, Mr. Chadwick, M.P., Mr. F. Cobb, Mr. A. Lewis, Dr. Mann, Capt. Mason, and Mr. H. Tucker.

The Committee for Promoting the Exhibition of the Works of John Phillip, R.A., and Thomas Creswick, R.A., met on Monday, when it was reported that upwards of two hundred and fifty of these works had been promised, and many others are expected. These works will be arranged in the East Picture Galleries, parallel with Exhibition-road.

Among the works of Art to be shown at the next International Exhibition will be a full-sized copy of the well-known Bayeux Tapestry. As this celebrated piece of needlework is about 230 feet in length and 22 inches in width, it is evident that this reproduction has been an undertaking of no common magnitude. At the suggestion of a well-known author of works on antiquarian art, the plan of this work was laid down before the Lords of the Committee of Council on Education, by whom it was duly authorised; and a correspondence was entered into with the municipal authorities of Bayeux, who have charge of the treasure which makes their city so famous. These gentlemen readily acceded to the request that the tapestry might be copied by photography, but they would on no account suffer it to be removed from its place, although report says, that when the Uhlans were prowling about Normandy, it was carefully rolled up and hidden, no one knows where. Queen Matilda's tapestry, as it is generally called, though it is really needlework on linen (very like an old English "sampler"), is shut in glass cases, which are disposed as the four sides of a long parallelogram, with an opening at the middle of one side, in a room which was built for their reception. As the Bibliothèque and l'Ecole d'Art of Bayeux occupy the galleries above, this room is lighted only by side windows, and, in taking the photographs, the difficulty of reflecting sufficient light on the needlework was so considerable, that a special apparatus had to be manufactured for the purpose. Thanks to the kind assistance of the venerable curator, the Abbé Laffetay, and the intelligence of the English photographers, who were under the superintendence of Mr. Cundall, these obstacles were successfully overcome, and the public will soon have an opportunity of judging the merits of the largest reproduction which has yet been accomplished by the aid of photography. We understand that Mr. Frank Rede Fowke has prepared a volume of descriptive notes, in which he has given the results of much investigation into the disputed question of the origin of the tapestry, explained the history of the events represented, and elucidated some of the curious subjects which appear in the decorative borders.—*Athenæum.*

EXHIBITIONS.

VIENNA EXHIBITION.

We learn from Paris that negotiations are to be opened with Austria for the modification of the treaty of commerce between that country and France, during the Exhibition.

The Government of Japan have voted a sum of £40,000 for purposes of the Exhibition, and a commission, headed by a relative of the Mikado, is to be sent to Vienna during the Exhibition.

The Managing Commission of the Vienna Exhibition have given notice to the Spanish authorities that unless the space allotted to them is taken up at once it will be appropriated to France.

The *Architect* says the French contributions to the picture-gallery of the Vienna Exhibition are upon a grand scale, including in all sixteen hundred canvases. In order to give *éclât* to the collection, the rule which prohibits the removal of pictures from the national galleries has been set aside, and a selection of about fifty works have been made from the Luxembourg gallery; these include, amongst others:—Baudry, "Fortune and the Child;" Bellange, "A Review in 1810;" Bertrand, "Death of Virginia;" Breton, "Return of the Gleaners;" Flaudrin, "Portrait of a Girl;" Giraud, "Slave Market;" Hebert, "The Cervarolles;" Levy, "Death of Orpheus;" Marchal, "Servants' Fair;" Moreau, "Orpheus;" Regnault, "Marshal Prim," and the "Moorish Execution;" Troyon, "The Return to the Farm;" landscapes by Corot, Rousseau, &c. Cabanel, Meissonier, Gèrôme, Baudry, Corot, Daubigny, and a host of other well-known artists also contribute. The city of Paris has appointed its own special commission for the Exhibition, M. Daviond its architect in chief, being president. The municipal collection includes models in plaster of the churches of La Trinité and Saint Ambroise, and of two groups of new school buildings, examples of sculpture, and a collection of medals struck since the year 1850 in commemoration of public solemnities and important events.

The *Staffordshire Advertiser* says:—"Messrs. Minton and Co., of Stoke-upon-Trent, have produced for the Vienna International Exhibition a magnificent collection of fine-art pottery. The collection is in every respect the finest which has ever left the works, and the brief catalogue which follows can give no idea of its extraordinary beauty. The thoroughly artistic works of

Mr. Solon, executed by the *pâte sur pâte* process, will probably occupy the most prominent position. They include a pair of vases of Grecian outline, a set of three Etruscan-shaped vases, and fifteen round dishes as cabinet specimens. The Etruscan-shaped vases have black grounds, and depicted thereon are figure subjects in that peculiar and poetical style which Mr. Solon has made his own. Messrs. Minton and Co. have been very successful in their imitation of the exceedingly rare and costly Henri II. ware, and they are sending to Vienna, in this style, a large centre vase, a pair of candlesticks elaborately modelled and inlaid, a pair of salt-cellars exquisitely finished, and various other specimens. Mr. Mussill's wonderful skill as a flower and bird painter is shown in various objects in which the artist has worked on red biscuit under the glaze. In this under-glaze painting are to be shown a pair of tall vases and a set of round dishes. There will also be a large collection of articles enriched with Messrs. Minton and Co.'s Persian glazes, which have recently come so much into favour, the colours including bright yellow, plum, and turquoise, applied to Oriental shapes. The following are among the principal objects produced in porcelain:—Two 'cloisonné' vases, in close imitation of original Chinese enamels, now in the South Kensington Museum; a pair of vases 40½ inches high, painted with flowers, in a very bold style on enamelled turquoise ground; a set of dessert plates elaborately pierced and gilt, bearing female heads, emblematic of various nations, the latter being in Mr. Boullemier's best style. in addition there are a pair of handsome lamp-holders, modelled by M. Carrier, and produced in celadon and white with gold enrichments; numerous novelties in coloured bodies, including parian; two pairs of vases after the Chinese, each 38 inches high, one pair having a yellow ground, with peach-trees in fruit, and the other bearing white peonies on a black ground. Very rich effects are produced by the coloured clays, and in the case of a parian body dyed red, are several imitations of terra cotta, but having this advantage over that 'body,' that being now thoroughly vitrified the articles are less liable to catch dirt and are more easily cleaned than terra cotta. There will also be a large selection of china and earthenware patterns, of table, tea, dessert, and toilet ware, including many novel and attractive designs."

HISTORICAL AND ARTISTIC MILITARY MUSEUMS.

The famous Hôtel des Invalides of Paris seems destined, like the equally famous Greenwich hospital, to undergo a total change in its application.

Since the war the contents of the old Artillery Museum have been transferred to the Invalides, and now the government proposes to form there a historical museum of war to illustrate military life, not only in France but in all the countries of the world and of all periods, thus offering a material history in chronological order from the most remote times, prehistoric, Egyptian, Greek, Roman, to our own days.

The divisions of the proposed museum are as follows:

1. Offensive arms, from flint and bronze weapons to the sword, rifle, and cannons of the nineteenth century.
2. Defensive arms, including armour, coats of mail, casques, shields, &c.
3. Military decorations of all countries.
4. Military distinctions, such as special arms, badges, swords of honour, plumes, cocades, the batons of marshals and commanders, epaulettes, chevrons, and other marks of grade and honour.
5. Standards and flags, from the Cap St. Martin, the earliest French flag, including all the banners, oriflammes, pennons, and other colours of the world.
6. Military costumes of all nations.
7. Equipments and defensive armour of horses, with harness, bits, spurs, &c.

Like our own collection in the Tower of London, the cavalry armour is proposed to be set up on figures of men and horses.

There is no doubt that such a military museum will be immensely popular, especially in France, but it will also have a great value in an artistic point of view. Artists engaged on subjects relating to war, or on military personages, have often to search far and wide for models of the proper arms, armour, and accoutrements. The value, to artists of the famous Meyrick collection, which was seen last year at South Kensington, was very great.

While on this subject, it may be mentioned that Sir Richard Wallace has purchased the fine collection of arms and armour late the property of Count Nieuwerkerke, but whether this collection will remain in France, or be transferred to this country, is not yet stated on authority, although Paris journals speak of its loss to France.

NOTES ON THE QUICKSILVER MINE AND WORKS OF VALLALTA.*

The Vallalta quicksilver works are situated in the province of Belluno (Venetia), at the south-western extremity of the Mis valley, where the two torrents, Mis and Pezzea, come together, marking the boundary between Italy and the Tyrol. The works are about ten miles from Agordo, and 2,339 feet above the level of the sea. The cinnabar mine itself lies a short distance from the works, on the right bank of the torrent Pezzea.

The rocks that are met with are chiefly clay-slate, and a reddish porphyry; the latter having broken through the former and altered it. Those who desire to study the special geological conditions of the mine can consult the small geological map accompanying the original memoir, which will give a far better idea than a tedious verbal description. We will simply note the fact that the metalliferous rocks are surrounded on the north-east by black and occasionally graphitic clay-slate, in an elliptical manner, and this part of the formation has been proved to be the richest in cinnabar, not only in the upper but also in the lower beds. Where the slate dies away, the porphyry widens out, and the cinnabar becomes less concentrated, and this renders the explorations more uncertain and more costly. The cinnabar occurs disseminated, both in the porphyry and the metamorphosed rocks, sometimes in the form of lumps or grains, sometimes in veins and little strings, but invariably in an altogether irregular manner. The masses occur in the form of "shoots," varying very much in dimensions and orientation.

The porphyry and slaty metamorphic rocks contain, besides cinnabar and a little native mercury, iron pyrites, gypsum, calcspar, mica, and chlorite.

As the work consists in discovering and excavating the masses of cinnabar, Vallalta mine may be said to be in a state of continual exploration.

About a century ago traces of cinnabar, disseminated through the porphyry in a valley on the right bank of the torrent Pezzea, induced two Venetian noblemen, Nani and Pisani, to commence work there. Two old levels, known by their names, still testify to the work they did. It seems, however, that soon after beginning to work they were obliged to stop, on account of a great error—viz., that of going to the expense of carrying the ore to the island of Murano, near Venice, where it is said to have been distilled. At the commencement of this century, Melchior Zanchi, a Venetian of great natural talent and a clever miner, set to work alone to reach the centre of the metalliferous zone of Vallalta; his plan was a very bold one, and was carried out eventually in 1867. Zanchi did not go on very far with his undertaking, as he was obliged to stop for want of means.

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* Extracted from a paper in the *Bollettino del Club Alpino Italiano*, for 1871, by Cavaliere G. Antonio de Manzoni.

Later on, some persons named Schena, Fusina, and Nogarola, of Agordo, and Bosio of Primiero, took up the works abandoned by Nani and Pisani, and made some rude attempts to smelt the ore on the spot.

In the year 1852 the mineral rights of Vallalta belonged to three partners—Fusina, Levi, and Bosio. It was then that the Venetian Mining Company obtained the permission to search for ore wherever it liked. This company adopted the project of the Government engineer, Joseph Bauer, who afterwards became managing director, and, with the O'Conor adit began that series of works which were destined to render Vallalta one of the most interesting of mining establishments. The O'Conor adit, after having been driven 196 metres, cut the first vein in 1854, the ore being quite sparking with native mercury condensed at the contact with the slate.

Encouraged by this success, the company bought up all the rights of the above-mentioned proprietors, and continued its explorations, not only with the O'Conor adit, but also above and below it. The year 1855 saw a large metallurgical establishment spring up rapidly and almost by magic in the unknown and hitherto solitary Vallalta, with two double cupola furnaces, a double reverberatory furnace, the necessary condensing apparatuses, buildings and houses for sundry purposes, bridges and roads. These furnaces failed, however, and it was not until 1857, with new furnaces, that the actual production of mercury may be said to have begun. Since then the production has gone on pretty regularly, although the mine suffered great damage from an inundation in 1860, and the works were partly washed away in 1868. In the following year, Cavaliere G. A. de Manzoni, the actual lessee, took mine and works off the company's hands, and continues to carry them on at the present time on his own account.

The mercuriferous rock has now been worked to a vertical depth of 122 fathoms. It is reached by various adit levels, and the workings are arranged in thirteen horizontal floors. The deepest workings are fifty-four fathoms below the lowest adit. The mode of proceeding is as follows: As soon as the existence of a mass which will pay for working has been proved, a winze is sunk through it, and then it is worked away entirely by successive horizontal floors. The timber employed is generally larch. As fast as the ore is worked away, the vacant space is filled up with unproductive rock, sometimes quarried on purpose, to prevent the chambers from falling in.

The ventilation is effected by means of a blast produced by a great fall of water and carried by wooden pipes to the workings.

The ore arriving from the mine is picked, and unproductive rock thrown away; the fine stuff or "smalls" is moistened with acidulated water, which runs away from the condensers, and, made up into compact lumps of nine pounds each, can then be treated in the cupola furnaces.

The cupola furnaces in use at Vallalta are cylindrical, lined with fire-brick, and 3 feet 11 inches in diameter by 21 feet high. They are built in pairs. Near the base is an iron grating, on which the ore rests, and the ore is charged from the top by a hopper. The cover of the hopper has a water-joint, so the top of the kiln is closed hermetically. Before putting in a charge two men work away with bars of iron through the grating, and draw out some of the burnt ore. The charge is composed of ore in large and small pieces, lumps of agglomerated fine stuff, and charcoal in the proportion of two per cent. by weight. Under the action of heat, in the presence of a good draught of air, the cinnabar is decomposed, and the mercury liberated passes off as vapour with the products of combustion into two chambers near the furnace, and thence into two rows of pipes, 3 feet 3 inches in diameter, and 49 feet long, in the open air and continually exposed to an artificial rain. The major part of the mercury is condensed in these tubes, and the residual vapours pass through four chambers at the end of the apparatus, and then by a third tube to the chimney. In former days there were occasionally difficulties with the mercurial vapour, which on a sudden change in the temperature would sometimes escape from the lower part of the furnace and occasion thereby not only a notable loss of mercury, but also serious injury to the health of the workmen, who could not always be cured by the internal use of chlorate of potash. Besides, the sulphurous acid which escaped from the chimney exercised a very pernicious effect upon the surrounding vegetation.

These evils have been entirely cured by means of a most simple exhausting apparatus. To the top of the chimney is fixed a descending wooden pipe, which joins an almost horizontal pipe, and to the lower end of this is attached another vertical pipe, which leads into a subterranean drain. A column of water is brought into the side of the last pipe near the top, and, falling through some 16 feet, draws with it the gases from the chimney. In this manner the chimney always draws properly, and the amount of draught can be regulated at pleasure by altering the quantity of water. A double cupola furnace can treat as much as 150 tons of ore in 24 hours; and as the use of wood for the condensers allows the mercury to be drawn off at pleasure, the furnace may remain alight for two years or more, in fact, until it requires repairs.

All the mercury is not obtained with its usual bright lustre; the tubes and chambers contain a sooty deposit, from which some mercury may be extracted by mechanical means on inclined planes, whilst the residue is made up into lumps and returned to the furnaces.

As at Idria, it has been found most convenient to send away the mercury in sheepskins.

The perfection of the metallurgical process at Vallalta is proved by the low produce required for profitable working. Up to 1870 the average contents of the ore did not exceed half a per cent. of mercury; the loss of metal is less than 8 per cent. The mine and works employ about two hundred men, the majority being miners. The miners work eight-hour shifts, and get about 1 fr. 20 c. a day; most of them possess a little land. Two per cent. of their wages is kept back, and goes to the sick club fund, the capital of which at the beginning of 1871 exceeded 18,000 francs. We will conclude this notice of Vallalta by giving the quantity of mercury produced of late years:—

Year.	Kilogrammes.
1856	533
1857	20,075
1858	40,992
1859	26,544
1860	31,584
1861	20,720
1862	29,288
1863	16,800
1864	22,400
1865	22,960
1866	17,080
1867	9,968
1868	12,768
1869	18,368
1870	34,776
15	324,856

(Nearly 320 tons.)

By blowing steam into molten scoriæ filaments are produced, to which the name of "mineral cotton" has been given. It is proposed to use this for steam-jacketting purposes, as it has the advantages of being non-inflammable.

Arrangements are on foot with a view to the removal of the Academy of Music from Hanover-square to premises in the Royal Albert Hall.

NOTES ON BOOKS.

Geometric Turning. *By H. S. Savory.* Longmans, 1873.—The principal part of this book consists of a description of Plant's new geometric chuck and the manner of using it. A great number of patterns are given, and full directions for cutting them are appended. Many of these patterns are of considerable beauty, and very complicated, but we are given to understand that they can be all cut with great ease and rapidity, and after no very great amount of practice.

Our Seamen; an Appeal. *By S. Plimsoll, M.P.* Virtue and Co., 1873.—From the recent action in Parliament of its author, Mr. Plimsoll's work is now pretty generally known. Of the accuracy of the statements in it a Royal Commission will soon decide; but, if only the half of them are true as regards the sort of ships in which our merchant sailors go to sea, and the way in which these ships are loaded, there is a strong case for redress. In any event, the country has reason to be grateful to Mr. Plimsoll for coming forward so courageously on behalf of a class certainly unable to help themselves. The book is illustrated with *fac-similes* (taken by the heliotype process) of newspaper articles, &c., bearing on the question, and amongst them a page of the *Journal.* We are not aware of any previous attempt of this sort to produce *fac-similes* of evidence by such means, but the idea is a good one, and capable of great extension.

GENERAL NOTES.

A New Industry in Tasmania.—The commencement of iron-mining in Tasmania seems likely, says a Launceston paper of Tasmania, called the *Cornwall Chronicle*, to open up a variety of industries. Messrs. Harrison and Just have patented there and in Victoria and the other colonies an invention by which asbestos is likely to be turned to very profitable account in the manufacture of fire-clay and fire-clay articles. The incombustible character of asbestos, and the refractory nature of the serpentine rock in which it is found, attracted the attention of Dr. W. H. Harrison, and the necessity for securing large supplies of refractory fire-bricks suggested to him the possibility of combining the two substances—the one incombustible and fibrous, the other refractory—in such a way as to produce the required article. Experiment is said to have justified this expectation. The material, it is hoped, will also be useful for gas retorts, crucibles, fire-bars, pipes, and other articles besides fire-bricks.

Portable Ink.—At a recent meeting of the Frankfort Polytechnic Association, Professer Boettger exhibited a novel kind of ink, which is adapted to take on journeys and exploring expeditions. White blotting paper is saturated with aniline black, and several sheets are pasted to form a thin pad. When wanted for use, a small piece is torn off and covered with a little water. The black liquid which dissolves out is a good writing ink. A square inch of the paper will give enough ink to last for a considerable writing, and a few pads would be all that an exploring party need carry with them. As water is always available, the ink is readily made.

Venetian Blinds of Coloured Glass.—A good idea has been put into form in an invention patented by Mr. Peattie, of Rankeillor-street, Edinburgh. It is simply the substitution, with several little improvements, of coloured and ground glass instead of wood in the ordinary Venetian long and short blinds for windows. The glass is bound round with brass, to preserve it; and heavy blinds are simply wound up and down with something like a clock-key. The play of colours, it is easy to see, may thus be managed so as to give beautiful effects. Outside at night and inside by day windows will look as if they were illuminated; and a city seen from the streets, of an evening, under such circumstances, would have quite a gay and novel effect.

Railways in America.—In an official report just published, Her Majesty's Secretary of Legation (Mr. Pakenham) gives some information with regard to new railway undertakings in the United States. Three important enterprises of this nature are specifically alluded to. The first is the Texas Pacific Railway, commencing in Louisiana, passing through Texas, and continuing west to San Diego, California. This line, it is said, will eventually monopolise the traffic and accelerate the silver-mining of Northern Mexico. The second work is the construction of a narrow-gauge road, commencing in Kansas, running south, and which is intended to reach the city of Mexico. It is anticipated, however, that this work will last a long time ere it is finally completed. The third undertaking is the construction of the Chesapeake and Ohio Railroad, which passes through the coal-fields, &c., of the Kanawha Valley, and unites the Ohio River with the harbour of Norfolk, on the Atlantic. As showing the rapidity with which towns spring up in America, it may be mentioned that the present terminus of the railway on the Ohio was quite recently part of a farm of no value, whereas now it is the town of Huntingdon, with five miles of clean-paved streets, several hundred houses well built and substantial, and a population of 2,000 inhabitants.

New Use of Rabbits' Hair.—The *Austrian Exhibition Gazette* calls attention to a new and and important industry, namely the incorporation of rabbits' hair with wool and cotton in weaving textile fabrics. The shorter hairs, which are incapable of being woven, are readily purchased by felt hat makers at three thalers a pound. When properly prepared, the hair affords a good strong yarn, which is said to be in no way inferior to wool. If all that the Austrian journal says on the subject be true, the raising of rabbits will soon become an important business. No animal is better adapted to raising on a large scale than the rabbit; they multiply almost as rapidly as white mice, and are not confined to any particular climate. It is rather remarkable that this use of the hair has not been thought of before, particularly when we consider how many hundred million rabbits are annually destroyed. The meat of the rabbit is agreeable and nourishing, and the skins have long been prized. An important industry is likely to grow out of the successful introduction of rabbit-hair weaving in all countries.

Venetian Glass.—The manufacture of beads is said to be threatened by the advance of civilisation amongst barbarous nations, where, until now, they have found extensive markets. It is suggested that great efforts ought to be made to obtain a reduction of import duties on beads in British India and in Egypt. The approaching abolition of the free port of Venice will, it is thought, be very beneficial to the glass trade generaely, though its effect upon the bead manufacture in particular will not be much felt.

Glass-lined Pipes.—In New York, glass-lined iron pipes, it is said, are being used to convey water, as the friction is lessened, the pipes are always clean, and the water is keop pure. Between the glass and iron is a layer of plaster of Paris, which, being a non-conductor of heat, prevents the water frem freezing in the winter. Whether this layer prevents the contraction and expansion of the iron from destroying the coating of glass may be a question.

It is feasible, according to Richard Jacobsen, says the *Journal of the Franklin Institute*, to secure carbon prints upon wares of plaster and clay. The process is stated to possess excellent features, which will secure for it extended application in the future. For burning in such prints, the carbon paper should be coated with gelatine and some fusible pigment instead of gelatine and India ink.

The Victoria Education Bill has passed both Houses of Legislature and received the Governor's assent. Education is now therefore compulsory, secular and free in the colony. The schools of design are continuing to be successful in Victoria, there now being twenty in various parts of the colony, with upwards of a thousand pupils in attendance.

According to the *American Manufacturer*, coke could be shipped from Pittsburgh to Sheffield, England, and sold at a profit of one dollar per ton.

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

REPORTS ON THE LONDON INTERNATIONAL EXHIBITION OF 1872.

The reports which appeared in the last volume of the *Journal* on the various sections of the above Exhibition, are now published complete, in a pamphlet form (price 2s.), and can be obtained at the office of the Society.

THE LIBRARY.

The following works have been presented to the Library:—

Geometric Turning: comprising a description of the New Geometric Chuck, constructed by Mr. Plant, of Birmingham, by H. S. Savory. Presented by the Publishers, Messrs. Longmans.

Report on the Cultivation by means of Sewage Irrigation of the Lodge Farm, Barking, from 31st August, 1871, to 31st December, 1872. Presented by Henry J. Morgan.

Why Pay Poor-rates? Why Give to the Poor? Why Punish Thieves? By Edward Eastman.

Concerning Sewage and its Economical Disposal. By F. H. Danchell, C.E. Presented by the Author.

Bulletin of the National Association of Wool Manufacturers (Boston, U.S.) for the year 1872. Vol. 3.

Steam in the Engine: its Heat and its Work. By P. Kauüffer. Presented by the Author.

Agricultural Returns of Great Britain for 1872.

Another World. Presented by the Publishers, Messrs. Bell and Dalby.

The following work has been purchased by the Library:—

The Antiquary. Vol. 1.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. The following meetings have been arranged:—

March 19.—"On Certain Improvements in the Manufacture of Printing Types." By J. R. Johnson, Esq.

March 26.—"On the Edible Starches of Commerce, their Production and Consumption." By P. L. Simmonds, Esq.

April 2.—"On Economy of Fuel for Domestic Purposes." By Capt. Douglas Galton, C.B., F.R.S.

April 9.—*No Meeting.*

April 16.—"On the Condensed Milk Manufacture." By L. P. Merriam, Esq.

April 23.—"On Silkworm Grain." By Mons. Alfred Roland (Orbe, Switzerland). On this evening Andrew Cassels, Esq., will preside.

INDIA COMMITTEE.

A Conference will be held this evening (Friday, 14th inst.) at 8 p.m., when a paper will be read by Robert B. Shaw, Esq., on "England and Central Asia." Major-General Sir Henry Creswicke Rawlinson, F.R.S., F.R.G.S., will preside.

A Conference will be held on Friday, March 28th, when a paper will read by W. T. Blanford, Esq., of the Indian Geological Survey, on "The Mineral Resources of India." Sir Louis Mallet, C.B., Member of the Council of India, will preside.

Members are entitled to attend these Conferences free, and to admit two friends to each of them.

CANTOR LECTURES.

The Second Course of these lectures is "On the Energies of the Imponderables, with especial reference to the Measurement and Utilisation of them," by the Rev. Arthur Rigg, M.A. The remaining lectures will be delivered on the following evenings, at eight o'clock:—

Lecture VII.—Monday, March 17th, 1873.

On the Energy of Heat, with especial reference to the Measurement and Utilisation of it.

The Third Course of Cantor Lectures for the present session will be "On Wines; their Production, Treatment, and Use," by J. L. W. Thudichum, Esq., M.D. The Course will consist of six lectures, the first of which will be given on Monday evening, the 21st of April, the remaining five on the Monday evenings succeeding.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...**SOCIETY OF ARTS, 8.** Cantor Lecture. Rev. A. Rigg, "On the Energies of the Imponderables."
Entomological, 7.
British Architects, 8.
Medical, 8.
Asiatic, 3.
Victoria Institute, 8. Rev. H. Moule, "On the Testimony of a Portion of the Vegetable Kingdom to the God of the Scriptures."

Tues....Civil Engineers, 8. Continued Discussion on "The Indian Railway Gauge."
Statistical, 7¾. Mr. R. B. Martin, "On the Purchase of Railways by the State."
Royal Institution, 3. Prof. Rutherford, "On the Forces and Motions of the Body."
Pathological, 8.
Anthropological, 8.
Zoological, 8½.

Wed....**SOCIETY OF ARTS, 8.** Mr. J. R. Johnson, "Certain Improvements in the Manufacture of Printing Types."
Meteorological, 7.

Thurs...Royal, 8½.
Antiquaries, 8½.
Linnæan, 8. Dr. Mücke "On the 'Take All' Corn Disease of Australia."
Chemical, 8. Mr. C. W. Siemens, "On Iron and Steel."
Architectural Association, 7½. Mr. Aitchison, "Coloured Decoration."
Numismatic, 7.
Royal Society Club, 6.
Royal Institution, 3. Mr. A. Vernon Harcourt, "On the Chemistry of Coal and its Products."
Society for the Encouragement of the Fine Arts, 8. Mr. Teniswood, "The Principles and Purpose of Art."

Fri ......Philological, 8¼.
Royal Institution, 9. Captain E. D. Lyon, "On the Mythology of India" (illustrated by Dissolving Views of the Temples).

Sat ......Royal Botanic, 3¾.
Royal Institution, 3. Professor Max Müller, "On Darwin's Philosophy of Language."

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,061. Vol. XXI.

FRIDAY, MARCH 21, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

TECHNOLOGICAL EXAMINATIONS.

The Programme of Examinations in the Technology of some of the Arts and Manufactures of the country is now ready, and may be had on application to the Secretary.

The subjects selected for 1873 are Cotton, Paper, Silk, Steel, and Carriage-building. Those desiring to become Candidates, should apply for the programme without delay, as all names must be sent in before the end of March.

The following Prizes are offered by the Society of Arts in each of the five subjects mentioned above :—

To the best candidate in Honours, £10.

To the best candidate in the Advanced Grade, £7.

To the best candidate in the Elementary Grade, £5.

In order that these Examinations may really be successful in promoting technical education in this country, it is desirable that encouragement should be given to candidates by the offer of additional prizes and scholarships. With this object the Council appeal to the Companies of the City of London, to merchants and manufacturers, and to members of the Society generally, to aid them by contributing to the Prize Fund.

The following special additional Prizes are offered :—

By Wyndham S. Portal, Esq., to the Second and Third best Candidates in the Elementary Grade, Paper Manufacture :—

A Prize of	£3
A Prize of	£2

By G. N. Hooper, Esq., to the Second and Third best Candidates in the Elementary Grade, Carriage Building :—

A Prize of	£3
A Prize of	£2

By the Worshipful Company of Spectacle Makers, to the Second-best Candidate in Honours, in the Advanced Grade and in the Elementary Grade respectively, in the Manufacture of Steel :—

A Prize of	£5	5
A Prize of	£3	3
A Prize of	£2	2

The Council beg to announce the following contributions to the Prize Fund :—

The Worshipful Company of Fishmongers	£52	10	0
The Worshipful Company of Vintners..	10	10	0
The Worshipful Company of Salters (annual)........................	10	10	0
Dr. Crace Calvert, F.R.S. (annual)	5	5	0
Sir Daniel Cooper, Bart................	5	0	0
R. L. Chance, Esq.	5	5	0

The Council invite the aid of masters and managers in promoting these examinations by encouraging their workmen to take advantage of them. An explanatory handbill, suitable for being suspended in factories and workshops, may be had on application to the Secretary of the Society of Arts Adelphi, London, W.C.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal early in May next. This medal was instituted to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows :—

In 1864, to Sir Rowland Hill, K.C.B., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty the Emperor of the French, "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

The Council invite members of the Society to forward to the Secretary, on or before the 12th of April, the names of such men of high distinction as they may think worthy of this honour.

FOOD PRESERVATION.

A process of food preservation, the invention of a French gentleman, named De la Peyrouse, was put in practice a few days since, at the Grosvenor Hotel, in the presence of a party of gentlemen, with a view to test its efficacy as a means of importing meat from long distances. The process consists in packing the meat in barrels or jars, and enveloping it in a casing of fat thoroughly impervious to the air. The packing of meat in fat is not new, but hitherto the drawback has been the rancidity and tallowy condition of the fat, imparting a disagreeable flavour to the meat. In the present instance, the fat employed is prepared by a special process, by means of which the inventor confidently expects to prevent decomposition and rancidity. He employs, according to the terms of his patent, "mixtures of alkaline carbonates (monocarbonates, sesquicarbonates, bicarbonates), of oxides of sodium, potassium, or ammonium, with some alkaline or earthy chlorides of sodium, potassium, magnesium, aluminium, dissolved and put in contact by ebullition with the fatty matters, and thereby effecting the melting of the fatty matters without the production of acids or 'greaves;' whilst at the same time the fatty matters separated from the membranes and so treated are neutral and inoxidisable" Under his patent, the inventor also forms solid soups by the mixture of this prepared fat with flour of peas, beans, lentils, &c., with dry meat or fresh vegetables.

In the present instance several casks and jars were filled with pieces of meat, some raw and some very slightly cooked, the object of this being to expel the air, and the melted fat, at a temperature of 300°, was poured in, the meat being so arranged as not to touch the sides of the vessel. This caused a considerable disengagement of air before the fat became solid. Several of these casks were subsequently sealed with the Society's seal, and will be sent a voyage to Buenos Ayres and back, as a test of the efficacy of the system.

SILK SUPPLY COMMITTEE.

The Committee met on Tuesday, the 18th inst. Present—Mr. A. Cassels (in the chair), Mr. Hyde Clarke, Mr. B. F. Cobb, Sir Daniel Cooper, Bart., and Major-Gen. F. Eardley-Wilmot, R.A., F.R.S.

The Committee had before them the following letter:—

"Thorneleigh, Concord,
"2nd December, 1872.

"Dear Sir,—By this outgoing mail I send you six cocoons of each variety of the worms you sent me last year, viz., white Sina, yellow Tuscan, and Milanese; also three cartoons of grain of each of same, and I now beg to report progress. On receipt they had commenced hatching, as I informed you in my last. They continued to come out two or three a day of each sort for about six weeks, but only lived for a week or two; then, without any apparent cause, died off, much to my dissatisfaction.

"After trying them for about six weeks with no success, I determined to winter them, and keep the balance until our season for silkworms began here. As it turned out, I took the wisest course, for on bringing the grain to light they immediately began to hatch, and I believe I hatched every worm, and, what is more, reared nearly every one, as I do not think I lost twenty of each variety until they spun up.

"As regards the different varieties, I may mention that the 'white Sina,' to my mind, is much the best, and is the one that I shall adopt as my peculiar breed.

"The 'Milanese' were pretty regular, although not what I had expected them to be.

"The 'yellow Tuscan' are a very mixed lot. If they are pure, I am astonished to see such a contrast between the various cocoons, some being of a bright buff colour, and others of a bright yellow; the latter, however, being generally very thin and badly shaped.

"I also notice that the cocoons of all three varieties are thin, but attribute this, in a great measure, to the fact that the grain was older than it should have been, through my having had to winter it. I am in hopes that my next crop will be greatly improved in this respect, as they will be out at their proper season.

"I shall feel much obliged if you will forward some of the grain I now send you to the different places from which the original stock came, and, if possible, let me have a report on it.

"I am glad, also, to inform you that I have a good supply of grain for next year. If I am successful with it, I shall have a large stock to spare to send home of each variety for sale.

"You will note the coat of arms I designed and had printed on the back of the cartoons, which I intend as my trade-mark should I export grain. I shall also sign my name on each cartoon, as I have done on each of those I now forward you.

"To secure the different breeds being true, I kept each variety in separate rooms from the time they began to hatch until they had finished laying. I can, therefore, guarantee that every egg is as pure as the stock was that I received from you.

"I cannot conclude without again thanking you and your Society for the trouble you took in procuring me and this colony such valuable stock, and trust that I shall show my appreciation of your kindness by carrying the enterprise to a successful issue in this colony.

"I have the honour to be,
"Dear Sir,
"Yours truly,
"Chas. Horne."

The "white Sina" breed, mentioned in the letter by Mr. Horne as acclimatising well, is a very valuable breed, procured with great difficulty by the Committee, and sent out with the view of introducing the most approved description into the country.

Arrangements were directed to be made for rearing some of the grain at the International Exhibition.

The Secretary reported that he had taken steps for displaying at the International Exhibition some scarfs manufactured by Messrs. Potts and Co., of Macclesfield, at the request of the Committee, from silk grown and reeled at Stellenbosch, Cape of Good Hope, under the auspices of Dr. Hiddingh, by whose means this industry has been introduced there and the filature established. The silk thus grown and reeled is estimated in the trade to be equal in quality to the Lower Italian samples, and worth 38s. per lb., and manufacturers would gladly take all the silk that can be sent of similar quality.

Sir Daniel Cooper reported the successful results of Mrs. Neil's experiment in conveying seed from Europe to Australia, and maintaining an artificial winter through the tropics by means of peculiarly constructed refrigerators.

The great object obtained by these means is to make the seasons of the antipodes coincide with those of Europe, and thus enable the colonists to supply grains or seed to the European market at the time purchases are made for the silk campaign, such grains to hatch naturally in the European spring, and not at the time of the Australian spring or European autumn. Hitherto this has been the great difficulty in the disposing of Australian-reared grain, viz., that the natural time for the worm to appear was in the European autumn; and when forced by the application of heat to hatch without having gone through the period of hybernation, the worms were sickly and either died or spun inferior cocoons.

Mrs. Neil is distributing the grain in Sydney and Melbourne, and it will be a matter of much interest to learn the result of the first campaign and the shipments of the produce. The *Melbourne Argus* reports that one of the directors of the Peninsular and Oriental Company had promised to send one of their largest steamers to bring home the grain as soon as it was ready, but as it requires a good many ounces of grain to fill a 4,000 ton steamer, the colonists must moderate their aspirations for the present, at least; in the meantime they may be congratulated on their success thus far.

PRIZE FOR STEEL.

1. The Council have resolved to award the Gold Medal of the Society to the manufacturer who shall produce and send to the London International Exhibition of 1873 the best collection of specimens of steel suitable for general engineering purposes.

2. The specimens exhibited must include a complete illustration of the applications of the varieties of steel submitted.

3. Each manufacturer should send with his specimens a statement of the nature of the tests he has applied to each kind of steel submitted, and give the results of such tests.

4. The samples tested are to be exhibited together with duplicate samples, or portions of the same samples; these will be submitted to tests should the Council consider it desirable.

5. All persons using steel for general engineering purposes, who are not manufacturers of such steel, are also invited to exhibit specimens on the above terms and conditions.

6. The Council reserve to themselves the right of withholding the premium, in the event of the specimens exhibited not being sufficiently meritorious.

PROCEEDINGS OF THE SOCIETY

INDIA COMMITTEE.

A Conference was held on Friday evening, 14th inst., at 8 p.m., Sir HENRY CRESWICKE RAWLINSON, F.R.S.,, F.R.G.S., in the chair.

The Chairman, in opening the proceedings, said it could hardly be necessary for him to go through the formality of introducing Mr. Shaw to the meeting, because he thought most of the members present must be acquainted with him from his writings. He would, however, mention that Mr. Shaw was the only Englishman living who had ever visited the city of Kashghar, in Central Asia. Mr. Shaw's first visit to that country was in the character of an enterprising man with commercial views. He took upon himself to make a journey from Cashmere into Thibet, a most spirited, and, he must say, a dangerous undertaking, for the mere purpose of seeing what commercial opening there was. It so happened that Mr. Hayward, who was engaged on a similar expedition, was there also, and they were together at Yarkand, although he believed they never saw each other until their return. On his return to India, Mr. Shaw reported to the government the result of his travels, and under the enlightened policy of the late lamented Viceroy, Lord Mayo, he was appointed to accompany Mr. Douglas Forsyth on a mission, which, though not called a political mission, was so in reality. On that occasion, in company with Mr. Forsyth, he again visited Yarkand. The governor of the country, the Atalik Ghazee, was at that time engaged on a distant expedition, 700 or 800 miles from Yarkand, and under the stringent instructions which accompanied the mission, neither Mr. Forsyth nor Mr. Shaw were able to remain there till his return. Accordingly, they came back to Calcutta, and reported to the government generally on the result of the mission. Mr. Shaw, consequently, had great experience of Central Asia, not merely the experience of a traveller, but that of a confidential political adviser. He might also say, judging from the papers he had sent to the Geographical Society, that he was an acute observer, and a trustworthy reporter, and any information that he had brought over might be thoroughly relied upon.

The paper read was on—

ENGLAND AND CENTRAL ASIA.

By Robert B. Shaw.

I appear before you this evening to carry out a promise which I made to the King of Eastern Turkistan when I visited him at his capital of Kashghar. That chief inquired of me particularly what were the sentiments of England with regard to him. I could not then tell him much on that point. In fact, had I told the entire truth, I should have had to say that the people of England in general knew very little about him or his kingdom. But I promised that I would do my best to make my countrymen know how he had brought the country now subject to his rule, which was formerly notorious in Asia for its unruliness, into a condition of order and stability. I also promised to declare his friendly dispositions towards the English, and his desire for intercourse and commercial relations.

It is a strange spectacle to see the Prince of the hitherto mysterious and inaccessible region of inner Asia stepping forward out of the darkness, and demanding that his country shall be received into the comity of nations. It would be still more strange if England did not welcome him; but, fortunately, there is no fear of that. The favourable reception given to his overtures of friendship by the late Viceroy of India, Lord Mayo, has led to the despatch of other envoys from Kashghar, who have been well received in India, and there seems every prospect of a permanent friendship being established between the two powers.

But still there are many erroneous opinions to be got rid of on both sides. On his part he has to be convinced, as I endeavoured to do when I had the opportunity, that England has no intention of overstepping the mighty mountain barrier which nature has placed between his dominions and ours —a barrier capable of the most complete defence against force from either side, but yet penetrated in such a manner by rivers, and so accessible by easy routes, that it forms no obstacle to peaceful commerce or to unopposed entrance.

On our side we have even more delusions to part with. In those regions, as in so many others, war has its chroniclers, but peaceful progress has none. The brilliant exploits of great conquerers, the conflicts of the military and wandering classes, and of their ambitious leaders, have attracted our eyes and blinded us to the condition and disposition of the mass of the peaceable and stable population which all the time has been pursuing its avocations, and effacing the marks of war. One most striking proof of this is visible in travelling through Eastern Turkistan. Instead of finding, as in Northern India, every village a sort of petty fort, all the houses crowded together for protection, and presenting outwardly a blank wall, with one or two narrow entrances, the traveller in Kashghar and Yarkand finds open farmsteads scattered about over a smiling land, and the villages unwalled and straggling, an unmistakable sign that the country has practically enjoyed security during a long period.

It is this side of the Central Asian character to which I desire chiefly to draw your attention. We, at a distance, hear of nothing but wars and rumours of wars from that region, till we fancy it a kind of volcano, always ready for eruption, whose crater every now and then gives forth destructive lava torrents, which are only a fair example of the confusion that is raging within it. It is only a personal visit and a nearer acquaintance that shows us how superficial this view is, and how much better the state of affairs in Central Asia could be compared to that of a blast furnace, where, although flames and apparent confusion reign on the top, yet the valuable metal is being produced below. I will first attempt to give a slight sketch of Eastern Turkistan.

In speaking of Tartary we are hardly prepared to hear of a well-cultivated country full of settled habitations, and containing flourishing cities of more than 80,000 inhabitants, where many of the arts of civilisation are carried on. Security of life and property exists; commerce is protected; light carts drawn by horses frequent the roads; markets are held on a fixed day of the week even in the smallest villiages. In the towns extensive bazârs, covered in against the rays of the sun, contain rows of shops where goods of every sort and from every country are exhibited. In Yarkand alone there are sixty colleges, with endowments in land, for the education of students of Mussulman law and divinity, while every street contains a primary school attached to a mosque, where turbaned rows of young true believers may be seen and heard daily at their first lessons of reading and writing. Different quarters of the town are set apart for the sale of different wares. In one street will be found spread out the silks of China, in another the cotton goods and prints of Russia, while a third will contain the robes made up of both materials, three or four of which form the ordinary dress of the Turkis. Further on you meet with sugar from Russia, tea, spices, and all kinds of foreign produce. In another part are the butchers, who offer a choice of horse-flesh, camel, beef, or mutton. The first is rather a luxury, but the two last are most abundant, selling at about one penny a pound. Next are the bakers, who make most excellent light loaves by a process of steaming the bread. The sellers of country produce supply vegetables of many kinds; such as cabbage, turnip, lettuce, carrots, &c., besides cream, nearly as thick as that of Devonshire, also a peculiar preparation of curds, and delicious cream-cheeses. At another place you can get sherbet made of fruit, which you can cool at every street corner from stalls for the sale of ice, which has been pitted in the winter. There are tea-shops where the great urns are ever steaming, and eating-houses where business-men can get their midday pilao. Elsewhere are horse and cattle markets; in fact it would be impossible to enumerate all.

Eastern Turkistan (or, as it used to be called on our maps, Chinese Tartary) resembles a huge bay, with its mouth turned to the east, and shut in on every side by gigantic chains of mountains. A broad desert, thirty days' journey in extent, occupies its mouth, and separates it from China, of which empire it was, until recently, a possession. This desert sucks up all the rivers of Turkistan, which die away in marshes and lakes, or form a vast jungle of scrub-wood, where they disappear under the sand.

Both the northern range, which is a continuation of the Thian-Shan, and the southern, which may be called the Himalayan system, converge towards one another as they run westward, and unite in a vast protuberance, or boss, supporting the high plateau of Pamir, which the natives call the "Bâm-i-dunya," or "Upper Floor of the World."

This protuberance, however, is of irregular shape, and north of it there runs back a kind of secondary bay, at the upper corner of the great bay, to which I have likened Eastern Turkistan. At the mouth of this inner bay stand the town of Yunghissar and the city of Kâshghar, the political capital of the country, as Yarkand is its commercial capital. Two long arms are pushed out under the northern and southern ranges of mountains, between them and the great dessert. These arms are formed by the province of Khoten, on the south, and those of Ush-Turfân, Aksu, Kuchè, &c., on the north. Thus the inhabited country resembles a crescent in general form, its convex side guarded by mountains, and the concave occupied by desert. Its general elevation of 4,000 or 5,000 feet above the sea-level, while some of the peaks around rise to an altitude of more than 20,000 feet, as well as can be judged without actual measurement.

In talking of the northern and southern boundaries of Eastern Turkistan, we must remember that they are by no means simple ranges, like the Alps or the Pyrenees, which can be crossed by a single pass. They are rather complex systems of mountains, composed of many chains, and enclosing considerable countries within their valleys. Thibet and Cashmere are examples of this. Eleven passes have to be crossed in travelling from India to Turkistan, and of these passes only two are lower than the summit of the Mont Blanc.

The northern mountain boundary of Eastern Turkistan is almost equally complex, excepting towards its western end, where only a single wall of mountain is left between the Kashgar territories and the upper valleys of the River Jaxartes, whose lower course is now held by the Russians.

That portion of the great mountain barrier which occupies, as it were, the head of the bay, and shuts it in on the west, is not less complex in character. Numerous valleys penetrate into it from east and from west, forming secluded hill-states, separated by lofty ridges, while the intermediate parts are occupied by elevated steppes, in which rise, almost intermixedly, the streams which form the Oxus on the one side and the Yarkand River on the other. This peculiarity makes the Pamir Mountain mass far easier to traverse from east to west than from north to south, a fact which has an important bearing on the trade routes, &c.

Having described the mountain boundary of Eastern Turkistan, it will be convenient to extend our inquiries briefly to the countries immediately adjoining. Thus, on the west we may again bring in the comparison of a sea running into bays. One and the largest bay, the Southern, is occupied by the head-waters of the Oxus, or Amoo, and the other bay is the valley of the Upper Jaxartes, whose sources extend back in a line parallel to, and to the north of, those of the Kashghar River. These two bays, or basins, are separated by a projecting mountain region, which gives birth to a third and intermediate river, the Zarafshan, or "Gold-scatterer," so called from its fertilising powers, which, indeed, are drawn upon to such an extent by canals, that the river itself is drained dry, creating at its own cost the rich cultivation of Bokhara.

You will observe that the Russians have secured possession of the upper portion of the Zarafshan valley about Samarcand, and thus command the waters on which Bokhara depends for existence.

The Russian advance has also blocked the mouth of the northern bay, containing the head of the Jaxartes, and the Khanate of Khokand (or what remains of it) is thus enclosed between the Russian frontier and the mountains of Kashghar, and is thus entirely cut off from all communication with, or support from, Bokhara.

I will now briefly point out the principal approaches to Eastern Turkistan, begining at Kulja, the scene of Russia's latest advance in this direction. In 1871 she occupied this district, and she is now only separated from Zungaria by a hilly region which, I am credibly informed, on native authority, is passable for carts. Now, although Kulja is separated by difficult snowy mountains from Eastern Turkistan, yet these mountains die away to the east, and from that point Russia has it in her power to push her advance or her trade in two directions over level country, either eastward to China, or westward to Turkistan.

Next, the Muzat Pass, leading between Aksu and Russian Kulja, lies over a formidable glacier, where I am assured that 40 men are kept at work in the summer roughing the ice for the passage of the caravans.

The Artush Pass leads over the same range from Kashghar to the Russian station of Vernoje, descending into the valley of the Naryn (the head of the Jaxartes river), where the Russians have built a fort. Baron Osten-Sacken, who lately visited it, has described the route. It appears to be extremely mountainous and difficult, crossing many high ridges and descending into deep gorges, but if we are to believe the Russian accounts, their engineers have been at work on the road, and have made it passable for artillery up to the Turkistan frontier. South of that point there are no great difficulties, though a native fort, armed with ten guns, was being constructed there at the time of my visit to Kashghar, the king himself superintending the work.

The Terek is the next pass. It leads into the still independent remnant of Khokand. It is only used in winter, owing to the obstacles interposed by the streams in summer. But at that season there is an alternative route further south, so that, practically, traffic is not entirely stopped for long at a time. This is the chief route by which Russian merchandise reaches Eastern Turkistan, and appears to have been the usual road taken by the Mongol and Tartar invaders from the east.

A little to the south of Yang-hissar I saw a deep valley, reaching into the heart of the mountains, and was informed that by it an easy road led across the Pamir into Kolab. The envoy from that principality was at Yang-hissar with a large camp, which had just come by that route, and his fine large horses seemed in no way to have suffered from the transit. *Apropos* of this route, Col. Yule, whose name carries the greatest weight in any inquiry concerning these regions, writes to me as follows:—"Don't you begin to think it likely that your Yang-hissar gap is the old Seric route? It certainly corresponds on the Western side to the hill country of the Comedæ." If this be the case we have here one of the oldest trade-routes in existence—that by which, in the time of the Roman Empire, the goods of China reached the western world, according to Ptolemy; but it is not much used in the present day, probably owing to political reasons.

South of this again, or about south-west from Yarkand, runs a road regarding which we have of late years been seeking and finding much information, and to which the public attention has been lately drawn, I mean the route leading through Wakhan. This, at the present moment, is perhaps the chief land route between the east and the west of Asia, or, at least, of Central Asia; and by the arrangement recently concluded with Russia, it has been retained in the hands of our ally, the King of Kabul. What makes it the more interesting to us is the fact that it also contains a side-door into India. The long valley of Chitral may be said to be the only valley leading from the level of the plains right up to the back-bone of the great mountain system which forms the watershed between India and Central Asia. It is the only route on which there is only one pass between these two vast basins, and that a very easy pass. And here I cannot help referring to the curious dearth of geographical information in the English press. Our newspapers seem utterly to ignore the fact that any English travellers have visited Central Asia. The travels of Captain Wood, 35 years ago, have only just begun to dawn upon their vision. And even with regard to points close to our own Indian frontier, our public instructors seem to be dependent for information on Berlin and Vienna. An extraordinary statement has lately proceded from an eminent military and geographical authority in the latter capital. General von Hauslab states that the mountains marked in previous maps between Badakhshan and Ladâk *do not exist!* I, who have lived in Ladâk, and seen peaks of 28,000 feet in the region between it and Badakhshan, am scarcely inclined to subscribe to General von Hauslab's opinion.

It is true the passage of the range is easy, but we must not misunderstand this fact, as some writers lately have. In these regions such is the physical character of the mountains that the actual passage across the watershed is the least of the difficulties of the routes. The terrible Karakoram itself, as regards the actual pass, might be taken for a mere railway embankment to be climbed over. The gorges on both sides, leading to these elevated regions, form the real difficulties.

Many of my hearers know the St. Gothard Pass. To compare great things with small, the approaches to the passes in Central Asia are like the gorge of the Devil's-bridge, while the water-parting itself resembles the plain of Andermatt and Hospenthal, from which the descent is by a continuous "via mala." This, enlarged into hundreds of miles of road, is the character of these routes with few exceptions, and certainly the approach to Wakhan from the north is not one of these exceptions. The main river Oxus, rising in Wakhan, afterwards turning northwards, makes its way out through gorges which are simply impassable, unless it is in exceptional years, when the rapid river freezes hard enough to bear travellers on its ice for a few days. Captain Wood's description is not inviting. He met the remnants of a party of travellers, most of whose companions had been destroyed by an avalanche on this route. "Nothing more was seen of them; every man, every animal, was in an instant overwhelmed and destroyed," he says.

Thus the caravans from the east, after leaving Wakhan, being prevented from following down the course of the Oxus, are obliged to cross over the mountains westward, into Badakhshan. The whole of this important route, therefore, including the side-door into India, is within the territory reserved to our allies, the Afghans, and by our influence with them we can keep it open to the commerce and traffic of the world, unfettered by monopoly or prohibitive duties.

I now come to the last of the great routes into Eastern Turkistan, that which passes through the country of our tributary, the Maharaja of Cashmir. Although the band of mountains is here very wide, yet for purposes of roads and traffic we can say that only about one-quarter of this width is really of an Alpine character, and through this portion an excellent mule-road has been constructed by the Indian government. Beyond that point the general character of the country is that of rolling hills and plateaux, all at a high level, but with such easy gradients and in such a rainless and snowless climate that there are few road difficulties to be encountered. The worst part of it used to be north of the Indus, where considerable elevations and depressions were encountered, culminating in the great Karakoram pass, where for four or five days' march the cattle were dependent on the supplies which they carried with them. But it has been found that by going round a little to the east the heads of streams can be turned or crossed at a high level, while the supply difficulty is so far diminished that there is only one day's march actually without grass for an ordinary-sized caravan.

To complete our view of the principal physical features of Eastern Turkistan we must consider its rivers. These, rising in all parts of the mountain boundary, collect into two main arteries, the River of Yarkand and that of Kashghar (the Tuman). These, again, unite further east, and finally disappear in the desert, giving rise first to dense jungles, and further on to swamps and lakes, in which they are lost at a level of about 2,000 feet. The most cultivated districts are between 4,000 and 5,000 feet above the sea, or the same height as Cashmir. The chief depression or trough of the drainage runs nearer the Northern than the Southern mountains.

Central Asia, even more than Egypt, is dependent on its rivers. Wherever a rill of water can be brought the fertility is amazing; but all around is a howling waste. As in Holland the very existence of the country depends on the care with which the canals and dams are regulated, so it is in Central Asia, only the object of the care is exactly the reverse. In Holland the water has to be removed; in Turkistan it has to be brought on to the land. This fact in itself will show us that the inhabitants of Central Asia must consist of other classes besides the wild hordes of depredators of whom we chiefly hear. Without the constant industry of a numerous and laborious peasantry, the country must have become waste in a very few years. This is more especially the case in Eastern Turkistan, where the rainfall does not exceed a few inches in the year, and where the rivers descending from the snows of the Pamir mountains supply a perfect network of canals. I have often seen three or more artificial water-courses crossing one another at different levels to supply different fields, and the cultivators are even acquainted (in an empirical manner probably) with the syphon principle, by which they make the waters of a canal descend under a roadway and rise up again to the same level on the other side.

If there is any exception in Central Asia to this rule of natural sterility overcome by human industry, it is in Badakhshan and Andijan, or the countries near the head of the Oxus and Jaxartes. Here the vast mountain ranges attract the clouds, which reach them chiefly from the west, and compel them to discharge the waters with which they are laden, and which from this high natural reservoir are conducted east and west by the rivers to fertilise, or rather to create, the countries on each side. Thus the western flanks of these mountains are blessed by frequent showers, and enjoy a natural beauty and fertility which has been extolled by all travellers. Marco Polo and Capt. Wood are loud in their praises, and an Afghan merchant expressed the same fact to me by saying:—"Beautiful is Hindostan, beautiful is Iran, beautiful is London (I suppose in compliment to my nationality), but the most lovely of all is Badakhshan."

It seems probable that these provinces may have for us Europeans an earlier and a stronger interest than that which they have lately acquired as being debatable land betwixt India and Russia. For certain facts go to show that they form the original centre of dispersion of the great Indo-Germanic race, or at any rate of its Eastern branch. The further back we trace the migrations of the Hindus and Persians, the nearer, in both cases, do we get to the western slopes of the Pamir Mountains; and the further back we trace their now divergent languages, the nearer do they approach to one another, till they at last point to the existence of some mother tongue from which both forms must have sprung. But in this very region, where we had lost the traces of the early Hindus and Persians through the haze of antiquity, we now find ancient and broken tribes living in secluded valleys (the common retreat of aboriginal races), and speaking dialects which, as far as can be judged by scanty vocabularies, partake almost as much of the Indian as of the Persian characteristics. The latter prevail most in Wakhan, Shighnan, &c., petty hill-states on the Upper Oxus, and the former among the Dard tribes south of the Indian watershed.

It may be conceived what a vast field of inquiry and of interest these facts open up in these regions, compared with which the temporary interest of the boundary question is as nothing

But we must now come to the main population of Eastern Turkistân, which consists of two great divisions, the wandering and the settled. The former occupy the whole of the western and northern mountains, and of the valleys leading from them, where they wander about with their cattle. So little is the old nomad spirit extinct among them, that the chief of one of the small Kirghiz tribes with whom I came in contact told me seriously that he had been in communication with his brethren of the main horde in the Alaï steppe, and that they had been so inconvenienced and straightened in their present pastures, that if the English would only give the word they would move down in their thousands with their families, their tents, and their cattle, and nomadise in British territory. Of course I begged him not to think of it, as we should not be at all anxious to receive such numerous guests. Their religion (though they are nominally Mussulmans) and civilisation are both of a very primitive nature. They chiefly trade by barter. One of them, after examining carefully a new "Henry" Express rifle in my possession, gravely bid me 17 head of cattle for it—of the long-haired breed called "yaks." But even under these conditions the native traders make a considerable profit in the commerce with these nomads, who are all dressed in outer clothing made of a mixture of silk and cotton of brilliant patterns. The Kirghiz are replaced further east, beyond Karashahr, by tribes of the same race, but of Shâman or Buddhist faith, whom their neighbours call Kalmaks. The mightiest chief of these tribes is a woman, who is said to be very rich. She wears such a number of gold ornaments in her hair that she has to be always followed by two pages to support the weight. This Queen of the Kalmaks lately made an offer of marriage to her ally, or suzerain, the King of Eastern Turkistan, which he refused on account of her religion. It is said that this has caused a considerable coolness between the two powers, and that the Kalmaks generally espouse the quarrel of their Queen. However, their interests are too much bound up with Eastern Turkistan to allow of a permanent estrangement from such a cause.

That these rich nomads, however, would be no bad customers of ours is shown by a proverb current in Central Asia, "Give the Kalmak cotton-cloth, and the Chinaman soft words," viz., what each has the greatest desire for.

If this is the case with the wandering tribes, much more is it so with the settled inhabitants, with their large cities, their numerous trades, their highly developed agriculture, their productive country, and, above all, their mercantile energy, which, from the earliest times, has led the inhabitants of these regions to confront every difficulty and danger of the most distant journeys in pursuit of gain.

The following will show the amount of life and prosperity which I found prevailing amongst a people whom we, if we have thought of them at all, have been accustomed to look upon as wild and uncouth barbarians, driven by the poverty of their own barren steppes into constant inroads on their more civilised neighbours.

Once past the band of desert (varying from 10 to 20 miles in width) which slopes down from the foot of the mountains, the traveller enters a cultivated country, where in spring—as I saw it on my return—a broad sea of green wheat stretches right and left, running into little bays and arms between the scattered farmhouses and hamlets, each surrounded by its orchard in full blossom. So numerous are these orchards that they close the view a few hundred yards from the eye. The productions are nearly the same as those of Cashmere. Apples, pears, apricots, peaches, mulberries, walnuts, melons, and even grapes, grow to perfection (the vines being buried in winter on account of the frost); while the chief crops are wheat, barley, Indian corn, and lucerne, which two latter are the universal feed of the horses. Cotton, flax, and hemp are also much cultivated, though neither of the latter for their fibre.

The roads are often crowded with people. I left the town of Kargalik on the morning of the weekly market, which is held in every village and town of Turkistan, The country people were flocking in from all directions, bringing the produce of their farms for sale. There was hardly one of all the multitude that was not mounted, even though it were upon a donkey. Rosy-cheeked farmers' wives and daughters, sometimes two on a horse, or mounted behind their husdands or fathers, and carrying their baskets of eggs or of butter: boys driving their files of donkeys, and always riding on the hindmost; farm-servants, taking in horses or cows for sale; merchants, with bales of goods; covered carts, with one horse in the shafts and two or three abreast as leaders; beggars with their tall caps and with calabashes by their side (even they often beg on horseback!); all these poured past us in a continuous stream for several miles. Then the crowd on the road began to get less dense, but we could still see parties of people in single file converging along bye-paths towards the road. Now, all this population is supported on land which but for artificial watering would be a bare desert. Many of the rivers are absolutely drained of their water for the benefit of the thirsty fields, even before reaching the great Desert, which would, at any rate, engulf them. Canals are the life of the country, and are felt to be so important that even the ruler himself, Yakoob Beg, was, during my stay at Kashgar, engaged personally in the construction of one. He used to visit it daily, working often with his own hands at the excavation, to encourage his soldiers who were employed at the work. His care is not confined to canals; new roads are being made and bridges erected by his orders; rest-houses for travellers and wells in the desert are being constructed. Almost all these works are being carried out by the troops, whom he keeps well paid and moderately employed, thus turning into a channel of public utility those restless energies which formerly found vent in constant insurrections against the Chinese, and undid the labours of the industrious classes whom they now assist.

I must say I brought away with me, from a seven months' residence among the people of Turkistan, a far more favourable idea of their character than I had arrived with. The lower classes are contented, industrious, and friendly to strangers. Their kind-heartedness was testified to by an unfortunate Indian who had been captured with his companions by some savage tribes on the confines of Cashmir, and brought over by Badakhshee slave-merchants for sale in Yarkand. After describing the hardships and brutalities that he had suffered from his masters on the road, he grew quite pathetic in his account of the kindness he had received from the peasants at whose houses they put up when once they entered Turkistan. The good-natured farmers' wives would bring him out warm food, most grateful to one who had been half-starved for many weeks; while the children smuggled out blankets to wrap himself in, which, however, the slave-merchants would sometimes discover and deprive him of. Finally, on reaching Yarkand, he was released by the governor and taken into the King's service.

Nor are the upper classes entitled to a less favourable verdict. Though, of course, tinctured with a little oriental duplicity, yet, socially, no one can be more pleasant. The Envoy who has just arrived in Calcutta, and who is an old friend of mine, is a type of an agreeable, gentlemanly, well-educated man; a firm believer in his own religion (indeed, he is considered rather a holy man), but perfectly tolerant to other people's faith.

The *abolition of the slave-trade* should secure the sympathy of Englishmen with a native Asiatic power which, entirely without pressure from without, and solely in obedience to its own notions of right and wrong, has taken a step similar to that which is reckoned one of the chief triumphs of Christianity in the 19th century. During the Chinese rule, there were open markets in all the towns of Eastern Turkistan where male or female slaves were exhibited for sale like cattle. One of the first acts of the present ruler, the Atalik Ghazi, was to close these markets. It is true there are still domestic slaves in many households, but theirs is a very mitigated kind of servitude, and it was long before I could discover which were the slaves and which were the free servants, so similar was their treatment. The regular trade, however, with all the horrors that are necessary to supply it, is done away with.

The security of life and property is very remarkable for an Eastern State. When I first went there I thought it necessary to be constantly armed and accompanied by armed servants. The second time I did not even carry a revolver. Rich caravans are met on the roads, attended by two or three unarmed men. One only theft occurred to my party, and that was of a thermometer which I had left outside attached to a tree, and it was restored as soon as I inquired for it.

Altogether the hospitality of the Toorkis and their kind treatment of a stranger like me, who came among them without any claim whatever on them, render me disinclined to accept blindly the very unfavourable accounts which the Russians give us of the same people, whom they choose to stigmatise as impracticable barbarians. It is a case of the lion painted by the man. That the Central Asiatics hold a different view of their relations with their neighbours is shown by the following little allegory, which was told me in Yarkand, and which may be called the native view of the Central Asian question:—

One day while the Archangel Gabriel was keeping the gate of Heaven, a man presented himself for admission. "Who are you?" inquired Gabriel. "I am a Russian," he replied, "and desire to present myself before the throne of Allah." On being admitted he bowed himself down and said, "Oh, Allah, we Russians are the only people that honour thee in the right way, therefore give us the dominion of the whole earth, that we may make all serve thee aright." Allah replied, "Have you not already your vast empire, which I have given you? What have you to do with more? Go thy way." In like manner the Englishman came, and begged for universal rule. But Allah replied to him, "Have you not your ships and your guns, with which you rule the entire seas? Go, and enjoy what is already yours." Similar answers were given to representatives of France, China, &c. Last of all came the Toork (or Tartar of Central Asia) and prostrated himself in silence before the throne. Allah raised him up and said, "You, poor fellow, have neither empire nor wealth, nor cleverness; you are a prey to the stronger." Then, turning to the Archangel Gabriel, Allah said, "Here let him rest, in the shadow of my throne."

This claim to the character of injured innocence probably as little represents the entire facts as do the views of their opponents. But it is at least useful to have the one to aid us in correcting the others. As yet we have never heard more than one side of the question. It would be strange if it did not contain some exaggeration.

We are often told now that the only way in which Central Asia can become civilised and opened out to the rest of the world is by the means of Russian conquest. Without trenching on such ground, we may inquire whether the character of the present rule, at least in Eastern Turkistan, holds out any hope of success by more peaceable means.

That country was ten years ago rescued from the icy grasp of Chinese isolation, which had been on it for a century. In 1864 it freed itself from this foreign paralysing yoke, and has since embarked in a career of progress under a ruler, the Atalik-Ghazee, who has produced the most perfect internal order and security, while trying to cultivate friendship with his neighbours. Unlike his Chinese predecessors, who employed their power in keeping the country secluded from intercourse with all other nations, the present Ruler has already sent down three several Envoys to invite us to visit his country; and these advances have been suitably received by us. If we inquire into the immediate cause of these overtures on his part, we must ascribe them in a great measure to the effect produced in Central Asia by Lord Mayo's grand reception of the Amir Sher Ali at Umballa. The Afghans are much looked up to all over those regions as a military nation, and the fact that their King had shown sufficient confidence in the English to leave his own kingdom and visit the Viceroy in the interior of India, had a most striking effect on other native potentates, and at once opened their hearts to us. That Sher Ali should have gone at all was strange, but that he should return safely without the English taking any advantage of his position, this at once proved us to be quite unique in our magnanimity. A few months after the news reached Kashghar, the first Envoy ever sent from Eastern Turkistan to India appeared on the scene. Other predisposing causes there may have been, but it was this (the visit of Sher Ali to Lord Mayo) that broke the ice.

I cannot here forbear referring to the favourable effect on our Mussulman fellow-subjects in India produced by the sight of all these Envoys coming from independent princes of Islam to court the friendship of our Viceroy. The Mussulman kingdoms of Central Asia, with Bokhara at their head, are looked upon proverbially as "the strength of Islam and of the faith;" and their conduct towards us will have no small effect in influencing the opinions of their co-religionists in India

But to resume, it may be asked what are the prospects of profitable intercourse with the people of Central Asia? What are their wants, and can they afford to pay us for suplying them?

Their wants are precisely those which our English manufacturers can best supply — piece goods of all kinds, chiefly cotton, but also woollen and mixed fabrics, to take the place of the coarse silken stuffs which they manufacture for themselves.

Tea from our Indian plantations and from China is in great demand, being a necessity of life with that nation.

Judging from what I have seen of their habits of life, I should say the inhabitants of Central Asia would consume more cotton goods and tea than an equal number of any average European population, while their ability to pay for them is vouched for by the possession of gold mines, which have been worked here from the highest antiquity, and by an extensive production of silk, which might be utilised in Europe either in the cocoon or in the reeled state. The finest of all wool, that of which the Cashmere shawls are made, is produced in quantities on their hill pastures. All these are light goods (in comparison with their value), and well adapted, therefore, for land transport. I have only enumerated a few of their chief articles, but the full list is a long one.

Now, it is not only the settled people of Eastern Turkistan with whom we should deal. The fabrics would be disseminated through all the wandering tribes up to the Great Wall of China, and into the western provinces of the Celestial Empire, which are cut off from the trade of the coast by political convulsions. The Russians, who have studied the question more than we have, talk of a trade capable of a vast increase over £5,000,000 sterling (the annual amount ascribed to their Tashkend trade five years ago), and also of a population of 60,000,000, whose wants could be supplied through the Kashghar market. We have at present no means of testing the correctness of these figures, but the efforts made by Russia to secure this market show the value she attaches to it. Now, it is certain that whatever natural advantages Russia possesses in this respect, England enjoys more. We can produce cheaper goods, and we can carry them cheaper to market. Our railways take us to within 400 miles of Yarkand, while the terminus of Russian cheap carriage is on the Caspian, a thousand miles off. The cost of transport is 20 per cent. less from England than from Russia into Eastern Turkistan.

Now, even before the conclusion of the Commercial Treaty with Russia, the population of Kashghar was almost entirely clothed in cotton goods from that country; but samples of their cotton goods which I brought back with me are recognised in many instances as being of English make.

If, then, our English fabrics can bear the extra charges of being imported first into Russia, paying also the Russian customs, and the profits of Russian middlemen, and then of being re-exported to Central Asia at a cost of transport in this section of the journey alone of 20 per cent. in excess of the whole expense of taking them out direct from England, how much greater would be the demand if we undertook this direct trade ourselves, and landed them in Central Asia free from all these extra charges. A difference of 20 or 30 per cent. in the price would bring our goods within the reach of millions of customers, who could not otherwise afford them. It is, therefore, obviously our interest to deal directly with Central Asia instead of through Russian hands. But, moreover, it can never be supposed that the Russians will content themselves with the role of disseminators of English fabrics. It has been calculated that the Russian public is taxed 10,000,000 of silver roubles annually in the price of their tea for the benefit of their manufacturers of piece-goods, which can only be sold to the Chinese at this vast sacrifice. Now it is inconceivable that Russia should tax herself at this rate to promote the growth of her manufactures, and yet allow the market of Central Asia to be flooded with English goods through the hands of her own merchants. These fabrics are merely used to try the taste of their customers, and are then imitated at Moscow. In point of fact we know that English goods are strictly excluded from the provinces lately conquered by Russia, and are subject to differential duties wherever her influence extends. How, then, can we delude ourselves into the idea that Central Asia will be opened up to our commerce by the efforts of Russia, and that we have nothing to do but to stand by and profit by them? Yet this was a theory propounded with the greatest air of conviction in some of the papers only a few months ago.

It is evident that if anything of this kind is done for us it will be done by ourselves. And it should be done quickly, or we may find ourselves forestalled. We all know the story of the elephant, which pushes before it a huge log to try the ground before venturing on it himself. So Russia pushes forward her protection tariff in advance of her own movements. Already she has got her Commercial Treaty. The next thing, judging by the past, will be the establishment of differential duties in favour of her products, to be followed, as her influence extends, by the prohibition of English manufactures in the Yarkand market. Add to this the energy of her merchants, who are always ready to incur every risk to secure a new market. In two years' time there might be no room left for English commerce in the last important region of Central Asia which is still open to us. Here is no question of military demonstrations or of costly works to be undertaken. Where, as in Eastern Turkistan, we are assured of the existence of a vast substratum of peaceful and industrious inhabitants, with a Chief who has both the prudence and the power to keep in check the turbulent classes, the true policy of neighbours would seem to be that on which we have already entered; viz., to add to the importance and influence of the well-disposed portion of the population by encouraging them in a lucrative trade with our own people. The moment is most opportune for action. The icy hold of Chinese exclusion, which has been on the country for a century, has relaxed, and the fiery grasp of Russian monopoly has not yet closed upon it. The King and his people are prepared to welcome us. They have not the traditions of former enmity to overcome, like the Afghans. All depends on the next year or two. Of the two great powers which adjoin Eastern Turkistan one has made herself a name for continual advances southward and eastward, while we are known as a power that has reached its proper boundaries, and whose motive for desiring intercourse with our neighbours cannot be one of aggression. They are thus thrown into our arms, and it is in our power to welcome them, and open up their country not only for ourselves but for all Europe.

This we can do in no spirit of jealousy of any other Power. The advantages gained by us would be gained for civilisation generally. Germany and other nations of Europe are already interested in the trade, and our method certainly contrasts favourably with that of our northern friends, whose way of opening up Central Asia seems to be to close it against all commerce but their own.

DISCUSSION.

Sir Louis Mallet, C.B., said the subject which Mr. Shaw had drawn their attention to was, in its commercial aspects, one that must have recommended itself to their judgments, and he could only enforce in the strongest way the arguments he had used, and express the hope that public opinion in England would support any efforts made in the direction this paper indicated. There seemed to be some hope, from the reports in the newspapers, that the envoy from Yarkand had been received at Calcutta, and that negotiations might lead, at no distant time, to very favourable results. He had been very much surprised, as he thought many of the members present must have been, at some of the facts which Mr. Shaw had brought to their notice; and he certainly was not prepared to receive such a picture of the civilisation which existed as Mr. Shaw had painted. Quite enough, however, had been told them to make them feel that there was no better way in which their efforts could be directed, to ward off those political dangers which some of them were too apt to apprehend from that quarter, than to promote peaceful intercourse with our neighbours on the northern frontier of India.

Sir Rutherford Alcock, K.C.B., said he had no special information to offer on Central Asia. His attention had been directed to it simply because the Chinese Empire was a part of it. He believed that a large commerce might be established with Central Asia, which we might compete for if the difficulties with our nearest neighbours as to transit could only be got over. Nepaul, which was more or less under the control of China—less, perhaps, rather than more—whenever there was any attempt to open the road, always put forward the Chinese authorities as being opposed to it. Until the last great insurrection they might have been under some sort of objection; but he believed it was mere pretence now, and that it would only require a decided effort of the British Government for Nepaul to give way, the pretext being removed. He sincerely hoped that, now attention had been drawn to the subject, we should not allow that country further to oppose, and compel the traveller to go through hill tribes of semi-barbarians, and other wild nomad tribes, before he could ever reach the fertile valley spoken of. The immediate result of all the attention which had been directed to this subject would be, he hoped, to cause Her Majesty's government to see the propriety of opening up Central Asia.

Mr. Eastwick, C.B., M.P., thought it should be forgotten what dreadful revolutions and frightful massacres had taken place in that country very lately. The head of Schlagenweit was placed on the top of a pyramid of heads in that very city, and at Kulja, not very long ago, there was a most bloody insurrection, succeeded by a most frightful internecine combat, after which, when almost the whole population had disappeared, in came Russia and occupied it. He fancied Kulja and the whole of that valley belonged to Tungaria. He would like to ask Mr. Shaw whether the Kalmaks, who crossed in 1781, and were pursued by the Russian general and almost exterminated by him and by the Kookhas, but who, nevertheless, did cross over and enter into the Chinese territory, were not beaten near there? It was known that the Kalmaks came in after the late insurrection to assist the Chinese, but were driven back and slaughtered by the Mahomedan rebels. The reason he mentioned this, was to point out how much the happiness of the people depended upon who was the ruler. No doubt the Atalik Ghazee had displayed wonderful power for government since the day he defended a fort on the Jaxartes against the Russians. He had reduced the whole country to peace; and if his rule should continue, there was every probability of a most important trade being commenced with his country. But what would be the case if he were cut off? It was only necessary to recal recent events, to see how very brief a tenure of office a ruler had in those parts. That being so, it was of immense importance that he should be assisted and supported on the throne by our friendly alliance. There had been negociations for a treaty, but he should very much like to have some definite statement as to what that treaty was, and how far it was likely to be supported.

Mr. Denison, M.P., had passed some four years of his career in the town of Umritsur; and he would like to know if it were true that, at the present moment, there were three different tariffs in Yarkand, the first most favourable for Mahomedans and Toorkis, the second in favour of the Chinese, and the third in favour of ourselves? And whether it was true that Russia had succeeded in obtaining the most favoured nation clause, that was, the same tariff which existed for the Mahomedans? He would also like to know what were the most recent arrangements for goods in transit through Cashmere, and whether there was a transit duty which operated as a prohibition?

Mr. Frederick Drew said two or three years ago a treaty was made between the government of India and the Rajah of Cashmere in regard to this matter. The routes through this territory were placed under two Commissioners, one on the part of Cashmere, and one on the part of the British Government, by whom all disputes were to be arranged. Therefore, as regarded the intermediate country of Cashmere, there was no difficulty. Although he had not been in Turkistan, yet, having been on the frontier, he had very great pleasure in bearing his testimony to the exact accuracy of Mr. Shaw's accounts. The discrepancy between the peaceful characteristics of the peasantry and the massacres which Mr. Eastwick had spoken of, was probably due to there being two races in the country. The real race of Yarkand was peaceful, but there was also a more warlike race, which, although not bloodthirsty, yet had not much regard for human life, and, in a state of turbulence, possibly they did not keep their hands from doing violence. But for some years past they had been quiet, and disturbance and violence were a considerable distance away. Therefore there was good reason to hope that the Atalik Ghazee's rule would consolidate itself, and be such as to lead to important commercial results. As to the amount of trade which it was possible to develop between this country and Yarkand, Mr. Shaw had not gone much into figures. But the first matter of consideration was the carriage. The immediate country between the Punjab and Yarkand was very barren in its supply of carriage, and of grass for the carriage animals. Although it had increased of late years, the increase could not go on indefinitely on that account; but they had not reached the limit yet, and it was worth while doing all that could be done to cultivate relations with Yarkand, and to improve the means of communication. The best plan was not to be restricted to use one route. There were three routes, one going to the south corner of the Pamir, down the Chitral valley. There was only one small power at the head of the valley that was likely to give any trouble, and he ought, for various reasons, to be very severely dealt with if he did. He did not think very much was to be done with envoys who came from Yarkand, as they were not entrusted with sufficient powers. The real way to effect anything was by an envoy going from this side to Yarkand, and, being thoroughly trusted, as our envoys were, and going there into the presence of the king, he would be able to make terms and arrange a treaty that would bring about important results. An embassy was sent from Calcutta in 1870, and returned, for sufficient reasons, without having accomplished its purpose; and for this country not to repeat it would be much the same sort of thing as calling on a man at his house, and because he happened not to be at home, taking offence at his absence, and never calling again. Therefore, if any good was to be done, it could only be accomplished by the government sending an envoy again; and if they chose the right man, one who was distinguished for his tact and prudence, and gave him the necessary powers, there was every reason to suppose the best results would ensue.

Sir George Balfour, K.C.B., remarked that an officer with whom he had conversed on the subject spoke in the warmest terms of the country and the climate, but not of the people. Mr. Shaw's description of the climate and country was fully borne out by the account he received from that officer. A very full and detailed description of the entire country had been published in an admirable work written by the late Mr. Inglis, and from this book he was sure that every Englishman who desired to know anything about the country would gain a vast amount of information. He had heard Badakshan spoken of as if it were a dependency of the Chinese empire. How far they occupied the country he had not been able to make out, but certainly the Chinese were in direct communication with Badakshan, and there obtained those green stones which were used to indicate the degrees of rank in the Chinese empire.

Major Burn gave the most unqualified support to all that Mr. Shaw had said. He was in Calcutta at the time Mr. Shaw wrote the letters, and also when he returned, bringing with him all his things, his shawls, and Manchester goods. Lord Mayo was deeply interested in the matter, and went through the entire narrative, for he was most anxious to encourage the trade between India and Yarkand. So much was Lord Mayo interested in the matter that, he himself calculated the cost of transit through the different routes, arriving at the decision of which Mr. Shaw had told them, that goods could be thrown much more cheaply into Yarkand from India than from Russia. On the subject of sending an envoy, he might say it was not befitting the position of the government to send envoys anywhere to any native State until those native States had themselves first sent an envoy to us; but as soon as an envoy was sent to the government from Yarkand, Lord Mayo sent one of his most trusted civilians, who was accompanied by Mr. Shaw himself, to return the visit. Whether the visit was successful or not he was not prepared to say. The King was 500 miles off, and was not likely soon to return; and if the mission had remained there, as the snow was coming down, the English envoy would have been imprisoned for five or six months, and this was not considered advisable. Nevertheless much good was effected, as could be seen by the result, and now the government had received two more envoys, and every encouragement had been given them. There was a great deal of difficulty with Cashmere, because Cashmere was as fond of trade as we ourselves, and they did not like our trade to go through their territory. But through the influence of the late Viceroy, the Maharajah of Cashmere actually did away with the transit duties, and goods were now perfectly free in their transit from Manchester to Yarkand, and *vice versâ*.

Dr. A. Campbell said—It is generally believed that the Russians have recently concluded a commercial treaty with the Atalik Ghazee of Yarkand; and we have just seen an envoy from the same potentate to the Governor-General has arrived in Calcutta. If these proceedings should lead to the conclusion of a commercial treaty with Yakoob Bey, or to placing our trade by any other means with Kashgâria on a satisfactory footing, I would submit the great importance of extending our efforts to attain the same end further east, through Thibet, to the capital of Lassa; as, under present circumstances, we are completely excluded from trade with that country; and in the event of Russian trade and political influence being extended to Thibet, we might be inconveniently and dangerously near, for the peace and safety of Bengal, in the event of a quarrel with Russia, on the Afghan boundary, or any other Central Asian question. You are aware that our means of trading with Thibet is at present confined to Ladak, on the extreme west, where we have an English agent, or commissioner, and that eastward from our Himalayan province of Kumaon, to the eastern extremity of Assam, we have no means whatever of gaining access for our trade, and this we owe to Chinese jealousy and exclusion, intensified by our immediate neighbours, the Nepaulese and the Bhootanese, whose territories overhang ours for an extent of 800 miles. To remove these obstructions, which I am most glad Sir R. Alcock has remarked upon, to our trade and to friendly intercourse with the people of these countries, is surely a very important work, and well worthy the attention of this Society. I shall be prepared to give any further information on this subject that may be required, and in the meantime will shortly suggest the means which should be adopted to further the ends in view:—1st. The Indian government should establish, as a principle, in its future relations with Nepaul, the necessity of reciprocal free trade along the whole length of her Indian frontier, viz., from Kumaon to Sikkim; as hitherto Nepaul has enjoyed free and unrestricted access to our Indian territories, from every point of her territory, while she shuts us out and imposes the most vexatious obstacles by levying high import duties on all our imports from India. 2nd. That we should claim freedom and protection to our trade through Nepaul to the frontier of Thibet. 3rd. That we should obtain freedom and protection to our trade in Thibet from the Chinese government. 4th. That we should connect the East-Indian railway with our own territory of Darjeeling, and open a road from Darjeeling through Sikkim to the Thibet frontier. 5th. That we should endeavour to remove all obstructions to our trade from Bengal and Assam through Bhootan. After the arrangements I propose are completed, I do not see why we should not go further ahead to develop our commerce with Thibet, and arrange to have a British consulate at Lassa. Russian goods are to be found in the bazaar at Lassa, and the Russians are fond of following their wares in this direction. Our English and Indian goods are also in great request there, and we may as well send them. Dr. Campbell concluded by saying it was not a thing to be done in a hurry. But having had an experience of thirty years he could say that a great deal could be done by persistent endeavours. It took him twenty years to get access through Sikkim to the Thibetan frontier, but that access was ultimately secured, and they were now free to make roads to pass right up from Sikkim into Thibet, and the same could be done with Nepaul. It was a very fitting occasion to take the matter up.

Mr. Blandford (Indian Geological Survey), said he had been very lately on the Sikkim frontier, and there was an absolute prohibition of the import of tea. He had not only received information from people in Sikkim. but he had heard that an offer of a present of Sikkim tea was refused by an officer, on the ground that he was not allowed to receive it.

Mr. Shaw, replying to the various questions and observations that had been made, said that with regard to Nepaul he could give no information. As to the character of the people of Turkistan, and their murder of Schlagenweit, to which Mr. Eastwick had alluded, it was true there was a race who were violent and warlike, but there was also a peaceable and orderly population, and he desired to give the other side of the picture. For that murder the present King himself had made a prolonged apology to him, and explained that it had not been committed by him or his people, but by invaders from Kokand, who, in endeavouring to wrest their country from the Chinese, committed this murder. The present rulers had nothing whatever to do with it. This was the only reason, he said, why an envoy had not been sent to us, as he feared we associated his people with it; but having seen by his (Mr. Shaw's) arrival there that we bore them no grudge, he would send an envoy. With regard to Tungaria, Kulja was a portion of it. Tungaria was an obsolete term; the kingdom was broken up entirely, and was occupied by people of a different race; they might be called the Chinese military. The Kalmuks were the same as those who were pursued, of whom Mr. Eastwick spoke. In replying to the remarks as to the power of the Atalik Ghazee to carry on his dynasty, he said the great weakness of all Oriental dynasties was the quarrels amongst the descendants of the reigning prince, as had been seen in the case of the Ameer of Cabul. There was no room for any fears of that kind in this instance. There was one son, who was a chip of the old block, and was absolutely supreme. The only other children were very much younger, and he did not think they were in Kashgar at all. As to the tariff of Yarkand, it was small, and was imposed by the Mussulman law, and consisted of $2\frac{1}{2}$ per cent., or one in forty on all goods of true believers and twice that amount on non-believers. But they were very easy in levying this; and if a Hindoo trader put in a Mussulman as an agent, he would be exempt from this double tax. The carriage was the great difficulty, but it must be remembered that this had hitherto been confined to mules and horses; but by the recent improvements in the roads, the route to Yarkand had been made passable by camels, and they could, therefore, employ those animals for carriage. Badakshan for a very long time had certainly not belonged to China. It was mentioned by Colonel Yule, in his edition of Wood's "Oxus," that the Chinese had a sort of nominal rule; and the stone, to which allusion had been made by Sir George Balfour, was the green jade-stone from the quarries, which were the only quarries in the world which supplied it.

Mr. Hyde Clarke hoped the important proceedings of that evening would not be allowed to rest without some result, and that the Indian Committee would bring the matter before the government, in order that the several questions might be amply discussed. What Mr. Shaw had said as to Turkistan seemed to have produced the same impression that it had whenever he had spoken in other parts of England. The important subject referred to by Dr. Campbell and others, of the trade through Nepaul, had received a very favourable confirmation from Sir Rutherford Alcock. He recollected when he was honorary agent at Darjeeling, under the instructions of Dr. Campbell, a request being made to her Majesty's government that there should be some demand made on the Chinese government to remove the obstacles on the Sikkim frontier; but it was said to be totally impossible. There could be no doubt it was of the greatest importance to remove from the local authorities the pretext of being able to say that the Chinese prevented the trade, and that must be done at Pekin. Looking at the whole of the subject, and the elucidation it had received, he trusted his colleagues on the Indian Committee would not fail to take advantage of the occasion to state what they had heard, and to endeavour to obtain some practical measures from the government. He would express his personal obligations to Mr. Shaw for the very valuable paper he had read, and the communication he had made to them, which, like all contributions to true knowledge, had brought forth assistance from other quarters. In no respect could his valuable efforts in regard to his own subject of Turkistan be marred by the efforts which might be made by others as to other parts of the frontier. The more attention was called to the true relations between the races, and to the influences of civilisation, the more would it be felt a privilege to communicate those advantages to the populations of Central Asia. If it were a right and proper work, we must be as well able to take part in it as the power which hitherto had shown very poor results in that respect. The more the civilising influence of Russia was regarded, the more did it appear under the very ambiguous aspect of increase of tariff and of obstacles in the way of commercial relations. It was therefore of the more importance that the inhabitants of Central Asia should be assisted in every respect by the influence of this country; for we had seen that wherever those people had been put under good auspices (as in the case of the Crim Tartars, and other populations) and adequate protection and assistance, they had turned out hardworking and industrious, and contributing to the resources of the world instead of destroying it.

The Chairman remarked, that in the first place, it was as well the meeting should understand that, although Turkistan had been until lately a Chinese possession, it was a recent Chinese possession. They conquered it in 1759, and it was only since that period that Turkistan had been under the Chinese. At that time they did subdue Turkistan, and marched their army to Yarkand, and sent a considerable force across the frontier in pursuit of the native ruler of the country, as far as Badakshan, and they fought a battle there. But that was the only connection in recent times between China and Badakshan. It was in consequence of the country having been a dependency of China for so many years that, up to the present time, there had been this objection on the part of European powers to open any political relations with it. He believed that the Indian government would have been disposed at an early period, as it was always the policy of this country to acknowledge *de facto* governments, to have acknowledged the power of the Atalik Ghazee, but the Russian government persistently declared that it could only look at Turkistan as revolted from China. That was really the status until quite recently. It was only this year that Russia had sent an agent to the country, who had concluded a commercial treaty, being satisfied, as he supposed, that after eighteen years of power the Atalik Ghazee might be considered a *bonâ fide* and independent ruler. Russia having thus taken the initiative, he fully expected that the consequence of the recent negotiations at Calcutta would be the despatch of a mission on our part, and the conclusion of a treaty with that power. But the conclusion of a commercial treaty was not the only thing required. What was required was to stir up the merchants of this country to take advantage of it. It was no use the government giving facilities unless the producers of this country would take advantage of them. The late Viceroy did everything in his power to promote this trade. Not only were the transit duties removed, but all Manchester goods, all English goods, bound for Central Asia, either from Cashmere or Turkistan, actually passed free through the whole of the British territory. If there was also the abolition of the transit duties in Cashmere, and a low tariff in Yarkand, he thought that the merchants would really have all they could expect. The great drawback had been the difficulty of carriage, in consequence of the difficult country through which the caravans passed, and the want of forage and water. But as time went on he believed that the great trade route would not go over those mountains, either by the Karakoram or any other tremendous pass, but by the Chitral valley, which was the natural route for commerce between India and Central Asia—a route along which carriges could pass as well as mules and camels. The other route was inaccessible and impracticable on account of political circumstances, but he never would believe that with three great powers on this side the small triangle of mountains was to be left a focus of intrigue and insurrection. Sooner or later it must be reduced and pacified, and then there would be a high road for communication with Central Asia. He was quite astonished at a remark of Mr. Shaw's, that the trade of Russia with Central Asia amounted to £5,000,000 sterling. That seemed to him a most exaggerated figure, and he could hardly believe it without seeing the details. Their trade, no doubt, was very considerable, and he quite agreed with those gentlemen who had addressed that meeting, that we ought to have some fair share of it.

Mr. Shaw said there could be no doubt that it was fully that—five millions sterling.

The Chairman said Russia had always endeavoured to protect herself by very high tariffs, while all we wanted was a fair field and no favour. If the market were thrown open to us on equal terms with Russia, he did hope and trust that the enterprising spirit of our merchants would cause them to throw their goods into Central Asia with a will, and he believed it would then prove to this country a most valuable market. In conclusion he would only say that he had very much pleasure in proposing a vote of thanks to Mr. Shaw. He had had the honour of presenting the gold medal of the Geographical Society to him, and he said then, and he repeated it now, that he believed the success Mr. Shaw had already achieved was only an earnest of a greater success in the future. He was a young man, and his experience and qualifications were of such a high character as to ensure his speedy employment if he returned to India.

General Vaughan, C.B., proposed a vote of thanks to Sir Henry Rawlinson.

FIFTEENTH ORDINARY MEETING.

Wednesday, March 19th, 1873, Lord Alfred S. Churchill, Member of Council, in the chair.

The following Candidates were proposed for election as Members of the Society:—

Alexander, E., Middleton Ship-yard, Hartlepool.
Cobbett, Edwin, 76, Jermyn-street, St. James's, S.W.
Cotton, Major-General Sir Arthur, K.C.S.I., Dorking.
Davies, Charles Langdon, 20, Threadneedle-street, E.C., and Widford, Herts.
Eagle, Vincent, St. George's-wharf, Grand Surrey Canal, Camberwell, S.E.
Fraser, John Henry, St. George's-wharf, Grand Surrey Canal, Camberwell, S.E.
Goff, Captain Robert, Guards Club, S.W.
Hodgson, B. H., 36, Onslow-square, S.W.
Vaughan, General John Luther, C.B., 30, Pembridge-villas, Bayswater, W.

The following Candidates were balloted for and duly elected Members of the Society:—

Beresford, Colonel Marcus, M.P., Sheen-house, East Sheen, S.W.
Danchell, Frederick Hahn, C.E., Vale-hall, Horwich, Lancashire.
Darby, Stephen, 140, Leadenhall-street, E.C.
Hargreave, James Sidney, 3, Victoria-street, Westminster, S.W.
Hollingsworth, William Thomas, jun., 106, Mile-end-road, E.
Imray, James Frederick, Foxgrove-road, Beckenham, Kent.

Kosloff, Stephen Alexandrovitch, 6, Great Winchester-street-buildings, E.C., and St. Petersburgh.
Pickersgill, William C., 30, Belgrave-road, Abbey-road, N.W.
Smith, Joseph, 6, Blenheim-mount, Bradford.
Stocqueler, Joachim Hayward, India Office, Downing-street, S.W.

The Paper read was—

ON CERTAIN IMPROVEMENTS IN THE MANUFACTURE OF PRINTING TYPES.

By J. R. Johnson.

The improvements which I have to submit to you this evening consist

1st. Of a complete automatic system of manufacturing printing types, the metal being fused by gas at one end of the machine, and perfect letters, fit for immediate use by the printer, passing out at the other end, without having undergone any operations by the hand of the workman, who merely watches the action of the machine, cleans the mould and working parts at intervals, and adjusts those parts when he wishes to make another letter of varying thickness.

2nd. Of an alloy, or series of alloys, for the manufacture of printing types of a much harder and enduring character than those formerly employed.

3rd. Of a definite unit of measure applied to the different sizes of type, so that they may become simple multiples of this unit; thus assimilating the manufacture of type in this country to that which has long obtained abroad, and supplying a want which has often been deplored by English printers.

Instead of proceeding to describe these improvements at once, and each as a whole, I propose to give a short history of the application of machinery to English type-founding, and to describe the improvements before you in the order of their discovery.

By this mode of treatment the matters in question will, I think, be better understood, and the value of the improvements introduced more correctly appreciated, than if the subjects were approached more directly.

At the Great Exhibition of 1851, at which the arts and manufactures of all nations were, with few exceptions, fairly represented, it was admitted that Great Britain, although inferior to other nations in some respects, stood proudly pre-eminent in the perfection of her self-acting tools and machines, and generally in the application of mechanical skill to economise human labour.

There was, however, one English art—that of the type-founder—which constituted a marked exception to the rule, and which, so far from showing itself in this country superior in mechanical appliances, was on the contrary lamentably inferior to many others of the world in this respect, so that the reporters of Class 17, when treating of this branch of manufacture in England, were compelled to state that "Since the invention of casting types by Peter Schaeffer, a process which goes back as far as the origin of printing itself, this art has made little progress."

This is the more remarkable as the cognate arts of the paper-maker and the printer had already made giant strides to their present degree of perfection. The automatic machine for making paper continously of M. Robert, improved by our countryman, Bryan Donkin, had already obtained a world-wide celebrity and adoption; and by these, and the subsequent improvements of others, continuous paper-making had become an almost perfect manufacture, leaving but little to be subsequently achieved.

The great machine of Applegarth, by which the *Illustrated News* was printed within the Exhibition itself, proved how far English invention had arrived in that progress of which at the last Exbition the Walter machine, daily printing the *Times* newspaper, was the ultimate expression.

While paper-making and printing had arrived at this enormous degree of expansion, the English type-founder was still using the hand-mould of Schaeffer, invented nearly four hundred years before. With this imperfect instrument in one hand, and a small ladle in the other, the workman cast a single letter at each operation, often with considerable bodily exertion, so that it is alleged that the average produce per man was not above 4,000 per diem. This mould had received considerable improvement at the hands of some ingenious American, whose name I have not been able to learn. By adding a small lever to the mould, and attaching the matrix to it, instead of swinging the matrix by means of a bit of string, the operation of the hand-caster was much facilitated, and the produce almost doubled. This improved instrument had not, however, entirely displaced the old mould at the date in question, and hence the observation of the reporters.

It was not so in other countries. In America the hand-mould had been attached to machinery imitating the movements of the hand-caster, and to this steam had been applied, and was in very general use. By these means, not four or even six thousand letters were cast in one day, but from twenty to thirty thousand letters could be produced. In Germany also these mechanical moulds, as they were termed, had become extensively employed. The great house of Brockhaus, of Leipsic, showed their form of the machine at the exhibition, and received a prize medal for the beautiful works printed with the type produced by it.

In France, Henri Didot had, thirty years previously, had invented his celebrated Polymatype, by which 200 letters were made at one stroke of the machine, and this could be repeated at least twice a minute. By this machine most perfect types were produced, for each letter was cast in a groove made specially for it, of the exact dimensions required.

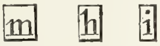
As all these different inventions—for there were many different modifications of the mechanical mould—had been patented and introduced into this country, it became a curious speculation, and one not foreign to our present object, to ascertain by what combination of circumstances Great Britain had become so inferior to other nations in an art so important—an art so materially affecting the communication of intelligence, the diffusion of knowledge, and education in general.

The technical objection which was urged against the use of the mechanical mould in all its numerous modifications, was that it was not accurate enough for the English founder, as it cast "big bodies."

And here some technical explanation will be necessary to enable you to understand the force of the objection, which at that day was considered fatal to the use of the machine. It is the more necessary as there may arise some discussion on this point; for I am under the impression, and I assert, that if the objection was good at that day, it should hold good now, for the error has never been corrected. Yet the mechanical mould is in very general use. If the correction has been made, and "big bodies" are no longer produced, how has it been effected? The means are invisible to the most close inspection.

I will proceed to explain the term "big body" and the inherent cause of their production in the mechanical moulds.

In diagram No. 1 you have an enlarged end view of several types of different dimensions in one direction, but of uniform dimension on the other. The fixed dimension is called the *body* of the type, and the variable dimension the *thickness*.



It is evident from the mere position of the letters upon the face of these types, that the "body" is by far the most important of these dimensions. It defines the name or genus of the type, the thickness being special to each letter. Thus to types of which the "body" is one-sixth of an inch the founders by common consent give the name of "Pica," only one founder having the pretension to differ in this respect from his fellows. If of the size of one-twelfth of an inch, by similar consent, not only in this but other countries, the term "Nonpareil" is applied to it.

It will be seen that uniformity in this dimension is imperative, for it is only by absolutely uniform "body" that we get true line. One "big body," that is, one type larger than another in this respect, will give an irregular line, and one irregular line affects all the lines in that page. Hence the type-founder's horror of "big bodies."

In diagram No. 2 you have a section of the two halves of the hand-mould A B and C D, with an opening between them. In Fig. 1 the mould is quite closed, showing a space in the centre which constitutes the mould proper, into which the metal is poured by the hand-caster, or injected, in the mechanical mould, by a pump. The dimension in the direction from A to C and B to D constitutes the body of the type, and that in the direction A to B or C to D the thickness. So long as the mould is perfectly closed and held firmly, true "bodies" are produced; but if, as at *a*, fig. 2, a small particle of dust or splash of metal intervene, the dimension *a c* is increased, and a "big body" results, and this imperfect result in hand-casting is only avoided by the care and skill of the workmen.

FIG. 1.

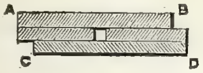
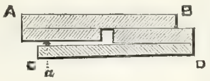


FIG. 2.



Having become intimately acquainted with the art of the type-founder, both in England and in France, I am enabled to say that the test by which the hand-caster knows that his mould is clean and the surfaces "home," is totally different in each country, and is applied respectively by a different sense. The English caster trusts to his sense of touch. He lays one half of his mould upon the four fingers of his left hand or upon the fingers of both hands, and with his thumb or thumbs placed upon the upper half of the mould, he rubs the two together, and knows by the feeling produced whether the metallic surfaces of his mould are clean and in perfect contact.

The French workman, with both hands, very slightly opens the two halves of the mould, and by a sudden effort snaps them together, the quality of the sound enabling him to arrive at the same knowledge. If the sound or "cliquetis," as he calls it, on the one hand, and the touch, on the other, are satisfactory, the workman proceeds to fill his mould with metal, and produce a type. If, on the other hand, they be not satisfactory, he opens his mould, and removes the intruding particle of matter, either with his brush or his picker, and again tries his mould for touch or sound.

It will be obvious, on a little reflection, that a machine can never exercise such discrimination. Mechanism can imitate and replace the muscular motions of the body, but not the sense of touch or hearing. Nor can the workman attendant upon a mechanical mould, even with a trained ear, catch the "cliquetis" of the mould, amid the noise of its many parts, and at the rapid rate of motion which is essential to the perfect machine. His only chance is to watch for the appearance of burr on the edges of the type; but between the commencement of the formation of "big bodies," and that exaggeration of the opening which produces burr, there is a large interval, and during that interval a great number of "big bodies" are cast and mixed with the others, are sent forward to be corrected as far as possible in the succeeding operation.

The English founder accounted for the use of the machine in Germany, by alleging that these irregularities were unimportant when casting the semi-Gothic German character; and when reminded that the argument could not apply to the American founder, he retorted that Americans would, in order to have cheap newspapers, put up with anything provided it were readable.

Such objections, however, could not apply to Didot's Polymatype. Here, as I have already said, no "big bodies" were produced, but the type was of extreme accuracy, as may be seen in the foundry of the Messrs. Thoret-Viret, of Paris, who are using the Polymatype apparatus at this day.

Mr. Henri Didot, the inventor of this ingenious process, and of the tools of precision by which he was able to construct it, sold the patent-right of the invention, with moulds and the tools in question, to a M. Pouchée, who, in partnership with Mr. Jennings, commenced a foundry, and cast a large quantity of type by the machine or apparatus, but ultimately succumbed under the vigorous hostility of the associated founders. And here, were we assembled to discuss questions of morality instead of those of a mechanical or chemical nature, we might raise the question of the sad importance of calumny in all successful commercial competition. What would a traveller or salesman be worth who could not depreciate successfully the quality of a neighbour's goods, as well as extol those of his employer? From whatever cause—we have it stated on authority—that the printers would not buy Pouchée's type, except at a reduced rate, yet a large quantity of it was purchased when Pouchée was sold up, was extensively used, and only discovered to be Pouchée's by a private mark. So much for its oft-descried quality!

It will throw considerable light upon the causes of England's exceptional inferiority in type-founding, if we trace the further history of this ingenious mechanism, and the cause of its absence from England, although so extensively employed abroad.

As the narrative involves a most extraordinary charge of vandalism in the nineteenth century, not inferior to that of the poor, starving, uneducated workmen of an earlier date, who called themselves Luddites, the history shall be given in the very words of the reporters already quoted, one of whom was a relative of the inventor, and the other one of the most distinguished of modern English printers, the proprietor of the well-known "Chiswick Press." As the story is scarcely credible, notwithstanding the high authority of the narrators, it may be thought to have been lightly made. I can, however, assert that I know that that statement was made deliberately, upon ample and abundant evidence, and from a sense of public duty:—

"In 1823, M. Louis John Pouchée took out patents in the three kingdoms for a machine for casting type, consisting of a mould formed by a combination of steel bars, with grooves and matrices secured by a frame, and a brace of iron upon a strong wooden bench, and a lever carrying a heavy rammer to fall down into the mould for the purpose of forcing a portion of the fluid type-metal, which had been poured out of a ladle into the receptacle between the ends of the grooves (each groove forming the mould of a separate type) through small apertures into the grooves and matrices (placed at the opposite end of the grooves) where the body and face of the letter are cast. By this apparatus about 200 types may be cast at one operation, and the casting repeated twice in a minute, or even quicker.

"M. Pouchée, having cast a large quantity of type by this machine, offered the type for sale, but the printers refused to purchase unless at a reduced price, and M. Pouchée preferred melting it. At the sale of M. Pouchée's type-founding effects, a quantity of type which had escaped the melting was sold, and was afterwards discovered to be machine cast, by a private mark on the side and an after-cut nick. The machine was not offered for sale, but Mr. Reed, a printer, in King-street, Covent-garden (related to Mr. Blake, of the firm of Blake and Stephenson, type founders, at Sheffield), was employed by the type founders to negotiate with M. Pouchée for the purchase of the machine, which was effected for about £100. The machine was conveyed to Messrs. Caslon and Livermore's, and destroyed, on which condition it was purchased. There was included in this purchase a valuable planing machine and cross-cutting machine for cutting the grooves. It was the invention of M. Henri Didot, to whom M. Pouchée paid 48,000 francs for the patent-right in England."[*]

It would appear, therefore, that if type-founding machinery was not used in England at the date of the Exhibition of 1851, it was not on account of its imperfections, or want of efficiency, but because English Trades-Unionism deemed the introduction of machinery hostile to its interests. Hence the condition of type-founding in 1851, at which time the Union was flourishing in the full vigour of triumphant success. And here we have an instructive lesson in political economy. It would appear that Trades-Unionism, when based upon a narrow, exclusive spirit, is as injurious to human progress, when intelligent educated men are the constituents of that Union, as when the imperfectly educated working classes are its originators; for here it was not the combination of the workmen, but of the masters, who perpetrated the wilful act of destruction referred to, and the argument which no doubt influenced them was that powerful one with which inventors are so familiar, "Let well alone." In their frequent contests with their workmen the masters' Trades-Unions had, I believe, usually come off victorious, hence labour, the chief cost of type under the hand system, was doubtless at a minimum; while the selling price of type to the printer, being fixed arbitrarily by the same authorities, was of course at a maximum. Why, then, should this satisfactory state of things be disturbed by the introduction of machinery?

My connection with type-founding dates from the Exhibition of 1851, and, as I have had a considerable share in the inventions I have to describe to you, I trust that you will pardon me if the narrative becomes somewhat personal, and savours somewhat of the egotist. Being myself the narrator, no other form of speech is possible.

I.—The Hard Metal.

At the Exhibition of 1851 a very ingenious machine, of French origin, was shown, which attempted to make printing types from a wire of copper or zinc, by means of pressure instead of by casting. I had formed a high opinion of the capabilities of this machine, and had induced some friends to join me in assisting the inventor to bring it into practical operation. On close inspection, however, many weak points in the system were discovered. Several difficulties were overcome, but others proved to be inherent and unavoidable, and the scheme was ultimately abandoned.

I had learnt from various printers who had seen this machine, how great a boon the introduction of hard type would confer upon the trade, and, on the failure of wire type machines, I commenced experiments to cast type in zinc and certain of its alloys. I succeeded, and in 1852 took out a patent for the mode of effecting this. I found, however, in a few months, that type containing zinc rapidly oxidised in a damp atmosphere, and became cemented together in the page.

I then endeavoured to ascertain how small a quantity of zinc could be used, when antimony also was employed, tin being used to effect the union. I at last found that tin alone was capable of imparting extreme hardness to the ordinary metal alloy of lead and antimony, which, as usually given in technical works, consisted of 75 parts lead and 25 antimony, provided that it was substituted for the lead wholly or in part.

To me, and to many practical founders in this country and in France, the discovery was a complete revelation, unsuspected and unforseen. Tin had long been used in making type-metal, but it had always been added to the usual alloy, and not substituted for a portion of its constituents; and when so added the result is entirely different, hardness not being obtained. The result is even apparently opposite to the other. The simple addition of tin has the effect of rendering the alloy not more hard, but more flexible or tough, and the quality of flexibility is usually associated with softness.

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[*] Jury reports of Exhibition of 1851, Class xvii., p. 409.

The alloy was patented in 1854, and, on its introduction and adoption by Mr. Ingram, to print the *Illustrated London News*, caused considerable sensation, and put the founders, to use a colloquial expression, "on their mettle." In 1855, Mr. Besley took out a patent for an alloy compound of lead, tin, antimony, zinc, copper, and nickel, the specification containing extraordinary metallurgical operations to render success certain; the zinc being directed to be subjected to a white heat to get rid of the arsenic!

Another English founder employed a French workman, who was acquainted with the hard metal which the Didots were in the habit of using for stereotyping by their peculiar process, and in which copper was the hardening ingredient. An excellent metal can be so formed, but when the copper is in sufficient quantity to give the necessary degree of hardness, the metal flows with the greatest difficulty, each matrix having to be dusted over with powdered pumice stone to get it to take the fused alloy. When a smaller quantity of copper is employed, there is a separation of the compound into two parts, one of which floats above the other, hence great inequality in the results, unless the hand-caster frequently stirs the metal, and thereby greatly increases its oxidation. In the mechanical mould, the pump draws off the inferior metal from below, and when the superior metal accumulates, it chills in the nozzle.

Other founders seem to have been superior to all experiment, and to have arrived, by a species of intuition, at the most economical proportions determined by the labours of the patentee, for whereas he fixed the limit of hardness, combined with economy, at an alloy in which one-third of the lead was substituted by tin, giving the proportions—lead, 50, tin, 25, antimony, 25. The first fount of type supplied to the *Times* newspaper, after the hard metal patent of 1854, was proved by the analysis of Dr. Frankland* to contain lead, 48.63, antimony, 25.72, tin, 25.84, copper, a trace.

This is a remarkable coincidence. Another, not less remarkable, is that whereas the inventor had stated in his specification, as a test of the quality of the new article of manufacture produced, and as a definition of the degree of hardness arrived at, that the type formed of the new alloy could be struck as a punch with a hammer into the old metal without injury to its face, the travellers of the type-founders in question were in the habit of using a hammer in the same way to show the quality of the new type which their employers had discovered!

The litigation which ensued, and which, by means of pleas dilatory and other ingenious legal devices, extended over some years, terminated at last by an utter confusion in the mind of all concerned in the trial, between tin added and tin substituted, surrounded as the question was by an immense mass of legal verbosity and testimony largely qualified by the reticence allowed on the plea of trade secrets, so that the plaintiffs were glad to accept a nonsuit, and, utterly ruined in pocket by the long litigation, were never afterwards able to renew the attack.

Since that period, the hard metal, without either zinc, copper, or nickel superadded, has come into most extensive use in this and other countries. Without further discussion as to the rights of the inventor, these two broad facts remain. First. Previous to the date of the patent, only one kind of metal was known to the printer, that formed of lead and antimony (with perhaps three per cent. of tin, and a small quantity of bismuth, provided tea-lead had been used) the varying hardness for large and small bodies being given by smaller or larger quantities of antimony; and only one metal was referred to in the published founders' lists. Second. In 1856 two kinds of metal found place in those lists—the ordinary type and the extra hard—in which more costly materials are employed, and for which an extra price is charged.

So highly has this alloy been appreciated that no such compound as the ordinary one is now offered to the trade for book and newspaper founts. By common agreement not two, but one metal is now referred to in the founders' lists, that metal in the first houses being unlike the old in its character and composition; and any printer having once used the alloy I claim as my invention, would feel aggrieved if a fount of type in the old alloy were now supplied to him.

I claim, therefore, to have been the means of having effected a total revolution in the art of type-founding in this respect, although for the want of the sinews of war I was unable to establish the validity of the patent.

II.—Casting Machine.

On the failure of the wire type machine, and after the possibility of casting the alloys of zinc had been ascertained, I resolved to make an effort to cast these alloys mechanically. I had in my employment, while experimenting upon the wire type machine, a very superior workman, Josiah, the son of the late Mr. King, a successful punch-cutter, who had introduced to the trade many novel forms of letters, and who was a type-founder in a small way of business. Josiah King was an excellent "justifier," and had generally a thorough knowledge of type-founding. He had on several occasions offered his services to the various persons who had endeavoured to introduce the German and American machines into England; and it was from him I learned the alleged defects of those machines, the chief of which I have discussed at length—that of casting "big bodies."

On reflection I perceived the cause of the defect, and I determined to avoid it by discarding the old mould, and forming one with a fixed opening, not requiring the workman's attention for its true formation.

I ultimately adopted the form shown by the Diagram 3, where in the fig. 1 (*a*) and (*b*) are two

FIG. I.

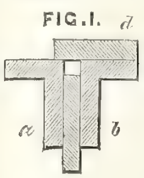


FIG. 2.

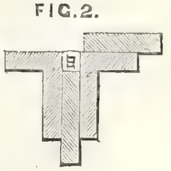
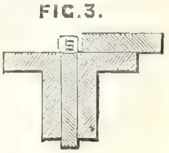


FIG. 3.



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[*] On referring to the original papers I find that the analysis was made conjointly by Messrs. Frankland, Warrington, and Tookey.

sides, with a fixed opening between them; (*c*) the sliding body piece, and (*d*) the cover to close the mould. As the dimension from *a* to *b* constitutes the "body," and is immovable, it is obvious that there can be no "big bodies."

Having succeeded in forming a satisfactory working mould, all that was required was to contrive the necessary mechanism to open and close it at the proper periods of one revolution of the handle, and this was effected by a series of levers placed under the small upper table supporting the mould, to which levers motions were given by cams placed upon the one single shaft of the machine.

The matrix, when used in the mechanical moulds, was alleged to have torn off the "seriffs" of the letters cast in them when the speed was rapid. I prevented this in my machine, by bringing the matrix, supported upon a carriage, to and from the mould by a motion at right angles to its face, and this was found thoroughly effective in practice.

Before putting my plans into execution I submitted the drawings of them to my friend, Henry Hensman, Esq., C.E., of the Bank of England, who cordially approved them, with the qualifications, however, that several of the motions were very unconventional, and that anybody could see that the machine had not been contrived by a professional mechanic.

On the completion of the machine, the usual search was made before taking out the patent. I found that the whole of the patents for mechanical moulds were based upon the use of the ordinary hand-mould, with one single exception, and that was a patent taken out many years before, by a no less distinguished person than Mr. Bessemer.

The mould of Mr. Bessemer was in principle identical with that I had devised, but in other respects there was not a feature in common, the moving parts and the general form being singularly dissimilar.

At the Exhibition of 1862, Mr. Bessemer was much interested in the casting machine, and called several times to examine it. It was obvious that we had both recognised the impossibility of using successfully the old existing mould, ready to our hands, and had started *de novo.*

Mr. Bessemer's father was, I believe, a master founder, and his son had, therefore, abundant knowledge of the defects of the ordinary mould. In my case the knowledge was derived at second-hand, from the experience of an equally practical man, who, however, had not speculated, like Mr. Bessemer, as to the cause or remedy for the defect.

The machine to which I have just referred is the casting machine before you, dissevered from the dressing machine, which is of much later origin. The action of the casting is easily understood by reference to diagram No. 3, which shows three sections of the mould. In Fig. 1, the parts of the mould are closed to receive a jet of melted metal injected by a pump to form the letter, the nozzle of the pump closing one end of the mould, or rather of the jet or conduit leading to it, the other end being closed by the matrix. On the letter being formed, the lever in connection with the sliding body-piece causes it to descend for a minute distance so as to release the matrix from the pressure of the levers moving it. The matrix is then withdrawn, and the top-piece retires to the position shown at 3, the body-pieces rising to thrust out the type from between the fixed side-pieces; the top-piece then advances to push away the type, and having done so the body-piece descends to the position at No. 2; the matrix next advances to close the opening, and the body-piece rises to the first position, when the mould is again ready to receive another jet of metal to form another type. These movements are all effected by the cams and levers already referred to, put in motion by one revolution of the handle; and as from thirty to one hundred and twenty revolutions can be made in each minute, according to the size of the type, the produce of the machine is very considerable. Even at sixty revolutions per minute, the produce per hour is equal to that of a hand-caster, using the American mould, in one day.

The machine has been fairly appreciated. The University of Oxford Press purchased two machines, for which they paid a very liberal sum, soon after the completion of the invention. These machines have been in constant work ever since. The Imperial Printing Office of France adopted it in 1855; and modifications of the machine, since the patent lapsed in France, are being made in large quantities and distributed over the world.

On its completion I invited the associated type founders to visit it, and it passed the ordeal successfully, only one hypothetical objection having been raised against it.

Next day I received a letter informing me that it was pirating one of their patents, and I then, for the first time, learnt their object in purchasing so many patents which they did not use.

Having succeeded in learning that the alleged piracy consisted in lifting the piston of the pump with a cam and lever and pulling it down by a spring, I reversed the operation, pulling it down by a cam and lifting it by a spring, and I heard no more of the piracy. I was informed semi-officially that none of the associated founders could treat with me separately, and I was requested to address Mr. Vincent Figgins if I wished to dispose of the machine.

Finding that I was at the mercy of this powerful body, and fearing that the same fate would attend my invention as that of M. Didot, I made no further advances towards the Associated Founders, but immediately formed a partnership with Mr. John Huffam King, a very successful punch-cutter and founder, who had succeeded to the business of his father, whom I have already referred to.

III.—ELECTROTYPE MATRICES.

Mr. King's stock of book founts was inconsiderable, but I hoped to make up the deficiency by the electrotype process, which had produced such valuable results in the hands of the director of the Imperial Foundry Printing-office, of Vienna, the only foundry which had received a Council medal at the Great Exhibition. I improved upon the system which I had had described to me as worked by the Austrian Printing-office. I found that by special contrivances I could not only produce a matrix from a type as had already been done, but a matrix very nearly "justified," that is, fitted for use in the mould so as to produce a type of due dimension without altering the registers of the mould. By this invention I not only saved the cutting of the punch, but a considerable fraction of the cost of the "justification."

I thus obtained an important weapon with which to combat the trades union of the founders—at that time dictating the price of type to the printers on their own terms. But before employing this weapon, I took care to assure myself not only of its perfect legality, but of its not contravening any recognised custom of the trade, as then practised. Even before making the improvements which led to the discovery of the methods just referred to, I had ascertained that the electrotype apparatus was used by many, if not by all, the founders, and this to a considerable extent.

I found that the Registry of Designs Act gave full property in any new character, or set of characters, introduced by the founders for a period of four years, on their registering the design, and such registry had been made in cases of "church text" and other ornamental characters. As regards, however, merely modified forms of letters, differing from preceding founts by greater or less "fatness," greater or less "strength or length of seriff," no copyright or property on such modified design was recognised either by the legislature or by the custom of the trade. Any new design or form introduced, of the nature referred to, was immediately copied, and even the name of the new fount was often adopted without any recognition of the introducer. Thus when Mr. King introduced his "Lean Antiques," and they found favour with printers, similar punches were cut by other founders. It was the same with the "Sans-seriffs" of the same punch-cutter, and the "Clarendons" of Mr. Besley. The custom was still more clearly shown when the younger King introduced a most important modification in the form of the note-head in music type, which led to his music founts becoming most extensively employed. The improvement was thereupon adopted in the music founts of other founders. Perhaps the most wholesale operation of this kind was that by which an eminent British founder copied not one, but a large series of the founts of Garamond, which Mr. Whittingham and the late Mr. Pickering had introduced and made fashionable, to the great profit of the founder in whose old stock these founts had been found. The quaintness and inequalities of these letters, which a few years previously would have been considered by English punch-cutters as defects, were so successfully imitated that a large portion of the original possessor's business was transferred to his clever rival, who claimed that his "modern antiques" were superior to the genuine article.

I have stated these facts because it would appear from a document largely circulated, but one which has been generally received as a mere trade circular, endeavouring to depreciate a rival's goods, and has hitherto been treated with contempt, that peculiar conventional notions now exist among the associated founders on the subject of copyright. It would seem that the firm which issued the circular in question, a firm to which I have alluded as having copied the old founts on so large a scale, think that while it is perfectly fair to copy any fount not registered by the hand of the punch cutter, yet it is very wrong, or even immoral to do so by means of the electrotype process. I say immoral, for it is admitted that it is not illegal. It is not a *malum prohibitum*, and therefore is, I presume, a *malum per se*, but in what code of morals, except that of the Trades-Union of the British type-founders, I have been unable to discover. I have, however. perhaps, stated the views of the case too broadly. If I may judge by the use of the electrotype apparatus, which so largely obtained among English founders at the date of my commencing to use it, that it is perfectly legal and moral to use that apparatus upon the types of foreign punch-cutters, even when strikes of the matrices can be purchased from them at a reasonable price. Judging, moreover, from late events, I believe that it is not considered derogatory to copy the designs of other founders even when registered, provided they are not members of that distinguished body.

If the law be considered deficient, by all means let it be amended. If four years' property in the design be not enough, let it be extended to ten.

However stringent the law had been made, it would not have restricted my operations in the slightest degree, for I solemnly declare that I have never copied or caused to be copied any registered design, either during the term in which legal property existed, or subsequently, after the lapse of that term. I am assured that those who succeeded me and used my apparatus can, and, if necessary, will, make the same assertion. Can any of the associated founders say the same ?

I and my associates have everything to gain and nothing to lose by the increased efficiency of the Act, and will gladly join in obtaining such improvement from the Legislature.

To resume my narrative. On myself and partner satisfying ourselves that not only in perfect legality, but in perfect accordance with the custom of the trade, ordinary book-founts and letters involving no special feature of original design might be copied, we set about the operation on a very considerable scale. I claim by these means to have produced a series of founts which are the "cream of the cream," as our neighbours say, and will bear comparison, not only with the stock founts of any other founder, but with the selected founts from the repertories of all those founders. The operation, as conducted by the aid of Mr. King, a punch-cutter, who had engraved some of the best founts in the trade, was not a mere slavish copy. A series of founts having been selected from the leading founders, each letter was carefully examined between the ems (m m) of each fount. The bevels were added by a special alloy fusing considerably below the boiling point of water, and these were not the original bevels of the punch, which greatly interfere with the dressing of the type, but sufficient to enable the letter to deliver freely and no more. In this respect the electrotyped matrices are very superior to those struck from the original punches, so that we now constantly produce electro-matrices from letters of which the original punch is in our possession. The "seriffs" were often shortened, and other touches with the graver given, so as to improve the form or correct defects, and having thus produced the model, a matrix was formed from it in solid copper.

IV.—NEW SYSTEM OF BODIES.

In preparing for issue the larger series of founts which we had electrotyped, Mr. King called my attention to the importance of a definite system of "bodies," a principle which I subsequently found had been introduced into France many years before by Fournier, and which had been largely adopted by the Didots and their followers, but not with the same unit of measure.

We both spent a considerable time in endeavouring to adapt this principle to the English founts without introducing any serious modification in their size. A table, which I will hand round, shows the sizes of the different bodies of the leading English founders, on the authority of "Savage's Dictionary of Printing." It will be seen from that table what great discrepancies there are in the sizes of founts of the same name, produced by the different founders, not one body being of the same size in all the foundries, not even excepting nonpareil, which, by almost universal consent, is made one-twelfth of an inch in "body."

In this table reference is only made to pica and the founts below it, but the system, of course, is applicable to the larger founts, which are usually multiples of pica or of some other body. Since the adoption of this system all the founts supplied by King and Co. and their successors have been issued in accordance with it, except where special bodies were demanded by the printers, and these founts have, I believe I may say, been highly appreciated by the trade.

Notwithstanding the persevering opposition of the members of the Trades-Union of founders, singly and combined, the petty firm of King and Co. met with great encouragement and support, and the prospects of the firm were so encouraging that in 1857 the late Mr. J. Staines Atkinson formed a company, chiefly of Manchester gentlemen, to purchase from King and Co. their business and the patents for the casting machine and the hard metal. On the complete formation of the company the business was removed to Red Lion-square, where the business is and has been carried on under the style of the "Patent Type Founding Company, Limited."

V.—Free Trade in Type.

Soon after this, whether from the attention the new system received from printers, or from other causes, mechanical moulds were brought from the limbo to which they had been consigned on their purchase from the different unfortunate inventors who had failed to get their patents adopted, and it was found, notwithstanding their imperfections, that use might be made of them. What with this innovation and the revolution which had been effected in the nature of the metal, for the first time for many years the Trades-Union withdrew its stringent rules as to the price of type, and type-founding was no longer an anomaly in the application of free-trade principles. To see the effect of this great change, let the printers compare their present invoices with those previous to the epoch to which I refer.

VI.—Dressing Machine.

Before communicating our ideas to each other, Mr. Atkinson and I had each, for some time, been experimenting upon the possibility of effecting by machinery the other operations of the type-founder, subsequent to the casting, viz., the breaking, rubbing, cutting out the foot, dressing, and setting up in page. I had already made some progress, indeed I had constructed a machine nearly complete, but I had based the operation of rubbing upon the file used in the modern "kerning-tool," acting, as in that tool, diagonally across the sides of the type, and not in the direction of the longitudinal axis of the type, as in the ordinary method of rubbing upon a stone.

This was not satisfactory, and the thin types rubbed in the machine were more brittle than those rubbed in the ordinary way. On his side, Mr. Atkinson had tried circular cutters to get the rub or its equivalent in the direction of the longitudinal axis of the types. In the machine before you this operation, that equivalent to the rubbing of the type, is based upon an idea communicated to me by M. Fiquet, a Frenchman, in the employment of the company, who had formerly acted as foreman in M. Laboulaye's foundry in Paris, and with that gentleman had made experiments in the hope of rubbing types by machinery, with some success, but not so great as to replace the female hand-rubber, for in France the rubbing is done by women. Mr. Atkinson and I took up the matter where Messrs. Fiquet and Laboulaye had left off, and, by considerable modification of the plan tried by them, succeeded in obtaining a very satisfactory result in dressing the rubbed sides, while the dressed sides were finished in the manner I had previously adopted.

The combined machine was patented in 1859, and worked satisfactorily. We afterwards, however, greatly simplified the dressing operation, and arrived at that plan which is carried out in the machine before you, and these improvements were patented in 1862.

I have already described to you, by the aid of the diagrams, the movements and action of the casting machine; it only remains to describe those of the dressing machine which forms part of the same apparatus.

It is almost impossible to do this without complete drawings, and as I have not been able to prepare these on a sufficiently large scale to be visible to the meeting, I propose to point out to you in detail the various parts in action upon the machine itself.

In conclusion, permit me to thank you for having listened to this narrative, and to thank the Council for the opportunity of relating it. My object in doing this is to put on record my share and that of those friends respectively who have co-operated with me in these transactions, and thus to furnish a chapter towards the future history of type-founding.

DISCUSSION.

Mr. Figgins said it was not often that an opportunity arose for discussing the type-founder's art, or the machinery and appliances he made use of, the trade being in but very few hands, and little being known about it. He did not, however, regret that the veil had been withdrawn and an opportunity afforded for refuting many of the statements which had been made. The paper endeavoured to show that type-founders did not use machinery, that they combined to keep it out of use, and that they combined to destroy one machine in 1823, though he was not aware that any powerful association existed at that time. There were no records of it, but it was known that the old association, formed in 1792 or 1793, was dissolved before 1820. However, if they did combine to destroy the machine, they only followed the example of Pouchée himself, for he had the machine destroyed on his own premises, and by his own workmen. The fact was he discovered that his machine would not cast accurate type, and founders would not adopt a machine which was incapable of turning out type as good as that produced by hand. Not only did the machine cast the "big bodies" which had been referred to, but it was utterly impossible to get type cast accurately for line or for general thickness. It was quite a mistake to say that nothing had been done by individual or associated type-founders towards the introduction of machinery. One machine was brought over in 1843, and many experiments were made with it, and it was only rejected because it was not found equal to the demands made upon it. So far from the type-founders uniting to oppose the introduction of machinery, he found in the minute book of the association, which was formed in 1851, and which was dissolved in 1863, "that a special meeting was convened to take into consideration the subject of machinery for casting and the best means of working in unity for the introduction of the same." Stewart and Duncan's, and Kronheim and Newton's patents having been purchased by two founders, the expense was divided amongst the whole body, and the machines offered by them not only to all type-founders, but to any printers who wished to avail themselves of them. What had been the result of the introduction of the machine before them? It was said there were six at work in Red Lion-square, two at Oxford, and others elsewhere, but of the machines to which he had referred, he was within the mark in saying that there were at least 300 in use in England and Scotland, and a similar number at least in America. With regard to the electrotyping of matrices, it was simply an ingenious process for appropriating the rights of other people; and he was somewhat astonished at any gentleman coming forward and declaring that he had been largely practising this piratical process, though he had taken care to keep clear of the law. It was false to say that electrotyping had been used by the associated founders; no respectable firm had ever used a battery except for the reproduction of accents and those matters of which they possessed the original punches. The system had always been condemned; and even when the founts cut by Mr. King were desired by other founders, they set to work and had the punches cut, thereby incurring the same expense, and carrying out the rule of the trade, which had never been objected to. The Registration of Designs Act only applied to articles upon which the full registered mark could be placed, and this could not be done in the case of small type; so that in reality that Act afforded no protection at all. The same difficulty arose in other countries, and in France rights existed which prevented this copying. In America, also, type-founders were allowed to place the mark upon the wrapper in which the type was sold, as it could not be placed on the type itself. It was not correct to say that English founders practised this system with regard to foreign productions, and he himself on one occasion, having purchased a complete foundry, and finding a large quantity of the matrices were of this character, the whole of them were put aside, and had never been used again. Many attempts had been made to secure protection for this class of property, because a type-founder might expend thousands of pounds in the production of a series, and yet the fruits of his labour and outlay might be reaped by others who had no right to them whatever. The question of the "bodies" was one for printers to decide; the type-founder had simply to manufacture what they would buy; but he believed those "bodies" which were tried many years ago, were generally considered a complete failure. With respect to the actual working of the machine, he was prepared to contest its superiority to others which were much more largely used; and the very fact of three operations being combined in one machine was a disadvantage. In other machines each operation was distinct; and when he mentioned that about 180,000 letters could be cast while 160,000 were being dressed, and from 400,000 to 500,000 could be rubbed, it was evident that the whole production was reduced to a minimum.

Mr. Gill (Messrs. Miller and Richard), while disclaiming any other motive than that of stating the real facts of the case, controverted the statement that after 1851 there was no successful casting of type by machinery in this country, for in 1849 the casting of type by machinery was being successfully carried on in Edinburgh, and the founts used for printing the Exhibition Catalogue of 1851 were cast solely by machine. That same foundry had been using machinery from that day to the present time, constantly improving it as time went on. There had been ample opportunity for the purchase of the machine which had been described, and if its merits had been at all apparent, unquestionably it would have been adopted. The superiority of the other machines, however, was proved by the greater popularity of the type produced by them. Reference had been made to the introduction of hard metal, and to the serious loss to the company from the litigation arising out of it. He might quote the issue of the trial which took place in 1860 on that point, when the judgment of Chief Justice Erle was to the effect that it was one of the many instances in which an ingenious person believed he had discovered something unknown previously—certainly to himself—but familiarly known to these engaged in the business. In the course of that trial it was shown that certainly ten years prior to the patent of Mr. Johnson, hard metal, consisting very much of the proportions which he adopted, was used in the Clarendon-press, Oxford, cast by the foundry to which he had before alluded, and stereo-plates were produced by a celebrated Oriental printer, Mr. W. M. Watts, which had been cast by himself fourteen years previously, and contained 25 per cent. of tin added to lead and antimony. With regard to the electrotyping process he would beg leave to read a letter, written by himself, to the "*Printers' Register*," some time ago, referring to this very subject. The letter ran as follows:—

> SIR,—In your publication for December and January last we find an article entitled "Patent Types and Popular Proverbs," in which the type of the Patent Type Founding Company is recommended. Amongst other commendations it is said, "We saw the stuff the type was made of, and critically examined the matrices in which it was cast; we found that for clearness and sharpness of outline the latter had no rival." In a contiguous page is a specimen of the company's type, entitled "Newspaper Founts, series No. 5." How have these faces been obtained? We feel it right to inform your readers that the minions and the ruby-nonpareil in that page—the ruby-nonpariel supplied by the company to the *Shipping Gazette*—and we believe other founts, have been cast from matrices produced simply by submitting our type to the electric battery; thus saving to the company all the cost of the punch-cutter's skill and labour. You are aware that if an engraving, a design of ornament, or printed work, were so dealt with, it would subject the perpetrator to the penalties of piracy. But inasmuch as the electro process was unknown as applicable to type when the Act for protecting original productions was passed, type was not included in its provisions. We would ask, is it fair, is it honest, to take advantage of this unforeseen exemption, and appropriate the skill, the toil, the capital of another? Will not the moral sense of printers as a body lead them to reject any offers of type thus surreptitiously produced? As the proprietor of the *Printers' Register* is also a manager of the Type Founding Company, there may be objection to the appearance of this letter in your columns, but we tender it for insertion nevertheless.—MILLER AND RICHARD.

It seemed rather strange, that whereas a book, or an engraving, or a work of art might be protected, and no one was entitled to copy it, yet that a type-founder could have no protection against a process of this kind. If there were to be this liberty of reproduction, it must have a very deterrent effect on the type-founding art, since it would prevent new forms and designs being introduced which could be pirated immediately they appeared.

Mr. Bonnewell desired to corroborate much of what had been said; for he had been in Scotland at the time referred to, when he saw the machines in use. Although not a type-founder himself, but a letter-cutter, he had suffered from the piracy of his designs to such an extent that for some years he had given up producing any. He should be very glad if the Legislature could be induced to make some provision for securing to a person who produced an original design of this kind such a property in it as would recoup him in some degree for the skill, labour, and money he expended in bringing it before the public.

Mr. Chitson fully concurred in what had been said with regard to Mr. Johnson's machine as compared with others. It might be a very good machine in itself, but no superiority could be claimed for it, whilst in many respects it was inferior. For instance, one man was required to work it, whereas one man could work two of the machines in ordinary use. Then, again, as to the proportion between the different operations, one man could dress three or four times the quantity of type which the machine would cast, and, therefore, it was not so economical as it was said to be. This machine was said to do everything, and yet he understood, and knew for a fact, that the company working it also employed dressers, which he did not quite understand if the machine itself turned the type out so perfect. The electrotyping process was simply abominable, in fact, very much like forgery; and he did not think any honourable man would make use of it to possess himself of the produce of another man's brains and skill. That which cost the type founder 2s. or 2s. 6d., could be imitated by the electrotypist, by the aid of an inferior workman, for about a penny; and a punch, which cost the founder £1, could be imitated, by the aid of a battery, for about 1s. or 1s. 6d., and without the exercise of any taste or skill in the workman. He recollected a fount of type being cut at a cost of many pounds, and it was afterwards found that there was a mistake in it; it was a script, and the dots of the *i's* were too far from the bottom, and so on. There was only one fount of it sold, and yet in about a month it was produced and offered by other persons, mistakes and all.

Mr. Strangeways said that he had had forty years' practical acquaintance with type, but he never heard of hard metal until after Mr. Johnson's made its appearance.

Mr. Johnson, in replying to various remarks which had been made, said the charge of vandalism which he had brought forward against the associated type-founders was not preferred by himself, but appeared in the Jurors' report of the Exhibition of 1851, and had remained there hitherto uncontradicted. Then it was said that Pouchée's machine was useless. But if so, why destroy it? But it was not true that the machine would not cast perfect type; it could not fail to do so from its peculiar construction; it was in use at the present time, and had been used for many years by several French founders. He did not know what had been done in Scotland, but he believed it to be the fact that at the date mentioned, 1851, type was not practically being cast by machinery in England, though there might have been machines under trial. Yet in America, and also in Germany at the same time, machinery was in full operation. The defective principle he had alluded to still remained. Had they overcome this defect? If so, it would have been interesting to hear an explanation of the mode of doing it. Had they ever made any improvement in the art worthy of being recorded or adopted by other countries? He knew of none. He charged them not only with doing nothing to improve the art themselves, but with doing their best to thwart other people. Then, with regard to copying, with the exception of Mr. Fox, the partner of Mr. Besley, who was an admirable punch-cutter, and brought out a beautiful church text and other beautiful founts, the specimen books were all alike. If they did not copy each other, how was it that they had founts of letter exactly alike? How did this marvellous uniformity arise? He did not wish any one to take his word for it; let them take the specimen books of the different type-founders and examine them. When he began he had the example of all the American founders, and of the Imperial foundry at Vienna, which had modified types to suit their wants, and then copied them. The French punch-cutters alleged that they were largely copied in England; and he knew of electrotypers being largely engaged in this class of work. It was only of late years, when they found that the operation could be pursued to their disadvantage, that the type-founders complained of it.

The Chairman concluded the discussion by proposing a vote of thanks to Mr. Johnson, which was carried and acknowledged.

A woodcut of Mr. Johnson's machine has already appeared in the Journal, vol. xx. p. 909, in the Reports on the International Exhibition of 1872. A description will also be found on p. 208 of that volume.

COMMITTEE ON THE MEANS OF PROTECTING THE METROPOLIS AGAINST CONFLAGRATION.

The following evidence was given at the meeting of the Committee on February 27th by Mr. William Swanton, of the Metropolitan Salvage Corps:—

Q.—Being informed that you have acted for eighteen years in the London Fire Brigade, and for some time as second in command of it to the late Mr. Braidwood, and that you are now and have been for seven years Superintendent of the London Salvage Corps, whose duties to the fire insurance companies are to attend all fires, and to save and prevent damage to property as much as possible, the Committee are desirous of obtaining the benefit of your long and close experience on the mechanical, structural, and administrative means of preventing conflagrations in the metropolis. Will you describe the nature of the arrangements you consider necessary for bringing to bear the whole of the water-service of the metropolis to stay a conflagration in any part of it?

A.—I have for a long time considered the great advantages which must accrue from uniting all the water companies' resources in London, with a view to preventing the possibility of there being a deficient supply of water for fires. Of course I am not now referring to the ordinary supply for domestic or other purposes, but solely in reference to fires. At present it frequently happens that the turncock is from home when a fire occurs during the day, and his absence is accounted for by the fact that he is in another part of his district turning on and off the intermediate supply to those localities then being served; and in consequence of being desirous to give a sufficient supply where he then happens to be, the other parts of his district are not only without his being directly available when called, but also the resources of those districts are for the time being concentrated to the particular neighbourhood in which he is working; leaving all the other districts on his beat unattended by a turncock, and, necessarily, deficient of prompt water-supply in case of fire, unless some one happens to know how or where to find a supply from the main, the ordinary service pipes being at that time, as a rule, without pressure; and if the mains of that particular water company are under repair, so that for a time at least that locality is without water, under such circumstances nothing can be done to save the place burning if the fire has already gained the ascendency.

To obviate most cases of the kind I have referred to, I would suggest that all the water mains and services be kept constantly charged

That every water company's main be joined (and regulated by a sluice cock) to that of any other company nearest to its district, so that in case of fire or repairs two companies could at once be made available, and in this manner all the water supplies in London could be concentrated.

That the present often obscure, and frequently unknown, plug supply should be superseded by standard hydrants in convenient recesses against a building, or in a kind of box fitted at the base of the ordinary lamp-posts; in every case the presence of the hydrant being indicated by a coloured glass in the lamp or recess to which it is attached, and to ensure its being available at any and all times, every constable should be furnished with a small key of these boxes, with which he could at once open the box and turn on the water. The key to which I refer should resemble those used by the postmen in opening the post pillar-boxes, so small and handy that it could not be considered inconvenient, the ordinary key to the hydrant being kept always within the hydrant box or post, and if the question of cost did not arise, I see no reason why each hydrant box, or every other, at least, should not contain sufficient hose and branch pipe to enable every constable to endeavour to extinguish a fire on his own beat, while the engines were being brought to the spot.

Of course to ensure the complete and efficient working of the foregoing suggestions, attention must first be given to the constant supply of water in all mains, at all times, and this I think could only be met by an Act which compelled every householder to keep the internal fittings in order, subject to occasional inspection, and to a fine for neglect in this respect, every building being supplied with a meter, and the water used paid for in the same manner as gas is now supplied. This question of using meters would, I believe, quite remedy any want of attention to the internal fittings, and would reduce the necessity for inspection to a minimum, besides acting as a check to the great waste of water which at present exists. Every meter being fitted with a key, the supply could be turned on and off at the will of the occupier, and thus necessarily ensure a reduction of charge in the event of a family being from home for any length of time, besides the facilities which would then be at hand for keeping the water out of any building, without interfering with others, while the internal fittings were under repair, or in the event of accident.

Q.—As you have had occasion to suggest arrangements of the water-supply for protection of particular public buildings, will you describe those arrangements?

A.—There can be no doubt that many of the serious fires which have occurred in London might, in a great measure, have been averted, if a supply of water under pressure with proper appliances and arrangements, had been fitted in convenient positions, and it is to be regretted there is not some authority who could insist upon such precautions being taken in every large building, the contents of which would produce an extensive fire in itself, and seriously endanger a whole neighbourhood if water was not forthcoming from the street mains in sufficient quantities, or if severe frosts prevailed at a time when a gale of wind was blowing. I am strongly of opinion that all large buildings, containing say 216,000 cubic feet of space, should have these appliances charged and fitted, to the satisfaction of some authority, and that in proportion to the size of the buildings, so the appliances should be the more complete and sufficient for the increased area, and if something like periodical inspection were established in respect of these buildings and fittings, I believe many serious fires would not occur, especially among the large mercantile warehouses.

Q.—Would it not be necessary, to facilitate the adoption of such mechanical arrangements, and inspections for keeping them in order, that the water-supplies should be placed on a public footing?

A.—It would, no doubt, be better if the whole water supply of London were under one control, all the present sources contributing to one of constant supply and great pressure, whereby so much fire engine power would not be required for the purpose of extinguishing fires, as is already proved in Liverpool, Glasgow, and other places, where the mains are under constant pressure. The hydrants might then be used for cleansing the streets, or any other purpose, and the frequent use of them would only make them the more reliable when wanted for a fire. Half the number of men now required for an engine would then answer the purpose, still keeping in view the good service to be rendered by the police, who could act as firemen till the regular brigade arrived.

Q.—What proportion of fires do you consider are raised for insurance money?

A.—It is difficult to tell the proportion of fires which have been raised with a view to obtain the insurance money, as no doubt a great number of them have been settled in a liberal manner, and in consequence of the position of the parties they have not even been suspected at the time of settlement, whereas circumstances have subsequently come to light which left no doubt on the minds of some authorities that those fires were the work of an incendiary, either in the person of the principal himself, or by agents, made use of for the occasion, several of whom, being dissatisfied with their reward, or as the result of a quarrel, have, at some future time (when too late), spoken freely upon the subject. The only remedy, then, open to the fire offices is to use great caution when insurances are offered, and even this remedy fails when other names and new businesses are adopted by these same people. I quite believe that if many evil-disposed persons knew a fire would be quickly extinguished, and their plans revealed, when contemplating incendiarism, they would not attempt the firing as frequently as has been the case, and in proof of this supposition it is a fact that very few fires occur near fire-engine stations, and therefore, by the street hydrants I have proposed, with the police aid suggested, a great check would be brought to bear upon this class of persons.

Q.—What do you find to be the chief causes of accidental fires?

A.—Temporary stoves improperly constructed, defective gas lighting arrangements, and improper receptacles for ashes, are perhaps among the most frequent causes of unintentional fires. And these are quite common in buildings let off to several tenants and occupiers, where in many cases, after a landlord or agent lets a room or floor, he does not take the trouble to see what is going on within, so long as the rent is regularly paid. Nothing short of occasional inspection can remedy this state of things, or properly-arranged agreements from the landlord to the tenant, restricting him from liability for any fire arising from these causes, by stipulating that a tenant shall not fix or use any of these things without the consent of the landlord, and he being restricted on his part till notice has been given, and an inspection made by some competent authority, who could have no interest in the matter beyond looking to the public safety. The only supervision in this respect now exercised is that by the fire offices at the wharves, docks, and some of the wholesale warehouses, where it is believed many accidents have been averted, principally owing to the suggestions given from time to time.

(*To be continued.*)

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

The third meeting of the Committee on Class 9, Steel, was held on the 18th instant, at the Royal Commisioners' offices, Gore-lodge. Mr. J. Latham occupied the chair, and there were present—Mr. F. A. Abel, F.R.S.; Mr. C. Asprey; Mr. Warington; Mr. W. Smyth, M.A., F.R.S.; Capt. A. C. Tupper, F.S.A.; and Mr. A. Vickers. The Committee inspected the steel goods which have already arrived and have been arranged in their assigned positions by the exhibition staff. Among these goods were chiefly noticeable a collection of swords, contributed by Messrs. Wilkinson and Son, of Pall-mall; a series of specimens illustrating the processes of bayonet manufacture, lent by the Council of the Royal United Service Institution; a complete series of modern English cutlery, exhibited by the Messrs. Unwin and Rogers, of Sheffield; halberds, swords, and lances manufactured by the Messrs. Mole and Co., of Birmingham; some Chinese cutlery and tools, from Shanghai; and a unique collection of steel jewellery forwarded from Brussels. It is understood that the heavy steel goods expected from the chief manufacturers, and from the government manufacturing departments, will not arrive for a few days later, but the Exhibition is to open this year on the 14th of April, and it certainly seems of great importance to those manufacturers who wish to make an adequate representation of their goods, that they should at once take time by the forelock, and deliver their goods so as to permit an effective arrangement being carried out.

Her Majesty's Commissioners' Board of Management met on March 19th, at Gore-lodge, and determined to adopt the following announcement respecting the School of Popular Cookery. The school is situate on the ground-floor, between the east galleries and the colonial annexe. The object is to give illustrations of cooking food in the best, simplest and cheapest ways, suitable for persons with incomes from £50 to £500 a-year. The utensils used are those which might be found in a house of £40 a-year rental. The lecture-room will only hold about 120 people, of which number not more than 70 can be accommodated with reserved seats, and there will be a charge of sixpence for each hour's instruction. Verbal explanations of the processes will be given by Mr. Buckmaster. There will also be a tasting-room. This room will not be regarded as a general refreshment-room, but arrangements will be made to allow a limited number of persons who register their names each day to taste the practical illustrations of the lessons in cooking at two o'clock and six o'clock. The subject of the illustrations given each hour in each day will be duly advertised.

The fifth meeting of the Committee on Surgical Instruments and appliances took place on the 19th March, at the Royal Commission Offices, Gore lodge. The following members were present:—Mr. Cæsar H. Hawkins, F.R.S., in the chair; Mr. W. White Cooper, Mr. H. J. Domville, C.B., M.D., Dr. Arthur Farre, F.R.S., Dr. G. T. Gream, Mr. J. Hilton, F.R.S., Mr. J. Hinton, Mr. R. Liebreich, Mr. J. Lake. F.R.S., Mr. A. E. Mackay, M.D., Mr. J. Marshall, F.R.S., Dr. W. S. Playfair, Mr. E. Saunders, and Mr. E. Sercombe. The Committee examined the instruments which had already arrived, and accepted the majority of those submitted for approval. They formed sub-committees for the purpose of examining the different classes of the instruments and appliances, and agreed that they should meet weekly until the Exhibition should open. It is therefore hoped that all the arrangements will be completed before the 8th April, so that a clear week for private views and the visits of reporters may be allowed before Easter Monday, when the collection will be thrown open to the public.

The Society of Arts Committee of Advice for Class XII., "Substances used as Food," sub-section (6), "Drysaltery, Grocery, and Preparation of Food," met at the Society's House, on Friday last, the 14th inst. Present:—Dr. Blakiston in the chair; Messrs. Sedgwick, S. Cowper, R. M. Curtis, E. G. Davenport, James Duncan, Reginald Hanson, T. Hicks, Edward W. Larner, J. J. Manley, F. W. Rowsell, E. B. Savile, C. Southwell, Seymour Teulon, E. Wilkinson, and J. A. Youll, attended by Mr. E. J. Craigie, Deputy-Commissioner, and Mr. P. Le Neve Foster, Secretary. The Committee received reports from the various sub-committees which had been previously appointed, and took into consideration the applications to exhibit which had been received since the last meeting.

The above Committee, acting as a Committee of Selection, met at Gore-lodge on Monday, the 17th inst., and inspected the various articles sent in for exhibition in the sub-section under their charge. There were present —Mr. F. A. Abel, F.R.S., in the chair, Major Gen. F. Eardley-Wilmot, F.R.S., Dr. Peybon Blakiston, Dr. Henry A. Pitman, Messrs. Hyde Clarke, Sedgwick, S. Cowper, Reginald Hanson, T. Hicks, E. W. Larner, Fred. Machin, J. J. Manley, W. Reed, Francis W. Rousell, Charles Southwell, Seymour Teulon, Geo. F. Wilson, James A. Youl, attended by Mr. E. J. Craigie, Deputy-Commissioner, and Mr. P. Le Neve Foster, Secretary.

The preparations for the approaching opening are going on rapidly. The Japanese Government are devoting several thousands of pounds to the purposes of the Exhibition. An immense consignment of silk goods is now on its way to England from Japan, and is expected to arrive in the course of a week or two. Japan also sends models and drawings of carriages, and a quantity of steel cutlery and surgical instruments. The building occupied by the Belgian Commission last year is devoted this year to the Australian authorities. Next year, in all probability, the Australians will extend the present annexe, giving it much larger dimensions. Among the silk and velvet fabrics will be a very interesting collection of ancient silk. Machinery connected with this manufacture will occupy the northern extremity of the western gallery, on the ground floor. The breeding of silkworms will probably be illustrated in one of the adjacent structures situated in the open space of the western side. The number of carriages will be much greater than in the Exhibition of 1862. Among them will be the Queen's state coach, and the state coaches of the Speaker of the House of Commons and the Lord Mayor. There will also be the carriage built for the Duke of Edinburgh in Australia, the Duke's Chinese sedan chair, the Earl of Onslow's dress coach, and a sedan chair sent by the Duke of Northumberland. The Duke of Beaufort sends a mail coach which formerly ran to and from Holyhead. The Postmaster-General contributes a model of one of the old mail coaches. Progress has been made towards a collection of photographs representing the state carriages of Europe, and the various vehicles in use throughout the world. Ten cab-builders are competing for the prizes offered by the Society of Arts. "Cooking and its Science" will be practically illustrated by a school of cooking, conducted in the building on the eastern side, known last year as the East Machinery Annexe. Biscuit-making, the preparation of mustard, the manufacture of meerschaum pipes, the cutting of orange-peel by machinery, the making of soda-water, the whole process of the chocolate manufacture as conducted by a French company, different modes of preserving meat, the most approved modes of coffee-roasting, the process of the maccaroni manufacture, and other processes of similar character, will be shown. One half of the upper eastern gallery will be devoted to the paintings of Mr. John Phillip and Mr. Creswick. Several of these, including the Marriage of the Princess Royal, are lent by the Queen. The total number is large. The entire British collection of pictures in the present Exhibition is considered to be somewhat superior to that of last year. The opportunities of selection have been considerable, owing to the immense number sent in. In foreign art Belgium is again conspicuous, sending in a large number of paintings. France is sending pictures, but apparently to no great extent. There will be a few Russian pictures, also Swiss, German, Danish, &c. Some of the Italian academies will send accredited works. The specimens of sculpture do not promise to be very numerous. Sketches by officers of the army and navy afford an element of novelty this year, and will occupy one of the upper rooms in the eastern gallery. Photographs, engravings, chromo-lithographs, and architectural designs, together with lace and needlework, will be shown in the gallery of the Albert-hall. Scientific inventions will be exhibited in the crush-rooms on the first tier of the Albert-hall, though not wholly limited to that spot. The French annexe will be filled with carriages, but the carriages will not be confined to this part of the Exhibition, many of them being allotted to the south gallery and to other parts.

EXHIBITIONS.

VIENNA EXHIBITION.

It is expected that a series of exhibits intended to illustrate the industries of Japan at the Exhibition will be remarkably noteworthy and interesting. Apart from works of art in porcelain, and textile manufacturers of great richness and variety, there will be a complete collection of various kinds of woods, and a very curious collection of mineral products, prominent among which may be cited the copper pyrites of Nipon, quite as rich as those of Australia; the coal of Takasima, equal to that of Cardiff, and superior, it is said, to the American anthracite.

America seems likely to be well represented as regards manufacturing industries at the Vienna Exhibition. At the last exhibition in Paris there were only 245 American exhibitors, whereas there are already 700 exhibitors for the exhibition in Vienna. The *Supply* sailed on the 1st inst. from New York for Trieste, with a cargo embracing every variety of American products and machinery — a boiler, four steam-engines, wood-working machinery, machine tools, sewing machines, pumps, shoe-making machines, fire-engines, scales, cloth-cutting machinery, agricultural machinery of every description, organs, pianos, telegraph apparatus, rock salt, steam-made salts, sugars, moss, various plants, products of the New West along the Northern Pacific Railroad, oils, 1,000 volumes of statistics, a collection of the American Geographical Society, and other articles. The *Guard* is expected to sail from New York on the 17th inst., carrying minerals, ores, metal goods, wooden ware, dental goods, hardware, chromos, American wines, tobacco, a windmill, a soda fountain, a street car, and some ready-made shirts. In some respects the American department, it is stated, will not be as complete as it might be. Not one American locomotive, not one billiard-table, and not one of the American light carriages, which surpass anything of the kind in Europe, will be sent to Vienna. The department of fine arts will be the one in which the United States, according to the *New York Herald*, will appear to the greatest disadvantage. The committee originally appointed resigned some time ago, and the council of the Academy of Design, which supplanted the committee, have done nothing.

According to the *Grocer*, the pork-packers of Cincinnatti intend to forward to the Vienna Exhibition a complete illustration of the method of killing hogs and preparing them for market, from the time they are drawn into the pens until they are transformed into neatly-trimmed hams and pickled sides.

Nashville (U.S.) Industrial Exposition.—The managers of the Nashville (U.S.) Industrial Exposition announce their third annual display to take place during the whole of the month of May next. Buildings have been erected specially for this exhibition, and the departments have been increased in number and extended in range.

THE TRADE OF THE LOWER DANUBE.

The Lower Danube is generally taken to be that portion of the river which divides the United Principalities of Wallachia and Moldavia (now called Roumania) on the left bank, from Servia and Bulgaria on the right —that is to say, from the Iron Gates to the Black Sea, a distance of about 600 nautical miles. The whole of this course is more or less navigable by sea-going ships, but they seldom ascend higher than Braila, 113 miles from the Sulina mouth. From Braila upwards, the trade is chiefly carried on in river craft; but when the water in the river is high, sea-going ships and steamers, drawing eight or nine feet, are able to ascend to the Iron Gates. The bulk of the Danube trade by sea is with the left bank of the river, from Braila downwards, this country having no other outlet than the Danube; whereas, the produce of Bulgaria is not only smaller, but a large portion is taken overland to ports in the Black Sea. Mr. Consul Ward confines his notice to the export trade of the Rouman side of the river, which consists in cereals, the produce of Wallachia, Lower Moldavia, and that part of Bessarabia ceded by Russia in 1856; these countries are flat, and the soil and climate are well suited to the cultivation of corn. The produce is brought down from the interior in bullock carts to the nearest port on the river-side, principally Galatz and Braila. From the ports above Braila the corn is shipped either for Tchernavoda, whence it is sent by rail to Kustendjie, or for Braila, to be stored or transhipped into sea-going vessels. The centre of the trade is at Galatz, the seat of the principal commercial and banking establishments. The other ports are Braila, Reni, and Ismail. The countries into which all this produce is imported cannot be known with any degree of accuracy, because the nature of the corn trade is such that the shippers themselves are ignorant of the destination of the vessels they load. There is, however, no doubt that the exports from the Danube to Great Britain far exceed those to any other country; on a moderate calculation they may be valued at £1,500,000 a-year on an average of the last five years.

In steam navigation the most remarkable increase is apparent; this increase is principally due to the circumstance that steamers are superseded by sailing-vessels in the general trade of Great Britain, and notably in the corn trade, though, if no improvements had been made at the navigable mouth of the Danube, steam-ships of the average size could not have entered the river at all. In 1857 there was only nine or ten feet of water on the Sulina bar; and the Sulina branch, a narrow tortuous channel, forty-five miles long, leading out of the main river to the sea, was full of shoals. The Sulina mouth was then, and it still is, the only practicable entrance to the river. Steam-ships in the corn trade seldom draw less than fifteen feet when laden, so if the bar had not been deepened, and the shoals removed, those ships, had they ventured to come to the Danube, would have been obliged to lay out in the roadstead. It is, therefore, entirely owing to the works undertaken by the European Danube Commission that the Danube has been opened to steamers of large burden. But the choice of the Sulina for these permanent works is most unfortunate There was practically a choice between two mouths, the Sulina and the St. George. The Sulina presented greater facilities for immediate improvement at a comparatively small expense; the St. George, being the outlet of a branch conveying to the sea a much larger volume of water, could not be dealt with so expeditiously, and the expense would have been greater; but this disadvantage was completely overweighed by the superiority of the St. George's in all other respects.

The Danube flows into the sea by three branches. The Kilia, to the north, is the principal; the St. George, to the south, is next in size; and the Sulina, which runs between the two, is the smallest. Dividing the quantity of water conveyed by the main stream into 27 parts, it has been calculated that the Kilia takes 17, the Sulina 2, and the St. George 8. The Kilia flows into the sea by many mouths, and is on that account alone so difficult to manage as to be out of the question for improvement. The St. George divides into two mouths close to the sea. The Sulina has only one mouth. The superiority of the former over the latter is quite in proportion to the quantity of water conveyed by each to the sea. The St. George is nearer to the Bosphorus by 18 miles; it forms a projection seawards, and has deep water not far from the entrance. Inside the mouth there is a large and commodious harbour. The river banks are sufficiently high and spacious to build a town. Thence upwards the branch has many bends, but the channel is broad and deep, with no shoals of any consequence. There is ample room for navigation, and pilotage would not be required. The Sulina, besides being further from the Bosphorus, is embayed, and flows into the sea on to a flatter sea-bottom. There is very little harbour accommodation. The banks of the river on each side are very low, consisting of mere strips of land, dividing them from the marshes behind. The channel, though somewhat shorter than the St. George, is so narrow as to require good pilotage. In some places a large ship getting aground across the stream suffices to block up the channel altogether. This branch, besides being comparatively shallow all through, was full of shoals. Owing to the greater facility of dealing with the bay at Sulina, provisional works were commenced there. A technical commission, which sat in Paris in 1858, recommended the St. George, but on a plan which it would have been impossible to carry out with success; and although the European Danube Commission was unanimously in favour of the St. George, the plan remained for further consideration. Political events then intervened, and eventually the Sulina works were made permanent.

Within the last two years, Sulina has been made a free port. It was expected that this privilege would have converted the place into a depôt of grain ready for shipment at any time, thus avoiding delay and the inconvenience caused by the interruption of the navigation by post, but there is no disposition to establish grain stores at Sulina. The inconvenience of the place itself, the cost of building, and doubts whether it would be prudent to incur that expense, until the question of opening the St. George be definitely settled, are the causes of this hesitation. If the St. George were hereafter to become the entrance of the river, any expense now incurred at Sulina would be so much money thrown away. Great praise is due to the European Danube Commission, and to its engineer-in-chief, Sir A. Hartley, for the success of the piers at Sulina, and for the efforts made to improve the river channel upwards; but it is very unfortunate that so much intelligent labour and so much money should have been expended in obtaining the result now witnessed. The effect of the piers has been to open the entrance of the river to ships of large burden, and to convert Sulina from a dangerous roadstead into one of the safest harbours in the Black Sea. This was a great success, but it is only a part of the main object sought to be attained, viz., a proper navigable channel between the sea and the main river. If ships which can enter the harbour are prevented by the insufficiency of the channel from going any further, and if those ships which are able to proceed are exposed to accidents from the same cause, half the value of the harbour is lost, and the work of the commission remains incomplete. It was not, of course, foreseen, fifteen years ago, that the corn trade, instead of being carried on in sailing-ships of 300 or 400 tons at the utmost, would require steam ships of twice that tonnage, and sailing ships of 500 tons and upwards. But such is now the fact, and the exigencies of the trade make no exception for the Danube. Under these altered circumstances, the improvements made in the Sulina channel, though as much as were wanted or desired when the works were begun, now fall very short of the requirements of the trade—above all, of the British trade.

ARTIFICIAL CLOUDS.

The idea of creating artificial clouds to protect crops from the effects of frost is rather startling, but the severe losses entailed on vine growers in France by spring frosts have directed the attention of many scientific minds to the subject.

M. Gaston Bazile, of Montpelier, a well-known scientific agriculturist and chemist, and M. Le Vicomte de Laloyère, hit upon the expedient of creating clouds with the vapour of heavy hydrocarbons, and met with decided success.

When the sky is clear, and the temperature little above freezing point, and there is an absence of dew, clouds, and wind, there is great danger of frost, and when the frost comes in April or May the damage to the vineyards is enormous. In the Côte d'Or and the South of France the loss of half a crop of grapes by this frost, known as the effect of the *lune rousse*, from an old notion that the moon at a certain period burned up the young buds to redness, is not an uncommon occurrence; and last year, in a single night, the magnificent vines of Thomery, which bear the famous table grapes known as Chasselas de Fontainebleau, were so injured by frost that they will feel the effects for years.

The theory of the effect of clouds is that they intercept the radiation of the heat of the soil into space, and therefore prevent frost. The plan recommended is, when the danger threatens, to light a number of grease pots filled with oil of tar, or other heavy oil, and placed all over the ground at the distance of fifteen yards from each other. Soon the heavy fumes will rise to a certain height, spread themselves over a large space, and hang there for three or four hours; sometimes it may be necessary to refill the pots. The cost is said not to amount to more than about eight shillings an acre, and the operation is not often necessary, twice or thrice a year at the utmost.

An experiment was made the other day at Suresnes, near Saint Cloud, in the presence of many of the members of the Agricultural Society of France and the farmers of the neighbourhood, and it was considered highly successful. A plot of about fifty acres was selected and three hectolitres (66 gallons) of heavy oil burnt; as soon as the pots were all lighted, columns of black smoke rose sluggishly over the surface, and formed themselves into heavy clouds. The wind was blowing pretty fresh, so the mass drifted towards Saint Cloud; but in calm weather, such as that when frosts threaten, the whole plot of land and a good deal more would have been protected for hours by the artificial clouds. The fruit growers present seemed much struck with the effect produced, and with the explanation given by M. Barral, and some of them declared that they would try to save their peach and other blossoms from the scorching effects of the next *lune rousse.* The hint will not, we believe, be lost upon our own countrymen, who are even more accustomed than our neighbours across the Channel to see their hopes of fruit nipped in the bud by mischievous spring frosts.

CORRESPONDENCE.

ATLANTIC TELEGRAPHY.

Sir,—The cable of 1865 is broken, in 1,875 fathoms of water. Such is the latest startling announcement. Let us see what this means. No anchor can have broken it — that is out of the question. What then? It must have broken itself, either by the action of a current, or by its own weight on some inequality of the bottom. This means that the sheath has rotted, and then a very slight force would break the core like a pack-thread. The sheath has rotted, and no wonder, for if the problem had been proposed, how to make a sheath that would rot soonest, the wit of man could not have devised a better method than the way in which the sheath of the Atlantic cable was constructed. It was formed of hempen cords, each with an iron wire in the middle. Now, most people know that if their washerwoman hangs their shirts out to dry on an iron wire, wherever it has touched the shirts there will soon be a hole—wherever there is a speck of iron mould on a table-cloth or a pocket-handkerchief there will soon be a hole. Well, I think no one will doubt that, in some parts at least, of the Atlantic, iron will rust; the rust destroys the hemp; iron and hemp both go, and then the core of copper and gutta-percha snaps from the slightest cause. How long will the 1866 cable last? But if the life of an Atlantic cable is to be eight years, how extremely important is it that the prime cost should be as small as possible? Now, I have satisfied myself, by costly experiments, that at least three wires could be laid at the cost of one of those now used. I should have said seven, but I remember how emphatically Stephenson was warned that if he ventured to tell the committee of the House of Commons that a railroad locomotive could go more than 10 miles an hour it would be fatal.

I am met at the outset on all sides by the cry, "Oh! every practical man knows it to be impossible." Now, if a man tells me a thing is impossible I consider him as self-condemned. If he will deign to tell me why it is impossible I will listen to him, and if his arguments are sound I will confess my error. Perhaps when half-a-dozen more expensive cables are laid it will be discovered that cheap cables are not impossible.—I am, &c.,

H. Highton.

Putney, March 17th.

[This letter appeared in the *Daily News* of yesterday].

SIGNALS AT SEA.

Sir,—Whatever may be the difference of opinion as to the best signal to be used by a ship in distress, there can be hardly any as to the advantage to be gained by any ships capable of making and reading the flashing signals advocated by Captain Colomb in his paper read on the 12th inst. But why should the usefulness of such a system be limited by a code of signals requiring to be referred to by numbers?

The combinations of short and long flashes (or dots and lines) to express every letter of the alphabet are probably known to every telegraph clerk throughout the world; and the only hindrance I can see to their being used with lantern lights, is that great rapidity would be required. With the aid of electricity, however, signals could be made faster than they could be read; for it is probable that the state of the atmosphere would be the only regulator of the speed of messages conveyed in this way.—I am, &c.,

F. R. W. Lauchlan.

1, St. Lawrence-terrace, Stockwell.

ECONOMIC STOVES.

Sir,—Stoves and grates, being supplied with air from the room or hall to be warmed, consume from two to ten or more cubic feet of air per second to maintain combustion. In a room 12 × 15 × 10 = 1,800 cubic feet within the walls, floor, and ceiling, usually fourteen pounds of coals, or twenty of dry wood will raise the temperature from 32° to 70° Fahr. in thirty minutes; but during this time the stove has had to warm, not only the 1,800 cubic feet, but 30m. × 60s. × 2 c. f. = 3,600 cubic feet in addition, the latter being drawn into the room through the accidental openings in the wainscoting around the doors and windows.

For combustion, introduce the air *into* the stove or *near* the grate through a pipe from the outside. As the air in the room will expand, a moderate outward current, instead of the inward, through the accidental openings will follow.

Architectural modifications, forms of stoves and grates, or improvised attachments and obvious means for ventilation and the introduction of fresh air, will, as a matter of course, require mechanical attention.—I am, &c.,

Thomas Clark, Civil Engineer.

Superior, Douglas Country, State of Wisconsin.

GENERAL NOTES.

Technical Education.—With the view of promoting the technical education of persons employed in printing and the other trades connected therewith, a course of six lectures will be delivered at Stationers'-hall, by Mr. Ellis A. Davidson, on the arts of printing, type-founding, paper-making, engraving, and wood-cutting, upon the following days: March 31st, April 7th, 21st, 28th, May 5th and 12, and will commence at 7:30 p.m. Admission will be gratis by tickets, to be obtained of the clerk of the Stationers' Company, at the hall, Ludgate-hill.

Aeronautics.—It is said that an American aëronaut, Professor Donaldson, intends this summer to cross the Atlantic to Ireland in a large balloon. The machine will weigh about 2,000lb., will contain 268,000ft. of gas, with two reservoirs to provide against leakage, and an electrical arrangement for light. The professor calculates to accomplish his trip in from 17 hours to two days and a-half, and intends, if the experiment proves successful, to establish a balloon mail and passenger line round the world.

Norwegian Fish.—A Grimsby firm propose to erect tanks near the mouth of Great Yarmouth harbour for the reception of lobsters, salmon, and other fish, which they intend to import from Norway and other places for the London market. Great Yarmouth is considered to be more conveniently situated for this trade than other ports.

Coal in the United States.—Advices recently received from New York state that the production of coal in the United States last year was 41,491,135 tons. This total presents an increase of upwards of 3,000,000 tons as compared with 1871. The production of anthracite coal last year was 22,039,313 tons.

Library of the Board of Trade.—The valuable library of the Board of Trade, which for some time past has been consigned to a wooden shed, is to be transferred forthwith to the Foreign Office. We trust that the time is not far distant when this and similar libraries attached to the various government offices will be thrown open to the general public.

Progress in Japan.—The Japanese government proposes to have an institution for the study of practical engineering, and have instructed their agents to procure a set of machinery and tools similar in all respects to that which the Crystal Palace Company last autumn constructed, for the purposes of their school for practical engineering, under the supervision of Prof. Wilson, as Principal.

A New Artificial Stone.—A patent has been granted in the United States for a new artificial stone, produced by treating asbestos, either ground or in fibre, with silicate of potash or soda, then pressing the same into moulds of the desired form or shape, saturating the mass with chloride of calcium, either pure or mixed with chloride of magnesium, and finally washing it in pure water. The result is a compound claimed to be fire-proof and impervious to water, which can be used with great advantage for many different purposes. By preference, the bittern, or mother water, from salt works, is used to saturate the blocks after they are pressed. The action of chloride of calcium and magnesium upon the alkaline silicate previously mixed with asbestos, is to decompose the silicate, and form insoluble silicate of lime and magnesia, with soluble chlorides of potassium or sodium, the latter being readily removed by washing with water. The principal advantage claimed for the compound is that it preserves a certain degree of elasticity, mainly due to the fibrous nature of the asbestos, which cannot be attained if, in place of the asbestos, clay or other material of a similar character is employed.

Provisions Preserved by the Action of Cold.—From the report of the *Academie des Sciences*, we learn that, in 1865, some beef broth was bottled, and then plunged for some hours in a freezing mixture. The broth, when opened, had all the qualities which it possessed on being submitted to the action of cold. Sugar-cane juice treated in the same way had undergone no change. These trials were suggested by the well-known geological fact that a low temperature becomes, in course of time, an obstacle to the decomposition of flesh. For example, in 1804, the carcase of an elephant was discovered, enclosed in ice, at the mouth of the Lena, in Siberia, in such a state of preservation that the animals fed on it. This is not an exceptional case. During the exploration on the coast of the Frozen Sea, between the Lena and the Kolyma (undertaken after the voyage of Capt. Beechey to the Bay of Escholtz), thousands of elephants, rhinoceroses, and buffaloes were, says the "report," discovered buried, either in the ice or in the frozen earth of those regions. One of the members of the Academy mentioned that his father had often told him that, in the Russian campaign, the bodies of the soldiers and animals buried under the snow were better preserved than those which were exposed to the air.

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

REPORTS ON THE LONDON INTERNATIONAL EXHIBITION OF 1872.

The reports which appeared in the last volume of the *Journal* on the various sections of the above Exhibition, are now published complete, in a pamphlet form (price 2s.), and can be obtained at the office of the Society.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. The following meetings have been arranged:—

March 26.—"On the Edible Starches of Commerce, their Production and Consumption." By P. L. Simmonds, Esq. On this evening Thos. Greenish, Esq., F.C.S., F.R.M.S., will preside.

April 2.—"On Economy of Fuel for Domestic Purposes." By Capt. Douglas Galton, C.B., F.R.S.

April 9.—*No Meeting.*

April 16.—"On the Condensed Milk Manufacture." By L. P. Merriam, Esq.

April 23.—"On Silkworm Grain." By Mons. Alfred Roland (Orbe, Switzerland). On this evening Andrew Cassels, Esq., will preside.

INDIA COMMITTEE.

A Conference will be held on Friday, 28th inst., at 8 p.m., when a paper will be read by W. T. Blanford, Esq., of the Indian Geological Survey, on "The Mineral Resources of India." Sir Louis Mallet, C.B., Member of the Council of India, will preside.

Members are entitled to attend these Conferences free, and to admit two friends to each of them.

CANTOR LECTURES.

The Third Course of Cantor Lectures for the present session will be "On Wines; their Production, Treatment, and Use," by J. L. W. Thudichum, Esq., M.D. The Course will consist of six lectures, the first of which will be given on Monday evening, the 21st of April, the remaining five on the Monday evenings succeeding.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Society of Engineers, 7½. Discussion on Mr. W. H. Fox's Paper on "Continuous Railway Brakes."
London Institution, 4. Prof. Thiselton Dyer, "Fungoid Organisms in their Relation to Mankind."
Institute of Surveyors, 8. Mr. W Brown, "Beech Woods and Larch Plantations."
Royal Geographical, 8½. Maj.-Gen. Sir H. C. Rawlinson, "Notes on Khiva, and Routes leading to that Country."
Medical, 8.

Tues. ...Royal Institution, 3. Prof. Rutherford, "Forces and Motions of the Body."
Medical and Chirurgical, 8½.
Civil Engineers, 8. Mr. Thomas Sopwith, jun., "The Mont Cenis Tunnel."
International Decimal Association, 8. (At the House of the Society of Arts.)

Wed. ...**SOCIETY OF ARTS**, 8 Mr. P. L. Simmonds, "On the Edible Starches of Commerce, their Production and Consumption."
Geological, 8. 1. Capt. F. W. Hutton, "Synopsis of the Younger Formations of New Zealand." 2. Mr. W. Carruthers, "On the Tree-ferns of the Coal-measures and their Relations to other Living and Fossil Forms." 3. Mr. A. H. Schindler, "Notes on the Geology of Kazirun, Persia." Communicated by Mr. Joseph Prestwich.
Royal Society of Literature, 8½.
Archæological Association, 8.

Thurs...Society for the Encouragement of the Fine Arts, 8. Mr. Benjamin Seare, "The Elizabethan Drama."
Royal, 8½.
Antiquaries, 8½.
Royal Institution, 3. Mr. Vernon Harcourt, "Coal and its Products."

Fri ......**SOCIETY OF ARTS** 8. India Conference. Mr. W. T. Blanford, "The Mineral Resources of India."
Quekett Club, 8.
Royal Institution, 9. Professor W. K. Clifford, "On the Meaning of Force and Energy."
Royal United Service Institution, 3. Capt. J. B. O'Hea, "Rifles, and Rifling."

Sat ......Royal Institution, 3. Professor Max Müller, "On Darwin's Philosophy of Language."

JOURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, MARCH 28, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

INDIA COMMITTEE.

A meeting is called of the Indian Committee of the Society, and others interested in the question, on Wednesday, 2nd April, at 4 p.m., for the purpose of arranging for a deputation to the Secretary of State for India, on the subject of facilitating our communications with Eastern Turkistan in Central Asia.

TECHNOLOGICAL EXAMINATIONS.

The Programme of Examinations in the Technology of some of the Arts and Manufactures of the country is now ready, and may be had on application to the Secretary.

The subjects selected for 1873 are Cotton, Paper, Silk, Steel, and Carriage-building. Those desiring to become Candidates, should apply for the programme without delay, as all names must be sent in before the end of March.

The following Prizes are offered by the Society of Arts in each of the five subjects mentioned above :—

To the best candidate in Honours, £10.

To the best candidate in the Advanced Grade, £7.

To the best candidate in the Elementary Grade, £5.

In order that these Examinations may really be successful in promoting technical education in this country, it is desirable that encouragement should be given to candidates by the offer of additional prizes and scholarships. With this object the Council appeal to the Companies of the City of London, to merchants and manufacturers, and to members of the Society generally, to aid them by contributing to the Prize Fund.

The following special additional Prizes are offered :—

By Wyndham S. Portal, Esq., to the Second and Third best Candidates in the Elementary Grade, Paper Manufacture :—

A Prize of	£3
A Prize of	2

By G. N. Hooper, Esq., to the Second and Third best Candidates in the Elementary Grade, Carriage Building :—

A Prize of	£3
A Prize of	2

By the Worshipful Company of Spectacle Makers, to the Second-best Candidate in Honours, in the Advanced Grade and in the Elementary Grade respectively, in the Manufacture of Steel :—

A Prize of	£5	5
A Prize of	3	3
A Prize of	2	2

The Council beg to announce the following contributions to the Prize Fund :—

The Worshipful Company of Fishmongers	£52	10	0
The Worshipful Company of Mercers	26	5	0
The Worshipful Company of Vintners	10	10	0
The Worshipful Company of Salters (annual)	10	10	0
Dr. Crace Calvert, F.R.S. (annual)	5	5	0
Sir Daniel Cooper, Bart.	5	0	0
R. L. Chance, Esq.	5	5	0

The Council invite the aid of masters and managers in promoting these examinations by encouraging their workmen to take advantage of them. An explanatory handbill, suitable for being suspended in factories and workshops, may be had on application to the Secretary of the Society of Arts, Adelphi, London, W.C.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal early in May next. This medal was instituted to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows :—

In 1864, to Sir Rowland Hill, K.C.B., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty the Emperor of the French, "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

The Council invite members of the Society to forward to the Secretary, on or before the 12th of April, the names of such men of high distinction as they may think worthy of this honour.

INSTITUTIONS.

The following Institution has been received into Union since the last announcement:—

Tonic Sol-fa Teachers' Association, 1a, University-street, Tottenham-court-road, W.C.

PROCEEDINGS OF THE SOCIETY

SIXTEENTH ORDINARY MEETING.

Wednesday, March 26th, 1873, Thomas Greenish, F.C.S., F.R.M.S., in the chair.

The following Candidates were proposed for election as Members of the Society:—

Backhouse, Thomas, Cleveland Iron Ship Yard, Middlesborough-on-Tees.
Cobb, Benjamin Francis, 9, Old Broad-street, E.C.
Eames, Alfred, Royal Naval School, New cross, S.E.
Galloway, Charles J., Knott Mill Iron Works, Manchester.
Gjers, John, Ayresome Iron Works, Middlesborough-on-Tees.
McEwen, Lawrence, Lombard House, George-yard, Lombard-street, E.C.
Packer, George, 71, St. Donatt's-road, New-cross, S.E.
Routledge, Edmund, 294, Camden-road, N.

The following Candidates were balloted for and duly elected Members of the Society:—

Colomb, Captain P. H., R.N., Harrow, N.W.
Hale, William Francis, 304, Goldhawk-road, Hammersmith, W.
Ricketts, Arthur, 12, Forbes-road, Penge, S.E.
Smith, Matthew (Messrs. Frederick Smith and Co.) Halifax, Yorkshire.
Wallace, Sir Richard, Bart, M.P., 105, Piccadilly, W.
Whitehead, Charles, F.R.G.S., F.S.A., Barming House, Maidstone.

The Paper read was—

ON THE EDIBLE STARCHES OF COMMERCE, THEIR PRODUCTION AND CONSUMPTION.

By P. L. Simmonds.

About fourteen years ago the subject of Starches was brought before our Society by my friend Dr. Calvert, F.R.S., the title of his paper being "On Starches, the Purposes to which they are Applied, and Improvements in their Manufacture." (*Journal*, vol. viii., p. 87.) Dr. Calvert, however, dwelt chiefly on the industrial and manufacturing uses of starches, and alluded very briefly to the edible starches. In vol. iii. of the *Journal*, page 774, I published a short paper on "New Edible Farinas and Starches." Since then the production and consumption of those used for diet has attained very large proportions, and as the food products will form a prominent feature of the forthcoming London Exhibition, I have thought that a few descriptive and statistical details on the subject might at this time prove of general interest.

Unlike the French, who have two words which they apply, with different meanings—fecula and amidon, or starch,—we are, in a great degree, limited to one, all being essentially starches in commerce, even with the minor classifications of arrowroots, sagos, tapiocas, corn-flours, &c.

The French confine the term fecula to the starch obtained from roots, such as manioc; of stems, as the sago; and fruits or seeds, as of the horse-chestnut, acorns, &c.; while the amylaceous product obtained from the cereals, which crystallises, on drying, into needle-like forms, they define as amidon, or starch.

Very little has been published on this extensive and important branch of commerce,—at least in a collected form, for occasional papers have appeared, from time to time, in various scientific journals. Perhaps, however, the best and most carefully conducted investigation into all the tropical starch-producing plants, their characteristics, and properties, was that carried out, about a quarter of a century ago, by Dr. Shiers, in British Guiana, and published locally in a pamphlet, of which I gave a digest in the chapter "On Starch-producing Plants," in my work "On the Commercial Products of the Vegetable Kingdom," published in 1852, a book now out of print.

It is not my intention this evening to trouble you with scientific and chemical descriptions of the special characters of the starches from various plants, or to treat upon the mooted question of how far they furnish nutritive food,—subjects which fall more properly within the scope of Societies like the Microscopical, the Chemical, the Pharmaceutical, the Medical, &c. I shall restrict myself to the commercial aspect of the question. I may, however, state that I have placed on the table, for the inspection of the members, a very large and varied collection of edible starches, which have all been carefully identified and referred to their proper sources, by my friend in the chair, for in commercial circles there is too much confusion on this point.

In justification for bringing the subject before the Society, I may give a few figures, which will serve to prove that the commerce in these articles is of considerable aggregate importance.

In 1850 we imported about one million pounds of arrowroot; in 1860 these imports had increased to more than 2,383,000 lbs.

In 1860 the values of the edible starches, &c., imported were:—

Arrowroot	£42,404
Maccaroni and vermicelli	14,206
Sago	149 748
	206,438

In 1870 these had increased to :—

Arrowroot	£33,063
Maccaroni and vermicelli	25,452
Sago	218,400
Tapioca	89,635
	£366,550

I will now take the figures of 1871, the last year for which we have the complete official detailed returns of imports; but, unfortunately, these are issued in a new form, and are given collectively, without the special enumeration which we formerly had.

The aggregate value of the farinaceous substances and manufactures therefrom imported is stated at £274,281; sago and sago flour, £197,381; total, £471,662. But as the article "maizena" is thrown in with Indian-corn meal, and much maize, rice, and even potatoes are converted into edible starches here, I may as well add the figures given for Indian-corn meal (£13,944) to the above, which would bring up the total to £485,706 for the year.

Our imports of arrowroot from the West Indies, in the last ten years, have fluctuated between 12,000 cwts. and 22,000 cwts. a year; from South Africa we now get from 3,000 to 4,000 cwts. annually.

Having thus given you an outline of the extent of our imports, I proceed to treat of the production and consumption in the several localities, preferring to arrange the information under these divisions, as more generally recognisable and more easily followed.

EUROPEAN STARCHES.

But few plants are utilised for edible starches in Europe. We are mainly dependent for our supplies of these on tropical and sub-tropical countries. Occasionally small quantities of Portland arrowroot have been made from *Arum maculatum*. In Italy the fecula of *Arum italicum* and of *Pancratium maritimum* is manufactured to some extent, and sold at 3½d. per lb. About two tons are made annually by one maker at Cava.

Starch is manufactured in the south of France and the neighbourhood of Paris from the horse-chestnut. It yields about 16 or 17 per cent. of starch. If it is to be used as food, it must be treated with water containing carbonate of soda, to remove all bitterness, and then washed repeatedly with pure water. Only small quantities of it have been imported into this country, more for curiosity than for commercial purposes.

Rice starch has, within the last few years, been prepared as a beautiful food product, under the name of corn-flour, by an eminent firm, and the care with which it is manufactured, and its nutritive qualities, have commanded for it a large sale. As much as 80 or 90 per cent. of starch has been obtained from some kinds of dry rice, but the average may be taken at 73. Imported maize or Indian-corn is also converted in this country into a starchy food product, sold as corn-flour.

Under the name of farina, without the prefix of "potato," a large quantity of potato starch is imported and sold here. The process by which potato starch is now so largely made on the Continent by improved machinery is very perfect. Its hygroscopic properties are however great; even when sold in the shops in the form of dry powder, as a substitute for arrowroot, it contains 18 per cent. of water, and if placed in a damp atmosphere, it will rapidly absorb double that amount of water. The percentage of starch in the potato ranges from 9 to 26 per cent. Sago, vermicelli, and various other food products are made on the Continent with potato starch. The famed gravies, sauces, and soups of France are largely indebted for their excellence to the so-called farina from potatoes.

As Professor Owen observed as far back as 1856, in his official report on the alimentary substances shown at the Paris Exhibition of 1855—"The French at present appear to excel in the art of preparing and modifying the starch principle of the potato, so as to simulate the product of the *Maranta arundinacea*, called under one form arrowroot, and under another, or granular form, 'tapioca;' as also to simulate the starch principle of the *Cycas circinalis*, called 'sago,' and that of certain Asiatic species of *Orchis*, called 'salep.' It must be added that the conscientious fabricators of these imitations vend them as 'French, or indigenous arrowroots, sagos,' &c., and at a lower price than that for which the genuine exotic article can be obtained. I am afraid that there is little conscientious principle manifested among vendors here, for European arrowroots and sagos sell as readily and promiscuously as Indian and American."

WEST INDIAN ARROWROOT.

Maranta arundinacea furnishes most of the genuine West Indian arrowroot, although other species, such as *M. nobilis*, *M. Allouya*, *M. ramosissima*, are also cultivated for a similar starch from their tubers, and several species of *Canna* are utilised for the starch in their tubers.

The Bermuda arrowroot was long considered the purest quality made, its superiority either arising from the nature of the water or soil, or from greater care in the manufacture, but the production has been declining, and has now given way to other more profitable crops. The general export from the colony was, in 1870, 45,675lbs.; in 1871, 30,276lbs.; and in 1872, 26,710 lbs., valued at £1,323. The decline in the production is best shown by the following figures, giving the value of the arrowroot exported from Bermuda in former years:—

1851	£10,334
1852	8,664
1853	7,820
1854	8,085
1855	6,439
1856	3,772
1857	6,281
1858	5,449
1859	2,851
1860	4,134
1861	4,291

The imports into the United Kingdom from this island have been as follows :—

	Cwts.	
1863	71	£814
1864	332	3,495
1865	197	1,837
1866	330	3,076
1867	1	9
1868	60	507
1869	91	679
1870	none	none

When made by the labourers in the West Indies on a small scale, arrowroot is prepared much in the same manner as potato starch in this country for domestic use; the only implements required are a grater and wooden troughs and trays; when made on a larger scale, as on the estates of the proprietors, the crushing of the root and the reducing it to a pulp are effected by simple and cheap machinery (a wheel and rollers) worked by water. The arrowroot is dried under sheds. Little or no use is at present made of the pulp after the extraction of the starch by lixiviation, but probably a serviceable paper might be made of it at a trifling cost.

In 1869 there were 65½ acres under culture in Jamaica, and in 1870, but 49¼ acres. The exports have declined year by year from 70,204 lb. to 6,343 lbs.

1866	70,204	lbs.
1867	44,566	,,
1868	27.346	,,
1869	11,731	,,
1870	6,343	,,

In the Island of St. Kitts, arrowroot and *tous les mois* (from Canna) are produced to some extent. In 1850, 95,460 lbs. were shipped; in 1860, 35,128 lbs. The imports into the United Kingdom for eight years have been as follows:—

	Cwts.	
1863	103	£213
1864	841	1,483
1865	1,139	1,329
1866	374	1,329
1867	7	6
1868	35	34
1869	57	54
1870	118	110

The amount of arrowroot exported from St. Vincent is now about two millions of pounds; in 1847, the quantity shipped was only 297,587 lbs.; and in 1851, 490,837 lbs.

Many circumstances have promoted this increased culture. When it began the price of the article was high, and the grower obtained a largely remunerative profit; its culture was not laborious; it was subject to few risks; it did not for its success require rich land or much manure; there was a constant and increasing demand for it; and in consequence of the abundance of pure water, great facilities were afforded for the manufacture, and that by a process so simple, easy, and cheap, as to require little skill in conducting it, and scarcely any capital.

St. Vincent is the only arrowroot-producing colony that has kept steadily progressive, as the following figures will show. There will necessarily be slight fluctuations in the out-turn, according to season, &c. From 1850 to 1854 the quantity made in the island ranged from 350,000 to 550,000 pounds, but of late years the production has often reached 2,250,000 pounds. The following have been the imports into the United Kingdom, and their value:—

	Cwts.	
1863	11.436	£30.994
1864	12.243	30,567
1865	17.691	34 813
1866	20.264	33 868
1867	20,786	29,393
1868	15,321	23.111
1869	15,870	22,875
1870	16,919	25,515

In 1850 the shipments were only 3,573 barrels and 7,493 boxes, valued at £15,864.

Of late there has been a steady increase in the production, so that instead of the stationary figure of 7,500 barrels, at which the exports kept from 1860 to 1865, they have risen above the large shipment of 10,000 barrels in 1859. In 1867 and 1868 the average export was 12,000 barrels; in 1866, it rose as high as 14,645 barrels; in 1869, to 11,226 barrels, being a decrease on the previous year of 422 barrels; in 1870, the shipments were 10,438 barrels.

I have not any recent statistics of the production of arrowroot in Barbados, but I believe little is made or shipped from the island now. The exports were, in:—

	Packages.	
1850	1,073	£1,526
1851	575	807
1852	735	794
1853	717	595
1854	1,057	1,403

In Antigua there has been considerable decline in the production. From 1850 to 1854 the exports were from 300 to 500 boxes and barrels, and from Montserrat, in some years, 250 barrels. Now our imports of arrowroot from Antigua have dwindled to the following figures:—

	Cwts.	£
1863	217	455
1864	419	740
1865	271	320
1866	164	172
1867	12	11
1868	17	16
1869	31	29
1870	30	28

Tortola used to export arrowroot and *tous les mois* of the value of £500 to £1,500 a-year, but has dropped out of the production.

North American Starches.

The enormous production of Indian corn in the United States, and the fact of its containing a less proportion of gluten than wheat, have led to its extensive utilisation for starch manufacture, and also as a food product, under the names of maizena and corn flour. As an alimentary product this starch is gradually working its way in Europe, and has been rewarded with silver medals at several of the Industrial Exhibitions. Maize contains about 75 per cent. of starch. A considerable quantity of Maranta starch is produced on the coasts of Georgia and Florida. The yield of roots of all sizes is from 100 to 150 bushels per acre. From a bushel of roots weighing 43 lbs., about 5¾ lbs. of clear, dry fecula is obtained.

South American Starches.

In British Guiana a good deal of edible starch is made from the various tropical roots, but the starchey products do not form an article of export from the colony now, the arrowroots, cassavas, &c., being locally used. Palatable starch can be obtained from the root of the *Alstrœmeria pallida*, Graham, and the starch from the various Chilian *Alstrœmerias* was suggested to be sought for and shown at the Exhibition of 1851. The tubers of many of these could doubtless be utilised in a similar manner. In Brazil considerable attention is given to the production and manufacture of edible starches. A most interesting and varied collection of these was shown at the Paris Exhibition in 1867; it comprised among others the following products, many of which I have not been able to identify, in the absence of either scientific name or other clue to the plants. Of most of these I am able to exhibit samples:—

Yellow pumpkin starch.
Pine starch, and pine farina.
Fecula of Itua.
Maizena—Indian corn fecula
Meal and tapioca of seeds of gergelim (*Sesame*)
Fecula and tapioca di forno.
Jacatupé starch.
Mango starch.
Potato starch.
Bread fruit starch.
Carnauba starch from the trunk of *Copernicia cernifera.*
Shushu or xuxu starch (from a bulb).
Fecula of bananas.
Meal of yam (*Dioscorea sp.*).
Arrowroot fecula (*Maranta*).
Starch of bitter potato.
Starch of Brazil potato.
Meal of Demerara potato.
Fecula of Maira potato.
Water farina of manioc.
Dry farina of manioc.
Beiju of manioc (dried slices).
Flour of manioc gratings.
Puba manioc.
Dry meal of white manioc.
Dry meal of yellow manioc.
Dry meal of white manioc, sold at three milreis the alquiere.
Coarse manioc meal.
Starch of manioc.
Tapioca of manioc
Carima of manioc in small balls.
Dried meal of Macacheira or Aipim (*Manihot Aipi*), sells at two and a-half milreis the alquiere.
Carima of macacheira in small balls.

Feculas from other roots and bulbs than the manioc are rarely manufactured. The *Maranta arundinacea* is grown in Para; there are two varieties, one with a large long root, which produces the most fecula, the other, named "ounce's paw," from the resemblance it bears to the fore-foot of that animal.

The arrowroot, after being subjected to the action of running water, is sometimes buried in the mud until it ferments and becomes a plastic mass, to which they give the name *puba*, as they do in like manner to the manioc, when it undergoes a similar process.

Jacatupé starch is extracted from the bulbous root of a climber whose leaf is poisonous. The starch is used in soups, puddings, gruels, and other food preparations, and is said to possess important medicinal qualities, in dysentery, nephritic and other diseases.

The manioc or cassava is, however, the plant chiefly cultivated for food purposes in Brazil. No species of plants have been more changed in scientific nomenclature by botanists than these, for they have been classed as *Jatrophas*, *Janiphas*, *Manihots*, *Curcas*, &c. I will adopt the names given by Pohl to the two principal species (most of the others seem to be but mere varieties) the bitter or poisonous species, *Manihot utilissima*, and the sweet species *M. Aipi.*

The manioc would seem to be a native of Brazil; it has been introduced into India, and is grown about Calcutta, Madras, the Straits Settlements, and other quarters. It flourishes better on the borders of the sea and on islands than in the interior of the continent. On the coast of Coromandel the roots are more fibrous, and therefore inferior to those raised in Malabar. It is extensively grown in Guiana, the West Indies, and various parts of Africa.

The tubers of the bitter cassava attain a length of three feet. They can be converted into bread or cakes. The volatile poison of the milky sap is destroyed by pressing the grated root in the first instance, the remaining acridity being expelled by the heating process. The starch, heated while in a moist state, furnishes the tapioca of commerce. Cassava is abundantly cultivated in Brazil and Venezuela—especially at Caraccas, where the singularly uniform temperature throughout the year is only 60 deg. to 70 deg. Fah. It is a very exhausting crop, and stands in need of rich soil and manuring. The propagation is effected by cuttings from the ligneous part of the stem.

The soil destined for manioc must not be wet. In warm countries the tubers are available in about eight months, though they continue to grow afterwards. The growth of the plant upwards is checked by breaking off the buds. The bitter is the more productive of the two species. The yellowish tubers attain sometimes a weight of 30 lbs. They do not become soft by boiling, like the Aipi or sweet manioc.

The sweet species, though a native of tropical South America, extends as far south as the Parana river. The root is reddish and harmless, and can be used, unlike the bitter species, without any further preparation than boiling as a culinary esculent, irrespective of its starch being also available for tapioca.

From the roots of the two species many food products are obtained, among others, coarse cakes made by rasping and pressing the root, which are cooked on a hot plate. The fecula, heated on hot iron plates, becomes partially cooked, and agglomerated in small, hard, irregular lumps, and in this form is known as tapioca. This substance, partially soluble in water, forms a nourishing food, much appreciated in Europe.

Farina of manioc in its crude form is often seen at Brazilian tables, but is more frequently mixed with water and baked in thin cakes, in this state forming the bread of the poorer classes. It thus forms a nourishing and cheap food; and it is to be regretted that in Europe the vendors should palm off potato-starch and other similar substances for the more delicate and agreeable cassava and tapioca.

Manioc meal is produced on an extensive scale in the province of Santa Catharina, where they employ improved machines for preparing it, especially in the settlements. These producers supply the markets of the capital and of the other provinces. The foreign export of manioc meal in 1845 was 145,722 alquieres. Manioc is the staple article of food for the whole population. There are more than 14,000 manufactories, and the total production is calculated at upwards of 500,000 alquieres. In abundant years the meal and fecula fall as low as 1 or 2 milreis the alquiere, but in years of scarcity often rise to above 8 milreis. The foreign export was for some time checked by a tax of 2 milreis imposed on each sack exported, but this tax was abolished in 1865.

There are two modes of preparing the root—the wet and the dry process. In the first, the grated root is put into water for four or six days, and afterwards kneaded with water, and pressed to extract the juice. The fecula which remains is sifted and baked in earth ovens, some fresh manioc paste, which has fermented, being always added. There are no less than fourteen varieties of the manioc distinguished in the province of Amazonas, some of which mature in six and others in twelve months.

The dry process is carried on as follows:—The manioc is rasped by hand, water added within, and then put to be pressed; afterwards dried, sifted, and subsequently baked. In making the starch, the deposit in the water is left for some time to allow the starch to settle down; it is washed three times, dried in the sun, and is then fit for sale.

The carima, or fine, creamy starch, is prepared by softening the puba manioc in water, after which it is strained and pressed in a sieve, and made into little balls, in which shape it comes to market, although sometimes reduced to farina. It is used in gruels and other food preparations, according to the custom of each locality.

The exports of tapioca from Brazil were 200,725 bushels in 1868, and as high as 332,823 bushels in 1866. In 1871 the exports were about seven million litres, valued at £26,050. The value of the imports of farinaceous substances from Brazil (nearly all tapioca) have been as follows in the last nine years:—

1863	£4,193
1864	5,413
1865	6,404
1866	8,024
1867	13 812
1868	15 188
1869	8,974
1870	12 960
1871	14,092

Twenty years since about 11,000 cwt. of tapioca used to be imported annually from Brazil, now we only receive about half that quantity.

At Santiago, one of the Cape Verdes, the crude farina of manioc costs about 1s. 6d. the decalitre, and when prepared fetches as much as 10d. the pound. One estate, the Praia Rei, on the island of St. Thomas, West coast of Africa, produces about 150,000 litres of farine of manioc. In Angola, 150,000 lbs. are manufactured annually. At Mozambique, the Portuguese also prepare a good deal, which is sold for export at 2½ to 3½ francs the decalitre (17½ pints); dried slices of the root are sold in great quantity in the markets at 5d. to 5½d. the decalitre.

The common mess of the Balonda Africans is porridge made of the manioc. The meal is stirred into boiling water; as much as can be moistened is put in, one man holding the vessel, and the other stirring the porridge with all his might. It is very unsavoury, and no matter how much one may eat, two hours after he is as hungry as ever. When made thin it is like starch made from diseased potatoes.

Eastern Starches.

The water lilies are much used by the Chinese for food. The seeds of *Nelumbium speciosum* provide an excellent meal, used like gruel, and the sliced roots furnish a species of arrowroot. The root of *Nymphæa alba*, in Sweden, and of *Nymphæa lotus, edulis* and *rubra*, are used for food in Egypt and the East. The starch from the roots of *Saggitaria saggitifolia* is employed by the Chinese, and from the *Alisma Plantago* by the Kalmucks.

At the Paris Exhibition, in 1867, arrowroots were shown in the Indian department from Sarun, from Palhully, from Dacca, from Dehra Doon, North Malabar, Penang, and Singapore. Although not so stated, I presume most of these would be from *Maranta* and some few from *Curcumas* and the Palms.

The *Maranta arundinacea*, a native of America, was introduced into India about 1840, by Mr. Elphinstone, and is now cultivated in several of the provinces, especially in the Presidency of Madras. It takes twelve or fifteen months to attain its full development. About a year, with good irrigation, brings the plant to maturity in the East, and the roots then contain the maximum of fecula. Thus after twelve months' culture they will afford 16 per cent. and subsequent yields were found on careful investigation by a good botanist (M. Lepine, of Pondicherry) to be—

Months.	Per Cent.
14	15
15	14
16	12
17	11
19	10

The fecula is obtained from the underground shoots, which are white, fleshy, about nine inches long by one and a half to two inches in diameter. They contain about twenty per cent. of fecula, but by the rude processes of rasping and washing not more than twelve per cent on the average is obtained. Arrowroot is in extensive use in India, and some is also shipped to Europe.

The roots of *Curcuma rubescens* yield a starch like arrowroot. In Travancore it forms a large part of the diet of the inhabitants, but has never been tried much in Bengal.

C. angustifolia yields an arrowroot in Tikor, Benares, and Madras; and *C. leucorrhiza* in Berar. Specimens of these may be seen in the India Museum.

The wild ginger plant, which furnishes starch, grows everywhere in the district of Chittagong; it is very difficult to eradicate from land, as the smallest root, or piece of a root, that has an eye, will spring up again. The plant dies off in December. A rough experiment was made with this root by the Civil Assistant-Surgeon of Chittagong, Dr. W. B. Beatson, and the yield was estimated at an ounce of starch from one pound of the root. The experiment, however, was not precise enough to be satisfactory, and he was inclined to think that the yield would be much larger, for the microscope shows the root to be loaded with starch granules. The supply of the root being inexhaustible, any quantity of starch might be extracted from it yearly and become a valuable article of commerce.

There would be no expense for cultivation, and, allowing for the cost of digging the root, and manufacturing the starch, by bruising and macerating the root in water, and drying the deposit, the product would be cheaper than Arracan rice, which is largely exported to Europe to be used, not as food, but in starch manufacture for laundry purposes, stiffening fabrics, &c.

It is not easy to decide whether the wild arrowroot plant found in Cuttack is identical with the cultivated arrowroot. A cup of arrowroot made of the one is not distinguishable from one made of the other—except, perhaps, by a slightly earthy taste observable in the wild arrowroot, which is easily accounted for by its imperfect preparation. The cultivation and more perfect manufacture of the garden arrowroot have been comparatively recently introduced into the province, so that it is neither generally grown nor its produce used by the natives. It is made from plants of his own growing by a native Christian of Khundittur, who sells his produce among the European residents of Cuttuck, his price being a little under 6d. per lb. This arrowroot is of excellent quality, and the process of manufacture is as simple as can be. The tubers are taken up in the cold season, washed, put into a large wooden mortar, and mashed. The mash is then taken out and well washed in cold water, the water drained off, and set to stand in flat vessels, in which it deposits a large proportion of the starch, which is re-washed in cold water and set to dry in the sun. The wild arrowroot, known in the bazaars as "Palooa," grows abundantly in the jungles of the district. It is collected in the cold season by the Sahars, the tubers pounded and washed, and the sediment dried in the sun. By these people it is eaten and sold for the manufacture of what is called "Abheer" in the Jumbul pore, and, to a less degree, also in the Cuttuck district; the wild arrowroot is made into cakes, or boiled with milk, and thus used as an article of food.

Under the name of "Beychundee" a starchy product is prepared by the Gonds and sold in the bazaars of Jubbulpore. It is not an arrowroot, but bears some resemblanee to it when pounded. It is obtained from the stem of some wild jungle plant.

In Akyab a kind of arrowroot, called by the natives Rembowah, is prepared from a root called Pemban-oo, obtainable in large quantities, and sold at four rupees the maund. It may probably be Penda-loo (*Batatas edulis*), but is most likely to be Pen-bwa (*Maranta*). Starch is obtained in Travancore, from the round yam (called Chana in Cochin), *Arum Rumphii*, or *Amorphophallus campanulatus*. Imitation sago is made, in Mergui, from *Tacca pinnatifida*.

In Ceylon there was found great difficulty, at first, in inducing the people of the villages to plant the cassava and arrowroot. While only 50lbs. of tapioca were made by the natives in 1852, 66,000lbs. were supplied in 1856; so, with arrowroot, the production increased from 50lbs., in 1852, to 6,900lbs., in 1856; and now, instead of importing arrowroot from Southern India, exports are made from Ceylon.

In India a fecula is obtained from the young roots of the Palmyra palm (*Borassus flabelliformis*, Linn.), which serves as food to the natives. This palm is very extended over India, and is one of the most interesting trees for study, from the numerous products obtained from it. At Goa they prepare a farina and fecula from the wild palm. Sago is obtained from *Caryota urens*, in Mysore, and pearl sago, tapioca, and tapioca flour, were sent to the Paris and other Exhibitions from Mysore, Singapore, and Penang.

The trunk of the Japan fern-palm (*Cycas revoluta*, Thunberg) is rich in sago-like starch.

In a paper which I read before the Society in 1861, "On the Trade and Commerce of the Eastern Archipelago" (vol. ix. p. 451), I gave some details on the manufacture and commerce of Sago, which may be appropriately quoted here:—

"Singapore is at present the chief place of manufacture and the principal mart for granulated sago and 'sago flour,' as it is termed in commerce, but which is, in fact, the fecula, or ungranulated starch. The granulated fecula, or sago, of a dirty brown colour, used to be exported from the Archipelago in small quantities, but when the trade in Europe was thrown open, in 1814, the Chinese of Malacca began to prepare a superior starch, known in commerce under the name of pearl sago.

"There are four or five species of palms which yield sago; those most cultivated are, however, the *Sagus konigii* and the *Sagus lævis*. These palms are found in every part of the Malayan Archipelago and Philippines as far as Mindanao, wherever there is a genial soil for them, and this consists of a marsh or bog, composed of decayed vegetables, near the sea. They are most abundant in the eastern parts of the Malay Archipelago, at the Moluccas and neighbouring islands, with New Guinea and Borneo, and in the Phillipines at Mindanao. In all these sago is more or less the bread of the inhabitants. These palms propagate themselves by lateral shoots as well as by seed, and they die after producing fruit. From the first of these properties it follows that a sago plantation once formed is perpetual.

"The sago tree, when cut down and the top severed from it, is a cylinder about 20 inches in diameter, and from 15 to 20 feet in height. The contents would, therefore, be nearly 26 bushels, and, allowing one-half for woody fibre, there will remain 13 bushels of starch, or say 700lbs.

"It may give some idea of the enormous rate of this produce, if it be considered that three trees yield more food-matter than an acre of wheat, and six times more than an acre of potatoes. It is far from being either so palatable or nutritous as it is prolific, and is never preferred, even where it is most abundant, to rice.

"All the raw sago manufactured at Singapore is brought from islands to the eastward, principally from the northwest coast of Borneo and the north-eastern of Sumatra, with its adjacent isles, from Siak to Indragari, but a considerable portion comes from places more than 1,000 miles distant."

This article is very easily prepared for exportation in its raw state; the tree is cut down, then the pith or cellular tissue is taken out and made up into bundles. In this form some 20,000 tons are annually imported at Singapore, where it is prepared by the Chinese, who clear the meal or farina from the fibres of the pith, or cellular tissue, when the flour is either made up for exportation in its natural state, or is granulated into pearl sago.

The imports of sago have steadily increased in England since the abolition of the duty which was formerly levied.

In 1830 the import and consumption of sago in the United Kingdom was only 3,000 cwt.; in 1841 it was 52,000 cwt.; in 1850, 90,000 cwt.; in 1860, 179,825 cwt.; in 1870 the aggregate of sago and tapioca received from Singapore was 344,000 cwts., of the value of £283,541.

In Singapore tapioca manufacture has been very successful, but the crop is said to entirely exhaust the soil in five years.

From Penang as much as 10,000 cwt. of tapioca and arrowroot is shipped annually to Great Britain and the United States.

The following table gives the British imports of sago and tapioco from Singapore in the last nine years:—

Imports from Singapore.

	Sago.		Tapioca.	
	Cwts.	Value.	Cwts.	Value.
1863..	123,870	£100,129	27,792	£30,107
1864..	111,423	100,675	27.530	36,268
1865..	106,409	89,162	18,191	27,509
1866..	151,788	126,384	14,346	25,695
1867..	142.844	119,295	15,660	34,007
1868..	241,860	208.428	38,409	58.354
1869..	268,978	209,812	48,418	54 858
1870..	268,666	208,982	75,524	74 559
1871..	245,123	197,381	———	———

In the colony of Labuan the sago traders have largely increased their business, owing to the Sultan of Borneo having removed some of the obstructions to the transit of sago in the neighbouring rivers, and it is not improbable that this island may yet become the centre of the sago manufacture of the Eastern Archipelago. In 1867 sago was imported into Labuan of the value of £9,811; in the following year the trade increased one hundred per cent., the value of the imported sago being £19,841, and the process of manufacture added £8,764 more to the value of the sago.

In Celebes all the inhabitants feed upon sago of a very coarse quality, which may be said to grow spontaneously, affording abundance of subsistence to the inhabitants. The sago plantations are situated in the valleys between the mountains, in swampy ground. There are several kinds of sago-trees, some of which will not produce any useful fecula or starch for the first 16 years. It is collected from trees of 8 years up to 32 or 35 years of age, after which the tree becomes perfectly hollow, and rots away from the top downwards. A sago-tree of 10 years growth will be about 27 feet high, and from 5 to 8 feet girth at the bottom, and is continually yielding its crop. When the substance of the edible sago is 3 to 5 inches thick they cut it, and this will be in two or three months, according to the nature of the soil, and the oftener it is cut the faster it grows.

Australian Arrowroots, etc.

Attention has of late years been much directed to the production of arrowroot in several of the Australian colonies, facilities having been afforded by the culture and distribution of the several plants from the excellent botanic gardens at Melbourne, Sydney, and Brisbane.

Canna Achras (Gillies) native of Mendoza, is one of the few extra-tropical Cannas eligible for arrowroot cultivation.

C. glauca (Lin.), and *C. coccinea* (Roscoe), yield, with some other Cannas, the particular arrowroot called *tous les mois*. *C. flaccida* (Roscoe) of Carolina is probably also available for arrowroot.

C. edulis (Edwards), the Adeira of Peru, is one of the hardiest of the arrowroot plants, for seeds, even if many years old, will germinate, and are commonly called Indian shot.

This species has been extensively introduced into Australia, and, according to Baron Müller, yields an excellent starch at Melbourne, Western Port, Lake Wellington, Ballarat, and other localities, from plants supplied by the Melbourne Botanic Garden.

The Rev. Mr. Hagenauer, of the Gipps Land Aboriginal Mission station, obtained 220lbs. of arrowroot from one-eighth of an acre of this Canna. The gathering of the roots in Australia is effected about April. The plants can be set in ordinary ploughed land. Captain James Hall, of Hastings, also prepared starch largely from this root. The starch grains, it is well-known, are remarkably large.

Maranta nobilis appears to be the species chiefly cultivated for arrowroot in New South Wales. There were seven exhibitors of arrowroot from it at Paris in 1867: Mr. E. S. Hill, Mr. D. L. Waugh, Mr. John Higgins, Mr. E. W. Rudder, Mr. W. C. Hetherington, Melville, Mr. G. T. Lodis, Wiley Flat, near Singleton, and Mr. H. Moss, Shoalhaven; the last three received bronze medals for their products.

In 1870 there were 84 acres of land under arrowroot in New South Wales, from which 13,567 cwt. of arrowroot was obtained, being 18,251 cwt. less than was made in the previous year from only 31 acres of land.

From Queensland, 26,368 lb. of arrowroot, valued at £548, were exported in 1869, the first shipment of a few packages having been made in 1860.

Good arrowroot used to be made in Norfolk Island, while it was a convict settlement, but I am not aware whether the production is maintained since the Pitcairn Islanders have been transferred there.

Arrowroot is made from *Zamia angustifolia* in the Bahamas, &c.

Under the local name of Coonti an arrowroot is prepared in Florida from the fecula of *Zamia integrifolia*. A fecula was also formerly prepared in Florida by the Indians from the saw palmetto *Chamœrops serrulata*.

Arrowroot prepared in Queensland from *Encephalartus (Zamia) spiralis* was shown in 1872 at the London Exhibition.

At the Paris Exhibition, in 1867, starch made from the seed of the bean tree, or Moreton bay chestnut (*Castanеospermum Australe*), was shown by the New South Wales Commission and Mr. T. Bawden, of Grafton, Clarence River district, which was highly commended. The seeds are said to be abundant, and the manufacture inexpensive. This large tree is found in abundance in the bushes from the Macleay River south to Cape York to the north. On examination under the microscope of the samples I obtained there, I feel convinced that this starch is not from a leguminous seed at all, but is merely a fraudulent substitution of cassava starch under a new name.

Mr. C. Moore, the colonial botanist, also exhibited it, and received a bronze medal from the Paris jury for this new starch. I should like to have the point cleared up as to there being any *bona fide* production of this leguminous starch in the colony.

Starches of the Pacific Islands.

A considerable production and commerce is carried on in various feculas in many of the Pacific Islands. One or two species of *Arums* especially are utilised. *Arum macrorhizon*, Linn., grows wild in Tahiti, and the rhizomes are occasionally eaten, but the *Arum esculentum*, Linn., the *Colocasia esculenta* of Ray, known under the name of *Taro*, is that most largely cultivated and esteemed for its starch, which is an article of food of prime necessity. The natives enumerate no less than thirteen varieties. The rhizomes range in weight from two to four pounds, but there is great variation, some varieties producing very small roots and others very large. They contain much fecula combined with a bitter principle, which is dissipated by heat. In preparing the starch, care has to be taken not to rub the pulp on the sieve with the hand, or a blistering effect will be produced. The yield of starch is as much as 33 per cent.

Another plant, largely cultivated, is the *Tacca pinnatifida*, Forster, which is indigenous to the sandy shores of the South Sea Islands, and is known in Oceanea, but especially in Tahiti, under the native name of *Pia*. This plant is, however, now widely diffused. It is met with in China and Cochin China, according to Loureiro. It is cultivated in the Moluccas, Arracan, and other parts of India, and at Zanzibar. It is found in large quantities in Cook's Archipelago, the Hervey Islands, at Raiatea, Huahine, Bora-Bora, Maupiti, the Hawaiian Islands, the Samoas, Tonga, the Feejee Islands, &c. The tubercles have much resemblance to the potato, but unlike that root the fecula is found chiefly in the centre and not towards the exterior. The proportion of starch yielded is 30½ per cent.

There is a large consumption of this starch in Tahiti, especially for children and invalids, and a considerable export of it under the name of arrowroot. The principal part of that which enters into commerce is made in the islands of the adjoining archipelago, Raiatea, Huahine, Bora-Bora, and Maupiti, where it can be purchased for 3d. to 3½d. per lb. In the Hervey islands it is sold at 2d.; and Tubuai and Raratonga produce it even cheaper. At Tahiti it retails, or did a few years ago, at 4½d. to 5d. per lb.

From it the main supply of the Feejee arrowroot is prepared. The Tacca starch is much valued in medicine, and particularly esteemed in cases of dysentery and diarrhœa. Its characteristics are readily recognised under the microscope. A Tacca occurring on the Sandwich Islands yields a large quantity of the so-called arrowroot exported from there. Other species, including those of *Ataccia* (*Tacca*) *integrifolia*, occur in India, Madagascar, Guinea, and Guiana, all deserving tests in reference to their value as starch plants.

Starch is made from several species of yam (*Dioscorea sativa* and *bulbifera*), but it is difficult to extract, owing to the ligneous character of the roots, which require to be soaked in water for two days before rasping, and the bitter principle has to be removed by washing and torrefication.

A few other starches are obtained. The cassava or manioc is never sold or cultivated, although its starch used to form a common aliment mixed with that of the *Tacca*. From the bread fruit (*Artocarpus incisa*) about 17 per cent. of fecula is obtained.

African Arrowroots.

On many parts of the West African coast arrowroot and cassava are grown and prepared. The Canary Islands, Liberia, Lagos, Sierra Leone, and other districts produce it, but not in any quantity for shipment.

The Cape Colony and Natal—especially the latter—have given much attention to arrowroot production. *Maranta arundinacea* is the species grown. I have not the recent statistics of the acreage under arrowroot in Natal, but in 1864, from 226 acres, the quantity obtained was 2,347 cwt. It is chiefly in the counties of Durban, Victoria, and Tugela that the cultivation centres, but the quantity varies considerably, for 61 acres in Tugela, yielded 1,220 cwts.; 66 acres in Victoria, 639 cwts.; and 98 acres in Durban, 488 cwts. In 1866, 2,835 cwts. were produced.

The prices ruling in the colonial market in 1867 were 30s. to 40s. per cwt., but it realised 67s. 6d. in some instances. The freight to London was 45s. per ton. The following figures will show the progress made in arrowroot production in this colony. There were nine exhibitors of arrowroot from Natal at the Paris Exhibition in 1867.

Natal Exports of Arrowroot.

	Cwts.	Value £
1856	818	1,827
1857	1,397	3,136
1858	2,218	5,464
1859	6,366	13,336
1860	3,679	6,680
1861	2,436	4,685
1862	983	1,547
1863	1,437	2,801
1864	1,015	2,848
1865	2,150	3,943
1866	2,804	5,744
1867	4,305	9,139
1868	3,201	5,501
1869	3,042	4,684
1870	3,323	4,696

The direct imports into the United Kingdom of African arrowroot have been as follows:—

	South Africa generally.	Natal alone.	
	cwts.	cwts.	Value
1863	1,136	913	£3,109
1864	1,534	1,414	4,690
1865	1,250	1,231	3,877
1866	2,865	2,832	7,708
1867	1,279	1,193	2,827
1868	3,873	3,571	8,049
1869	3,471	3,447	6,031
1870	3,108	2,974	5,551

I was a little puzzled for some time at the incidental mention of Madagascar arrowroot in this country, as it is scarcely an article of commerce, but I have traced out that 7 cwt., valued at 35s. were sent from the east coast of Madagascar to the Mauritius in 1868, and

552 cwts. 2 qs. 17 lbs. of starch of other kinds, valued at £286. *Canna indica*, a native of India, has been introduced and naturalised in the Mauritius, and the *Maranta arundinacea* is also grown there, exhibitors of this arrowroot having sent samples to the Paris Exhibition in 1867.

I have thus skimmed over the surface of this wide and interesting field of inquiry, contributing my mite towards the general fund of information which is so useful on commercial topics, and I trust it will lead to some discussion and added information on the character, quality, and uses of the various starches touched upon.

DISCUSSION.

Mr. Edwin Lawrence said no doubt many persons would be surprised at finding how many different kinds of starch existed. He had observed a smile when it was said that thin starch made from manioc would be very similar to that made from diseased potatoes, but he had recently seen it stated that the whole population of Ireland at the time of the famine might have been fed with starch prepared from the diseased potatoes, and that it would differ very little, if at all, from that prepared from healthy tubers. There was a considerable agitation going on with reference to the employment of starch in the form of glucose in brewing, but he believed it was prohibited at present by the Excise, though it was largely used for this purpose in Germany.

Mr. W. Smith said the conversion of starch into glucose was one of the simplest and readiest processes known to chemistry, and it was not quite the fact that sugar produced from starch was prohibited in brewing and distilling. In truth, the government received about £4 per ton on the manufacture of glucose and about £7 per ton for its use in brewing operations. The scientific principle upon which the manufacture of glucose was carried on was very simple, and the process most ingenious, a ton of sago being converted into almost an equal weight of sugar in a few seconds. Some remark had been made on the largely increased importation of sago of late years, but when it was found that almost an equal weight of sugar could be obtained from it, that might afford an explanation. The use of glucose was being rapidly introduced for distilling as well as for brewing, and was found to be economical.

The Chairman said he hardly thought the increased quantity of sago imported could be accounted for on the supposition that it was made into glucose, since that was principally made in Germany from potato starch. For some years there was great difficulty in inducing the Excise authorities to sanction the use of starch for brewing and distilling, but the difficulty had been got over by imposing the same charge as on the quantity of malt which would produce a similar amount of sugar.

Mr. Botly remarked that it was matter for congratulation to find that Natal and other colonies produced an article of such great commercial value. He should like to know, however, if any reason could be assigned for the diminution in the amount of arrowroot produced per acre in Australia one year, as mentioned in the paper.

Mr. Simmonds said the crop was a very variable one in all countries, depending very much for its success on the season.

Mr. McMinn said the chemical constituents of the various starches had not been touched upon. There were known to be great differences in the characteristics of sago, tapioca, arrowroot, and other edible starches, and he should like to know whether these differences extended to the chemical constitution of the starches themselves, or whether they were merely derived from the plants yielding them.

Mr. W. Smith observed that this question might be answered by a reference to some experiments undertaken at the request of the Excise, which showed that the starch was the same in all specimens, the different configuration being due to the plants from which they were obtained.

The Secretary said that there had recently come under his own observation an application to the Board of Inland Revenue for permission to use, not glucose, but starch itself, in the process of brewing, which had been refused on account of the difficulty in ascertaining the proper charge to be made for revenue purposes, and especially with regard to the drawback to be allowed on exportation. This starch, maize starch, was now being extensively used in France, Belgium, and Germany for brewing purposes, and with success, the starch in the process of brewing becoming converted into glucose. The English brewers were, by the prohibition of its use, thus placed at a disadvantage in competing with their foreign competitors. The following was received from the Treasury in reply to the application:—

Treasury Chambers, 23rd March, 1872.

Gentlemen,—In reply to your application, in which you propose an alteration of the British Revenue Law for the purpose of allowing brewers to use amidine or maize starch made by you under a patent, and request that a trial may be allowed to be made by some qualified brewer, on payment of the duty equivalent to that on malt, and under the supervision of the proper authorities, I am directed by the Lords Commissioners of Her Majesty's Treasury to state that your proposal, in fact, amounts to a claim for the admission of starch generally as a material for brewing, as it would be impossible to distinguish the patent maize starch from any other starch; and I am to state that, for reasons connected with the revenue, and also because there would be peculiar difficulty in securing the duty on such an article as starch, my lords are not prepared to take action with a view to your request being complied with.—I am, gentlemen, your obedient servant,

Charles W. Stronge.

Messrs. Leconte, Dupond Fils,
Estaires (Nord), Lille, France.

Mr. Trewby thought the paper would be rendered more valuable if a table were added giving the relative amount of nutriment contained in the different kinds of starches.

The Chairman said it was rather curious to observe how the cultivation of the *Maranta arundinacea*, as a starch-producing plant, was spreading. It was found originally in North America, then it went to the West Indies, from whence came the finest specimens of arrowroot, then to Brazil, Natal, Australia, and the Mauritius, so that it was gradually taking the place of other sources of supply. At the present time a very excellent *Maranta* came from Natal. With reference to the remarks which had been made about the Irish being fed by potato starch, it must be borne in mind that starch was not adapted for food by itself. The object of food was twofold—the renewal of the various tissues, and the maintenance of animal heat; and while starch filled the latter function, it lacked that azotised principle which was essential to the proper nutrition and support of the tissues. Again, it was by no means the case that all starches were alike, regarding them simply as food; for one kind appeared more suitable and much more easily digested than another. Very often the stomach of an invalid would digest *Maranta* starch, when other descriptions would be rejected, and medical men were by no means agreed as to the cause of this difference. It might be that the integument of one variety was more difficult of solution than another, but there was no doubt of the fact being as he had stated. He had found a good deal of cellular matter mixed with the starches from some of the colonies, probably owing to imperfect washing, showing a marked contrast to West Indian arrowroot, which was remarkably clean and beautiful. Mr. Simmonds had alluded, in passing, to the microscopic part of the question, and there were on the table drawings of the different starches, showing how much they differed in appearance from one another, though, to the naked eye, they appeared very similar, and probably even the eye of an experienced dealer would be deceived. The microscope, however, speedily detected the difference, and a practised observer could readily assign the source from whence the starch was obtained. In examining a sample of starch in this way he always liked to compare it with the granules of the same starch in the meal, and, if possible, also *in situ.* An acquaintance with the appearance of starch under the microscope was of great value at the present time, for it often appeared where it was not suspected, and sometimes where it was not desired. As an instance of this he was informed, in a letter from one of the public analysts, that rice starch was frequently mixed with flour, and that when this was used for making bread, it would take up from 16 to 20 per cent. more water than it would otherwise. It was only the microscope which could enable one to test the purity of flour in this respect.

Mr. Simmonds, in reply, said he believed the greater portion of the increased supply of sago went to feed pigs, and he could not agree with Mr. Smith that much of it was converted into glucose, because the latter article could be imported from the Continent at a cheaper rate than it could be made in England. A long article on this subject appeared in the *Journal of Applied Science* two months ago, and to that he begged leave to refer for full details. There was no doubt, however, that the use of starch for brewing and distilling purposes was rapidly extending, and if he had not alluded to it in the paper, it was because such matters did not come within its scope. In fact, an account of the various uses to which starch was applied, with the processes by which beautiful clear syrups were obtained from potatoe starch, would form admirable matter for a special paper. With reference to the suggestion that a table of the relative nutritive qualities of the different varieties of starch should be added, it would be very difficult to prepare one, simply because competent authorities were by no means agreed on the matter. Dr. Shiers had made some analyses on the subject, but they were confined to colonial products. Many really splendid meals were not imported into England to any great extent, the supply being practically confined to a few kinds, such as cassa, sago, and arrowroot. The microscopic portion of the subject he had been compelled to omit, as it would have occupied too much time to go into, but every one who was in the habit of using a microscope was aware how interesting and important were the results obtained by it in this field of inquiry, and no one was more entitled to speak on that point than his friend in the chair.

COMMITTEE ON THE MEANS OF PROTECTING THE METROPOLIS AGAINST CONFLAGRATION.

The continuation of Mr. Swanton's evidence (of which part has already appeared), as referring to a different portion of the inquiry, will be published hereafter. The following evidence was given by Mr. J. QUICK, C.E., engineer to the Southwark and Vauxhall and the Grand Junction Water Companies, before the Committee.

Q.—You have been examined, on account of your long experience and position as a water engineer, before various Royal Commissions and Parliamentary committees on the subject of the supply of water to the metropolis. You gave full and particular information in 1850 to the General Board of Health. On that occasion you gave evidence to the effect that about one hundred thousand pounds per annum was to be saved by the consolidation of the companies, and by unity of a responsible and competent administration?

A.—Yes, I did.

Q.—Are you of opinion, from your experience and observation of the several companies, that the like gains from such consolidation might be obtained now?

A.—Certainly. I believe the gains from consolidation are increased with the extended works, and that certainly the gains from consolidation may be safely taken in round numbers at £100,000 per annum when the constant supply is given and the consolidation of the works made perfect.

Q.—It then appeared, from various gaugings of the run of water, that nearly three-fifths of the water pumped into the metropolis ran to waste under the intermittent system? What do you believe is the proportionate waste at the present time?

A.—Since then the water fittings in the better class of property have been very much improved. I believe, of the whole metropolis, the waste of water is now at least one-third; in the poorer districts I believe it is about one-half.

Q.—That is to say, the waste in the metropolis is about one-third of about one hundred millions of gallons pumped in daily?

A.—Yes.

Q.—What is the average supply per head of the population?

A.—About thirty-three gallons per head.

Q.—It is stated that at Manchester, where the supply of water for manufacturing purposes is considerable, that the supply, under the constant system, is about twenty gallons per head; and at Berlin, where the supply for other than domestic purposes is also considerable, that the average consumption is little above eighteen gallons per head. To what extent, with adequate administrative power, do you think the supply might be brought under the constant system in the metropolis?

A.—My belief is, that the great waste might in a measure be saved, or the supply brought down to the Manchester proportion of twenty gallons per head.

Q.—The companies not having succeeded separately in staying the waste, will not the intervention of some stronger authority be necessary to effect it?

A.—There is no doubt of that. Some public authority will certainly be necessary, and a public authority will be more readily obeyed than a company.

Q.—It is then your opinion that it is impracticable to carry out the constant system of supply by the agency of the trading companies acting separately, even with the best will to do so. That is say, that it is impracticable for the eight companies to effect separately and independently the economy that may be obtained by unity?

A.—Yes, that is certainly so?

Q.—It has been stated that to obtain a constant supply, and to prevent even augmented waste, considerable alterations must be made in the water fittings and appliances, especially in the poorer class of houses. Do you not conceive that, if the saving to be obtained by consolidation, that is to say, £100,000 per annum, be capitalised, it would suffice to defray the expenses of the change?

A.—No doubt; and it would obviate the difficulties in making the necessary alterations now experienced by the owners of the poorest class of property, many of whom have very short interests in the premises, and to whom the immediate payments of the full amount of the outlay required might operate as a confiscation of their remainder rents. It may be made a very great and just measure of relief.

Q.—For the purpose of the prevention of conflagrations in the metropolis, the chief object of the inquiries of the committee, do you concur in the general statement of Mr. Reynolds, the manager of the London and Southwark Insurance Company, as to the need of the connection of the water supply of the metropolis under one system for the purpose, and that a system of constant supply at high pressure?

A.—Yes, certainly; for the sake of efficiency for that purpose it ought to be so. I have myself represented the necessity of having junctions made between the trunk mains of each company, so that they might be opened in case of large conflagrations.

Q.—Would it not facilitate the extension of protective arrangements of pipes over warehouses and private premises where considerable quantities of inflammable property is kept, if the supplies were put on a public footing?

A.—Yes, very much so, especially on one large class of property—the wharf property. At present, along the water-side warehouses, there are only very small mains, three-inch pipes, for small domestic supplies only; just for hand or face washing in the offices. This is wholly inadequate for large fires.

Q.—Great opposition is at present made to the proposed plan of enlarged reservoirs at Thames Ditton. Under a consolidation of the companies, might not that measure be avoided?

A.—Yes, certainly it might.

Q.—The plan of the General Board of Health, in 1850. was (besides compensation to the engineering, legal, and all the other officers of the companies) to give as compensation to the shareholders of the companies security to them for the payment of their existing dividends, conferring an additional value to their shares, which would have cost the public nothing, whilst it would have enabled the consumers to have improved and additional service without additional rates. What do you now say to the like proposal?

A.—Speaking for myself, my opinion is that that is the least that can in justice be offered to them. It is to be remembered that for a long time the shareholders were without any dividends whatsoever. Even ten per cent., instead of an average of seven, could hardly be said to be high payment. The increased value of their shares obtainable by additional security is surely as little as they ought to take (and they ought to have credit for taking it) for a compulsory purchase, which will be largely for the public advantage.

Q.—If those terms had then been accepted, would not a considerable saving been effected in the expenses subsequently incurred in separate works, which would have been rendered unnecessary?

A.—Undoubtedly.

Q.—If a consolidation is not now effected, will not considerable unnecessary expense in the separate system be maintained, and further largely augmented expense for any separate works on the system of constant supply be incurred?

A.—Undoubtedly; a very great expense.

Q.—You have been engineer to the Southwark and Vauxhall Co. for upwards of 30 years, and to the Grand Junction Co. for upwards of 20?

A.—Yes.

Q.—With respect to your proposal that the existing dividends of the companies should be secured to them, are you in a position to tell us approximately what the dividends of these companies are at present?

A.—The Southwark and Vauxhall 5½ per cent., and the Grand Junction 7½ per cent. See return last year to Board of Trade.

Q.—Was not the plan proposed by Mr. Shaw-Lefevre in the Metropolis Water Bill of 1871 substantially the same as the one you expressed your assent to?

A.—I think not; I never saw that Bill.

Q.—The saving of £100,000, which you assume would be the result of consolidation, refers to the whole of the companies.

A.—Yes.

Q.—If that sum were capitalised, would it not go very far towards paying the cost of effecting the junctions, providing hydrants, and making the necessary alterations to the fittings in the poorer districts to receive the constant supply?

A.—It would go a long way towards it. The hydrants alone would cost between £400,000 and £500,000. Then there would be certain alterations to the trunk mains to divide the high and low level districts, and a large portion of the saving ought to go towards making the necessary alterations in the poor districts. It will be impossible for the poor to find the capital necessary to alter the fittings to prevent waste, or the owners or occupiers of property of that class. There are thousands of houses held by widows and poor people, having merely the residue of a lease with a few years to run. To call upon them to lay out £3 or £5 per house would amount to a confiscation of their property. In Bermondsey particularly there are great numbers of owners of property of that class.

Q.—Would it be necessary to make that outlay immediately?

A.—It will be absolutely necessary before they can have a constant service, because if waste went on in districts of that kind, the upper part of London would never get any supply at all. Otherwise it would involve a separate set of trunk mains for the high districts, which would involve an outlay of some millions.

Q.—Can you give any idea of the total expenditure required for new fittings in order to carry out the constant supply system?

A.—Between three and four millions sterling.

Q.—When you stated that the expense required to put the house fittings in order to receive the constant supply might amount to that sum in the metropolis, was not that on the supposition that every house would require a new adaptation of fittings, and that each individual owner or occupier would have to carry out the work himself by his separate tradesman or plumber?

A.—Yes, that was the supposition.

Q.—But if the work were done by a public authority, under a common contract for all the work required, say within a district, by private improvement rates, under the Public Health Act, would not the expense be considerably reduced?

A.—Very much indeed.

Q.—How much do you suppose?

A.—From one-third to one-half?

Q.—Your answer was given on the hypothesis that alterations were required for every house, and not upon actual inquiry?

A.—Yes.

Q.—But actual inquiry may greatly reduce the proportions that will require adaptation?

A.—Yes.

Q.—As the work to be done, besides being for the individual benefit, is also for the common or public benefit, would not there be an important equity in having it done from a common fund?

A.—Certainly, particularly for the smaller class of house property in the poorer districts, because, as I have stated, so much of that property is in the hands of persons, lessees who have only a short interest in the premises, and on whom the immediate outlay would operate often to a confiscation of their remainder rents. This is, indeed, the great source of the opposition to the constant supply.

Q.—Under a common contract, by how much do you conceive the cost of the new hydrants required for protection against fire might be reduced?

A.—At least by 20 per cent., or a sum equivalent to £100,000.

Q.—If the private fittings were done by common contract, might not the saving effected enable the new system of hydrants and other works for the prevention of fire to be brought within the economies obtainable by a consolidation of the works under a public authority—namely, £100,000 per annum, or, capitalised, two millions and a-half?

A.—I consider that there is every presumption that it might be so with the addition of the new supplies to at least 10,000 new houses yearly, producing a rental of £20,000 per annum.

Q.—In what time do you conceive the junctions of the trunk mains of the eight companies might, under a public authority, be made for available protection, as required, against conflagrations?

A.—The works are of a sort that are not kept in store, but I believe that the junctions might be completed in from three to six months.

Q.—In what time might the requisite hydrants be provided?

A.—Perhaps in about the same time as for the nine hundred miles of main which are now under constant high pressure. This is about one-third of the whole; the rest could be put on as the constant supply became general.

Q.—You have, no doubt, seen the report of the committee of the Metropolitan Board of Works, and the estimate prepared by Mr. Stephenson of the cost of applying fittings according to the company's regulations?

A.—Mr. Stephenson seemed to think it would be necessary to alter the whole of the fittings to make them conform to the regulations as laid down. My idea would be to leave all existing fittings which are efficient. Under Mr. Stephenson's plan of taking away all existing fittings which are not in strict conformity with the regulations, the expense would be no doubt nearly £7,000,000 or £8,000,000.

Q.—Have you any means of checking those figures?

A.—If it was necessary to carry out the regulations as printed, no doubt the estimate would be perfectly correct, but it is subject to the deduction that some of the existing fittings may be approved.

Q.—You are aware that the change from an intermittent to a constant supply has been made in Nottingham, Manchester, Norwich, and other places?

A.—Yes.

Q.—Are you aware that the expense in Manchester was much less in proportion than you have named, and would not a similar expenditure suffice for the metropolis?

A.—No; for this reason: that the water-closets are the most expensive part of the alterations, and they were quite the exception in Manchester. There are whole districts where you do not find a single water-closet; they use the earth system. In London there is a water-closet of some kind to the very poorest houses. Some of them are of a very rough kind, consisting merely of what is called a "Serpent" pipe, and if there were a constant supply the water would be running away continually.

Q.—Were there not large districts in Manchester where the houses were provided with water closets, and did not the expenditure there justify the estimate?

A.—Manchester is altogether very different to London. In Norwich, judging from the evidence given by Mr. Aris, I should think the change was as expensive as it would be in London. There they had to take out all the fittings, from time to time, and the cost varied from £7 or £8 up to £20, and even £30 a-house.

Q.—Has this estimate of the cost been made on an actual house-to-house survey in any district?

A.—Mr. Stephenson made a survey for the Metropolitan Board. I only judge by what I know it would cost in the Bermondsey district. There it would cost £3 or £4 for the lowest class of houses. In the Grand Junction district it would cost from £10 to £14 or £15 per house.

Q.—Are you not aware that new houses have been supplied *de novo* with water closets, soil-pans, and fittings, and everything necessary to the water supply at a much lower rate than that; at an average cost of £4 or £5?

A.—That must be a very low class of property. I am taking the whole of London. It would cost at least as much as that per house in the poorest part of London. In the first place you must have a regulator to the closet, to prevent waste; and then there is the pipe to that, and the fittings. At present you do not find a single appliance to turn off the water, but simply a common piece of iron tubing.

Q.—Would not the constant pressure of the water in houses tend to prevent the chances of conflagration?

A.—No doubt, if you could draw water at any time.

Q.—With a constant supply and proper fittings might not the amount of water used be considerably reduced?

A.—No doubt, with very close supervision, and everything in proper order, the amount used might be reduced from 34 to 20 gallons per house.

Q.—Would not superior fittings do that at once?

A.—Yes, with proper waste-preventive apparatus.

(*To be continued.*)

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

The fourth meeting of the Committee on Scientific Inventions and New Discoveries was held on 20th March, at the Royal Commission Offices, Gore-lodge. The following members attended the meeting:—Mr. Charles B. Vignoles, F.R.S., in the chair, Mr. F. A. Abel, F.R.S., Capt. Colomb, R.N., Major W. Crossman, R.E., Major-General Harness, C.B., Mr. John Hick, M.P., Dr. David S. Price, Professor Roscoe, Mr. C. W. Siemens, D.C.L., F.R.S., Mr. T. Sopwith, M.A., F.R.S., Lieut.-Col. A. Strange, F.R.S., and Sir C. Wheatstone, D.C.L., F.R.S. The Committee examined the objects already delivered, and rejected those that, in their opinion, were unworthy of admission in the class, which consists of objects the excellence and novelty of which are so great as to render it undesirable that their introduction to the public should be delayed until the proper year for the exhibition of their class of manufacture in the Industrial Division.

The School of Popular Cookery is situate on the ground floor, between the east galleries and the colonial annexe.

1. The object is to give illustrations of cooking food in the best, simplest, and cheapest ways, suitable for persons with incomes from £50 to £500 a year. The utensils used are those which might be found in a house of £40 a year rental.

2. The lecture room will only hold about 120 people, of which number not more than 70 can be accommodated with reserved seats.

3. The charge for admission on Mondays, Tuesdays, and Saturdays, will be sixpence; on Wednesdays, Thursdays, and Fridays, one shilling. Reserved seats, extra on all days, sixpence. Admission to the front row (which accommodates only twelve persons), with the privilege of tasting while the food is being cooked, one shilling and sixpence each. Verbal explanations of the processes will be given by Mr. Buckmaster.

4. Tickets must be purchased beforehand, and may be procured of all the attendants in the Exhibition.

5. While the tasting room is not to be regarded as a general refreshment room, arrangements will be made to allow a limited number of persons, who register their names each day, to taste the practical illustrations of the lessons in cooking, at 2 o'clock and 6 o'clock. Tickets of admission must be obtained beforehand, and may be obtained of all the attendants.

6. Popular dishes can be had at all times in the ordinary refreshment rooms conducted by Messrs. Spiers and Pond, at the south end of the Exhibition.

7. The subject of the illustrations given each hour in each day will be duly advertised.

Messrs. Novello, Ewer, and Co., having made the necessary arrangements with Her Majesty's Commissioners, state that—

1. With a view to an adequate exposition of the art of music, and generally to its advancement in this country,

daily orchestral concerts will be given in the Royal Albert Hall during the period of the Exhibition, *i.e.*, from 14th April to 31st October, inclusive. The orchestra will consist of at least fifty performers, chosen with special care from the best available sources, and including some of the most esteemed London professors, as well as instrumentalists of high repute from the provinces and abroad.

2. The performances will be limited to music of a high class. As a rule, each programme will contain a symphony or concerto, two overtures, and a selection of solo vocal music. It is proposed to vary this order on Wednesdays by means of recitals of operas, and other works exceptional in their interest. The production of music unknown or unfamiliar in England, will be kept steadily in view.

3. The programmes will include examples of all schools of orchestral music which may fairly claim to be considered classical. The works of acknowledged great masters, from Sebastian Bach to Schumann, will of course be largely drawn upon; due attention being also paid to living composers—Gade, Brahams, Liszt, Wagner, &c.

4. With a special view to the encouragement of musical composition in this country, prominence will be given to the works of English composers. The works already sent in at the invitation of Her Majesty's Commissioners, and those which may hereafter be submitted for examination, will, if found worthy, be publicly performed.

5. Advantage will be taken of these concerts to bring forward young English artists, both vocal and instrumental, whose ability may entitle them to the privilege of a public appearance.

6. In order to make the concerts as educational in their results as possible, each programme will contain historical and analytical details of the works to be performed, accompanied by illustrations in music type. The preparation of these annotated programmes has been entrusted to Mr. Joseph Bennett.

7. All the concerts will be conducted by Mr. Barnby.

8. In addition to the orchestral and choral performances, daily recitals will be given upon the grand organ in the Royal Albert Hall by Mr. Best, organist of St. George's Hall, Liverpool, and by Dr. Stainer, organist of St. Paul's Cathedral. The organ will also be used, with the orchestra, in the performance of Handel's concertos, and works of a similar character.

Visitors to the Exhibition will be admitted to the daily concerts without charge. The prices for reserved seats will be, on Mondays, Tuesdays, Thursdays, Fridays, and Saturdays, in the amphitheatre and arena, one shilling; and in the balcony, sixpence. On Wednesdays the charge will be half-a-crown and one shilling respectively. To give visitors an opportunity of attending the concerts frequently, season tickets for reserved seats in the amphitheatre and arena will also be issued: price for one month, 10s. 6d.; for the whole series, £2 2s. A few Saturdays will be excluded from these arrangements, but due notice will be given of any change in the price for reserved reats.

Mr. Shaw writes to request notice of the fact that the estimate quoted by him in his paper, of the trade of Russia with Central Asia, of £5,000,000, was a Russian estimate, and not one for which he could be held responsible. He adds that the figures are correct, and refer to pounds sterling, not Russian roubles. He also states that the route characterised by Sir H. Rawlinson as "inaccessible and impracticable on account of political circumstances" was the Chitral, not the Ladak route.

In the last number of the *Journal*, page 343, at end of letter "Signals at Sea," for F. R. W. Lauchlan read F. H. McLauchlan.

EXHIBITIONS.

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VIENNA EXHIBITION, 1873.

A meeting of her Majesty's Commissioners was held at Marlborough-house, on Saturday last, under the presidency of His Royal Highness the Prince of Wales, K.G. There were also present—H.S.H. Count Gleichen, Captain, R.N.; the Earl Cowper, K.G.; Lord Henry Gordon Lennox, M.P.; Lord Acton; Sir Anthony de Rothschild, Bart.; Sir Richard Wallace, Bart., M.P.; Sir Francis Grant, P.R.A.; Mr Henry Arthur Brassey, M.P.; Mr. Thomas Hawksley, P.I.C.E.; and Mr. Philip Cunliffe Owen, secretary.

We understand that the British exhibitors are well forward with their work, no other country, except Switzerland, being in so advanced a state. There seems to be no doubt that by April 26th the whole arrangement of the British section will be completed. At present there is an immense mass of heavy machinery on its way to Vienna, all the lines of route being nearly crowded. On the whole, there is every reason to expect that this country will be very strongly represented at Vienna.

Her Majesty's Commissioners have been enabled to make special arrangements with the various railway companies for a limited number of cheap through tickets to Vienna and back. These have been issued to the Royal Commission for the use of attendants and workmen, travelling third class, who are in the employment of British exhibitors, and proceeding to Vienna in the execution of services in behalf of their employers. The ticket issued is £4 1s. 9d. for the journey to Vienna and back, and is available during any period of the Exhibition. Upon an application in writing, signed by the firm, guaranteeing that the signatures given are those of the attendants or workmen legitimately entitled to the privileges, and accompanied by a cheque for the amount, the necessary tickets will be forwarded. All delays on the journey, loss of luggage, and other risks must be borne by the exhibitors. Forms of application have been published by the Commissioners, and issued from their London office.

The usual rates are—1st class, from Antwerp to Vienna and back, 215 francs (£8 12s.); from London to Antwerp and back, £1 5s.; in all, £9 17s. 2nd class, from Antwerp to Vienna and back, 162 francs 25 cents (£6 9s. 10d.); from London to Antwerp and back, 15s.; in all, £7 4s. 10d.

On Monday last, by a majority of 397 to 213 votes, the French Assembly rejected a Bill allotting a sum of 100,000 francs for the purpose of sending French workmen to the Vienna Exhibition. The impression seemed to prevail among the members that the International Society had been the result of the visit paid by French workmen to the London Exhibition in 1862. M. Tolain, who was himself one of the delegates to that Exhibition, denied that the International was responsible for much with which it was charged. He spoke in favour of a small money grant being made, to enable French operatives to see the best work of the Austrians, who were becoming formidable rivals. The Minister of Commerce objected, however, principally on the ground of want of funds, but also because of the danger of demoralisation to which the workmen would be liable by the journey.

From New York city will be sent 1,000 volumes of statistics, maps, charts, and photographic views of American scenery and architecture, contributed by the American Geographical Society, and school books, globes, &c., to represent the American system of common school education. The list of exhibitors include over 700 names.

Printing in its various departments will be represented at the Vienna Exhibition by three English firms, viz.:—

J. M. Johnson and Co., M'Clure and Co., and Grant and Co.

The Prince Imperial of Germany will not be able, it is announced, to attend the opening of the exhibition, on account of the state of his health.

NORTHUMBERLAND-HOUSE AND THAMES EMBANKMENT.

A meeting of members of Parliament and ratepayers will be held at Willis's-rooms, on Saturday, 29th March, when the following memorial is to be submitted and discussed, and, if adopted, to be delivered to the Prime Minister:—

"We, the undersigned, feeling strongly the truth and force of your statement made in the House of Commons, in 1866, that 'there is still a lamentable and deplorable state of our whole arrangements with regard to public works—vacillation, uncertainty, costliness, extravagance, meanness, and all the conflicting vices that could be enumerated, are united in our present system—there is a total want of authority to direct and guide,' would respectfully draw your attention to the Charing-cross and Victoria-embankment Approaches Bill, now before Parliament, as showing the necessity of establishing some system of supervision and control over public works planned and undertaken by corporate bodies and public companies, and of thus giving practical effect to the recommendations of the Select Committee of 1869, which we append to this memorial.

"The Charing-cross, &c., Approaches Bill proposes to deal with one side of Trafalgar-square, the finest and most important site in the metropolis, and takes powers to purchase and sweep away Northumberland-house, an ancient historical mansion, with a view to the making of a new street, leading in a direct line from the Nelson column to the Embankment, at or near the Hungerford-bridge Station of the Metropolitan Railway. Under the present system of Parliamentary procedure, the Bill that is to effect this great change in the character and aspect of Trafalgar-square will, unless some special action be taken by Parliament, pass through both Houses as an unopposed Bill. No designs, elevations, or models of the proposed buildings, nor any view of the general effect of the new street, and of the changed aspect of Trafalgar-square, will, in the ordinary course of things, be submitted to the committee. No opportunity will be given to Parliament of considering the general question of the Thames Embankment approaches in connection with any rival plans; and thus this new line of street, in the heart of the metropolis, involving the destruction of Northumberland-house, will be dealt with precisely as if it were an equivalent portion of a new public road or railway in some remote and purely rural district of the country. We respectfully submit, that while we boast of our civilisation, we are thus acting in a way in which it can hardly be supposed that the most barbarous people would deal with the collection of huts or wigwams, which, by courtesy, may be called their capital. So far, then, as relates to the Bill in question, we would urge that further and fuller considerations should be given to it than under our present forms of Parliamentary procedure it is likely to obtain, before the powers sought by the Metropolitan Board are granted.

"But we also hope that your attention having thus been specially drawn to this subject, you may be induced to devise some system of efficient supervision and control in such matters, which, without interfering with the freedom of initiative on the part of any corporate or public body or company, will, nevertheless, afford a sufficient guarantee to the inhabitants of the metropolis and to the public in general that no important public work shall be planned or executed without having been fully and maturely considered by Parliament, and by competent persons appointed for the purpose, in all its aspects, regard being had not only to public utility, but also to appearance and general effect, and without an opportunity of forming a judgment upon it being given to the ratepayers and inhabitants of the metropolis by the public exhibition of plans, designs, elevations, or models of the proposed work. We would also venture to point out that the remarks we have here made with reference to works planned by corporate and public bodies or companies in the metropolis, apply, in our opinion, with no less force to public buildings and works executed at the public cost under the superintendence of her Majesty's Office of Works.

"And if any further proof be needed of the existing want of system and want of co-operation between the different authorities in the matter of metropolitan improvements and public works, of which we complain, it is to be found in the fact that we have had before Parliament in the present session two Bills—one the Admiralty and War-office Bill, promoted by her Majesty's Board of Works, and the other the Charing-cross, &c., Approaches Bill, brought in by the Metropolitan Board of Works—and although these Bills deal with the same district of London, and even with opposite sides of the same street, the authorities in question, under their present constitution, are acting independently of each other, through which the public interests must necessarily suffer."

CABS AND THEIR HISTORY.

As the present International Exhibition is partly devoted to carriage-building, and as the Society has offered prizes for improved cabs, it may not be wholly without interest to attempt to get together some history of our hackney vehicles. No one has yet, so far as we know, tried to do anything of the sort, and it may be of some use to put on record such facts as are worth recording at all before they are forgotten. The generation which saw the first origin of our present cabs is growing old, and if the history is not written now, it can never be written at all. The following is an attempt to collect such materials together:—

It was in the reign of Queen Elizabeth that coaches were first introduced into England. Stow gives us the exact date, 1564, and Taylor, the water-poet, says that—

> "When Queen Elizabeth came to the throne,
> A coach in England then was scarcely known."

Before that time folk rode on horseback, or sometimes in horse litters, an awkward and dangerous contrivance, slung between two horses, one before and one behind. At first the use of coaches was confined to the wealthy, but it was not long before they began to be let out for hire, and so to come within the reach of the middle classes. In Knight's *London* is contained a tolerably full account of the history of hackney-coaches, and indeed we have been able to add but little to the information there given about early means of locomotion in London. The poet above quoted, John Taylor, has left us a good deal that throws light on the subject. He was a waterman, doubtless a better waterman than poet, and he was greatly exercised in mind about the interference of the coaches with his business. His opinion of his own importance may be guessed from the fact that he actually presented a petition to the king, that he would forbid any theatres to be built on the north side of the river, in order that all theatre-goers might be obliged to go to the play by water! With such notions he little relished the idea of having his trade ruined by competition on land, and he called up all his powers of satire to crush the innovators. It was too bad that coaches should increase, until—

> "Almost all the streets are chok'd outright,
> Where men can hardly pass from morn till night,
> Whilst watermen want work."

Nor could verse suffice to express his feelings. He wrote several books in prose, with the avowed object of putting a stop to the noxious invention. But neither the opposition of the watermen nor the jests of the mob prevented the increase of coaches, hackney and others. In spite of the bad roads, they got so numerous that it was worth while to establish "stands" for them. By accident a record has been preserved of the establishment of the first of these. In a letter, dated April 1st, 1634, from Mr. Garrard to Lord Stafford, the following passage occurs:—

"I cannot omit to mention any new thing that comes up amongst us, though never so trivial. Here is one Captain Bailey; he hath been a sea-captain, but now lives on the land, about this city, where he tries experiments. He hath erected, according to his ability, some four hackney-coaches, put his men in livery, and appointed them to stand at the May-pole, in the Strand, giving them instructions at what rates to carry men into several parts of the town, where all day they may be had. Other hackney-men seeing this way, they flocked to the same place, and perform their journeys at the same rate, so that sometimes there is twenty of them together, which disperse up and down, that they and others are to be had anywhere, as watermen are to be had by the water-side. Every body is much pleased with it. For whereas before coaches could not be had but at great rates, now a man may have one much cheaper."

In another letter from the same person, and in the the same year, it is said, "There is a proclamation coming forth about the reformation of hackney-coaches, and ordering of other coaches about London. One thousand nine hundred was the number of hackney-coaches of London, base lean jades, unworthy to be seen in so brave a city, or to stand about a king's court."

There seem to have been several of these proclamations. One in 1635 prohibited hackney-carriages from traversing the streets of London, but allowed them to go "out of town." Another, in 1660, prohibited their standing about to be hired, and ordered that they should be kept in yards or stables for hire. Quaintly enough, Pepys has a note in his diary, on the day of this proclamation coming into force, to the effect that in spite of it he got a coach to carry him home.

The character of the vehicles themselves may be imagined. From the nature of the roads they were obliged to be strong and heavy. They were very narrow, that they might get through the narrow streets; and the coachman generally, if not always, rode one of the horses. When the streets got wider he mounted the box, so called because it really was a box, and nothing else, and contained a set of tools to repair the effects of the frequent accidents that occurred.

One of the best descriptions of the old hackney-coach is that given by Dickens, in the *Sketches by Boz*, and those who remember these crazy vehicles will readily acknowledge its accuracy. "A great, lumbering, square concern, of a dingy yellow colour (like a bilious brunette), with very small glasses, but very large frames; the panels are ornamented with a faded coat of arms, in shape something like a dissected bat; the axletree is red, and the majority of the wheels are green. The box is partially covered by an old great coat, with a multiplicity of capes and some extraordinary-looking clothes; and the straw with which the canvas cushion is stuffed is sticking up in several places, as if in rivalry of the hay, which is peeping through the chinks in the boot."

The first rival of the coach was the sedan chair, introduced, it is said, by Prince Charles, on his return from Spain. This, too, was soon to be let on hire. Garrard says in one of his letters, "Here is also another project for carrying people up and down in close chairs, for the sole doing whereof Sir Sander Dunscombe, a traveller, now a pensioner, hath obtained a patent from the king, and hath forty or fifty making ready for use."

The new chairs soon became popular. They passed more easily through the City streets than the coach, and there was less chance of a break-down. Then the distances in London were not very great, and so altogether the chair had the best of it. Down to the earlier part of this century the chairs were still used, and after they had disappeared from London they still held their ground in Bath and other provincial towns.

Such was the origin of the hackney-coach, and its history, so far as it had one, down to our own times. It may be worth mention that the popular idea that its title is derived from the parish of Hackney is quite a delusion. A "hakeneyman" was a letter of horses for hire long before coaches, hackney or other, were used in England. The word occurs in a deed of 1308. But the hackney-coach—though it outlived the sedan—had another rival to fear, and this was a more successful one, the "cabriolet" or, as we now have it, the cab.

The original cab or cabriolet was an importation from Paris, in 1820, where these vehicles had been for some time in use before they came to London. In 1813 there were 1,150 *cabriolets de place* in Paris. This vehicle was a lofty, hooded gig, and some specimens of it are yet to be found in remote country places, both in this country and in France. The driver sat inside, and there was room for only one person beside him. The great disadvantage of the cab was its danger; if the horse fell (and the horses were not of the best), the occupants of the vehicle were certain to be pitched out from a considerable height to the ground. The first improvement was to put the driver outside, and thereby give more room within. He was accordingly perched on a small seat, over one wheel, at the side, and in this condition the cab continued till it was replaced by our present vehicles, the "hansom" and the "four-wheel." We may first investigate the character of the former.

Mr. Hansom's cab, as originally made, consisted of a square body, hung in the centre of a square frame. At the sides of the frame were short axles, on which a pair of large wheels were fitted. This frame enclosed the whole carriage, passing over the top and bottom and down the sides. The wheels were of the same height as the vehicle, about 7 feet 6 inches, a height which was afterwards reduced, as the large wheels did not prove well adapted to London work. The driver sat on a small box in front, and the door was behind in the original model, though in the cab as patented, there were two doors in front, one on each side of the driver's seat. In the first constructed vehicle of this sort, Mr. Hansom tells us, he drove from Hinckley, in Leicestershire, to London, much to the astonishment of the coach-drivers and waggoners he passed on the road, who could not imagine what the big-wheeled, lopsided concern could be. This new cab was patented in 1834 (No. 6,733 in the Patent-office List), but is was soon found that though the main idea was a good one, the means employed to carry it into effect were far from perfect. The framework, though ingenious, was heavy and clumsy, and the friction caused by its weight went some way to counterbalance the advantages of easy running and convenient disposition of the weight. A company was formed for the purpose of introducing the cabs and effecting the needful improvements, and a couple of years after (1836) a fresh patent was taken out, in the names of Messrs. Gillett and Chapman, in which were embodied the various improvements suggested by practice and experience. The exact share contributed by the original inventor it would be difficult at this distance of time of state, but we believe some additions were suggested by him and some by the two patentees. Briefly, we may say that the hansom-cab, as now known, was the result of these combined efforts. The driver was placed behind, the doors were made to open sideways, the sliding window (Mr. Chapman's idea) was added, and the general form now in use adopted. Another important addition was the patent safety frame, a framework under the body of the cab, which rested on the ground, and supported the vehicle when tilted either forward or backward. Of the window, awkward and inconvenient as it certainly is, we may remark that we have not yet found a substitute for it. As a bit of mechanism it is decidedly ingenious. The axle of this cab was cranked, to allow it to pass under the body, and an early improvement was to cut away the body under the seat sufficiently to allow the axle to pass straight across. This important change was very soon adopted, though we cannot say to whom the credit of it is due. Most of the other changes since made have been in minor details, such as adjusting the weight, attaching the shafts, and so on, until the form now in most general use has been arrived at.

As soon as the cab was finished, and the patent taken out, the company went to work. It built fifty cabs, bought 150 horses, and started an establishment in King-street, from which the public were to be supplied. But as soon as the advantages of the new cab became apparent, imitations sprang up in all directions. The company prosecuted one man after another, got verdict after verdict, but found the infringers of their rights were men of straw, and that no real redress was to be obtained. After the expenditure of £2000 in lawsuits, we understand that only one solitary fine of £500 was paid. Under these circumstances the company gave up litigation, and continued on no better footing than their rivals. They had the advantage of knowing that they had supplied a public want, but that was all. Mr. Hansom himself had the satisfaction of seeing vehicles plying for hire with his name on their sides, which had never paid him a penny royalty, and we are given to understand that his receipts from his invention were very trifling. His original claim of £10,000, the sum for which he made over his rights to the company, he gave up.

Since the original invention, a good many patents have been taken out for hansom cabs, most of which are included in the following list:—

In 1843 J. Harvey patented a two-wheeled cab, in which the driver's seat was let into the body of the vehicle, instead of being a separate attachment behind. It was at the back of one of the sides.

In 1854 J. Roberts proposed to place the doors at the back of the cab, and make the seat move on a pivot, with several minor additions.

In 1856 E. Hunt invented a sort of folding screen, intended to replace the doors of hansom cabs. It was to be actuated by a system of levers worked by the driver's foot.

In 1861 T. Stewart received provisional protection for an invention by which the portion of the cab over the door was made semi-circular, and fitted with sliding sashes. Some other minor improvements, such as the addition of splash-boards, &c., were also included.

In 1862 J. Snider proposed to substitute a curtain for the present windows.

In the same year J. Rimmer received provisional protection for an invention in which the cab was hung on spiral springs.

In 1864 J. W. Nottingham patented a cab in which the head was fixed on pivots, so that it could be either open or shut, and a blind of laths was used instead of the windows. There were also some alterations in the construction and hanging of the cab.

In 1863 R. Walter proposed to add a third wheel, in order to give greater security.

In 1866 M. Cole received provisional protection for a cab in which the horse was carried further back, so as to be actually in the middle of the cab, which is on each side of him.

In the same year W. H. Gore invented a cab in which the front was brought forward to the splash-board, and the doors carried rather to the side, thus giving increased space within.

F. Ockerby also obtained provisional protection in the same year for a method of attaching the driver's seat to the cab.

T. Earp and R. Ashton, in the same year, patented a method of connecting the doors, so that when one was opened the other also was.

In 1867 J. Day and W. Dorber patented a method of opening and closing the doors by a lever.

In 1868 S. Benjamin invented a glazed sash, to replace the folding window.

In the same year R. A. Gold proposed to make the door behind and the seat "parallel to the axle."

In 1869 G. Clarke obtained provisional protection for a cab in which the top part folded back, with other improvements.

In 1870 Messrs. Standfield and Crosse brought out a new carriage, which they now propose to convert into a hansom. The body is hexagonal, the three sides behind being occupied by the seat, the one in front having a window in it, and the other two sides forming the doors.

In 1872 a cab of somewhat similar form, though differing in details of construction, was patented by Messrs. Glass and Hopkins. In it the doors open from a centre pillar down the middle of the front. They can be opened by the driver from his seat.

There are many other inventions of improvements in the construction of the ordinary cab, and there are also several new forms that have never been patented. The best of these we may shortly hope to see at South Kensington.

It may be mentioned as a curiosity, that a vehicle, in external appearance exactly like the "hansom," is given in an illustration in Pennant. The picture represents Temple-bar, with the traitors' heads upon it. Knight states that another print, of a date about the beginning of the century, represents the same carriage, and states that it is the invention of "the ingenious Mr. Moore." In it the driver is placed on the top, and there are two large wheels, as on the present cab.

In the indexes of the Patent-office a two-wheeled carriage, invented by Mr. Moore in 1790, is mentioned, and the specifications describe a vehicle hung on two large wheels, with a separate driver's box in front and a door behind. This has little or no resemblance to a "hansom," and the weight is hung high instead of low. Whether this is the same as the carriage figured by Pennant we cannot say, but it seems very doubtful.

Such is the history of the invention of the "hansom." About the same time came in the four-wheeled vehicle, which usurped the title of "cab," originally given to the two-wheeled cabriolet. There is hardly sufficient novelty in its construction for us easily to apportion the amount of credit due to its inventors. It was simply a modification of the old post-chaise, enlarged, and with a driver's seat in front. The growth of railways, and the increased habit of locomotion, caused a demand for means of traffic subordinate—so to say—to the railways, and hence the increase in cabs, four and two wheeled. Before the present form was generally adopted several other shapes were tried. Such was the "slice off an omnibus," which was just what its name implied. In it the driver sat at the top, and the door was behind. The objection to this was, that the driver had little control over his "fare," who could get out without stopping to pay. None of these, however, came into very extensive use, and the hackney-coach held its place till it was ousted by the present "four-wheeler." An interesting circumstance in connexion with this cab is, that it was the parent of the "brougham." Lord Brougham was taken with the shape, and ordered his coach-maker to build him a cab, but of better make and finish than those in public use. The result was the carriage now so popular.

Mr. Silber has informed the St. George's, Hanover-square, Committee of Works that the petroleum oil burned in his lamp costs a penny for six hours, and gives a light equal to 16·36 sperm candles. He suggested that a hundred of his lamps should be tried in the parish. It was decided to try one of the lamps at the vestry-offices, Ebury-bridge.

ATLANTIC TELEGRAPHY.

The following letter appeared in the *Daily News* of March 24. The letter to which it was an answer was published in last week's *Journal* :—

Sir,—I observe a letter from Mr. Highton, in your widely-circulated paper, which I think requires correction on one point. Mr. Highton thinks that iron destroys hemp in submarine cables, as ironmould destroys pocket-handkerchiefs. A very extended experience has shown that in submarine cables no such action takes place. Hemp in contact with iron will last perfectly sound for twenty years at least, if covered by the iron. In some seas it is eaten by animals, but no case of this kind has been shown to have occurred in the Atlantic. Bad hemp does also gradually decay where there is any wash, but iron and hemp mutually protect one another. The break in the 1865 cable is an unexplained but not unprecedented accident. There is much less cause for a panic now than when, in 1860, I described a similar case to the Institution of Civil Engineers, and in my evidence before the Board of Trade and Atlantic Commission. The cable in question broke in the Mediterranean, without any known cause, in 1,200 fathoms; it was simply iron-covered. I am not aware that any similar case has happened since then, and this alone is enough to show that any generalisation based on the accident will be wholly misleading. Probably the Atlantic failure is connected with some local decay, and experience has shown that decayed patches occur here and there with perfectly sound cable on either side. I therefore, for one, expect that the 1865 cable will be repaired, and that it will continue to be a valuable property for many years. At the same time, I concur with Mr. Highton in thinking it very desirable that a light cable should be tried.—I am, &c.,

Fleeming Jenkin.

This letter produced the following on Tuesday, from Mr. Highton :—

Sir,—No doubt Professor Fleeming Jenkin is right in his facts, but they do not prove me to be in error. I will trespass on your space as little as possible in explaining this. Iron in contact with hemp destroys it by acting, in the form of rust or oxide, as a carrier of the oxygen dissolved in water, and so burning the hemp. Now, when hemp "is covered with iron" the outside of the iron extracts the oxygen from the water, and so saves the inside where the iron is in contact with the hemp. But all this, though true of most cables, is reversed in the Atlantic cables. The hemp is not "covered with iron," but the iron with hemp, consequently the iron rusts in actual contact with the hemp and burns it. In some parts of the bottom of the sea there may, from various causes, be very little dissolved oxygen; where the cable is covered with fine sand or mud, the oxygen in the water immediately surrounding it is soon exhausted, and as there is little change of water to bring fresh oxygen, in such parts the decay is very slow; but in other parts, where these conditions do not prevail, where the nature of the bottom is unfavourable, or where a current brings continually fresh oxygen, the decay is very rapid. Some years ago the West India Dock Company—and, I think, other dock companies—tried hempen cables, with iron wires inside, for the sake of strength, and the iron and hemp destroyed each other in even a few months. *Absit omen.* I am, &c.,

H. Highton.

On Wednesday, Mr. Cromwell F. Varley joined in the correspondence with the following letter :—

Sir,—A discussion is going on between Professor Fleeming Jenkin and Mr. Highton as to whether iron oxide destroys hemp. This is so important a question that I venture to state the facts of the case. The hemp used in nearly all cables—and notably in the 1865 Atlantic Cable—is tarred with Stockholm tar. The hemp of the 1865 cable was still further protected by a hot mixture of pitch and other ingredients, and Professor Jenkin would be strictly correct in his remarks had he inserted the words "tarred hemp." The 1865 cable is reported to be broken 500 miles from Ireland. The water at this point shoals to 1,600 fathoms. It is well known—from the soundings taken by the various naval officers both of the English Government and of the United States who have made the deep-sea soundings in the Atlantic—that the water at this depth is icy cold, and contains less salt than the upper water. It is a well-known fact to all chemists and telegraph engineers who have had actual experience in recovering cables from great depths, but where the water is cold, that iron is oxidised by it very slowly indeed, and that vegetable substances, even when unprotected by tar, scarcely undergo any decay. These two well-established facts give me reason to believe that a properly organised expedition can lift the 1865 cable west of the break, splice on a new shore end, and make it as good as before. This done, the piece between the fault and Ireland might be subsequently picked up, for the gutta-percha core is now more valuable than when first laid down. Last year I tested portions of the French Atlantic cable, of which we had many miles in store. The hemp in this cable was treated with tar and pitch, as previously described for the 1865 cable. And, notwithstanding this cable had been shipped and unshipped 18 different times, and kept in tanks filled with water of the daily surface temperature, yet the cable was found to have suffered no reduction in strength during the period of five years—in which it had been more exposed to the danger of decay than the cable laid in deep cold water. The experiments as to strength were tested at Kirkaldy's well-known testing establishment, and the latter gentleman's report upon our experiments is in the hands of the French Atlantic Telegraph Company. None of the samples broke with less than 7½ tons, and some bore more than 8 tons.—I am, &c.,

Cromwell F. Varley.

CORRESPONDENCE.

ATLANTIC TELEGRAPHY.

Sir,—Professor Fleeming Jenkin has answered in the *Daily News* my letter on the breakage of the cable of 1865, which appeared in that newspaper and in your *Journal*.

I have answered his letter briefly in the *Daily News*, but should like to go into the matter a little more fully and scientifically than is suitable for the columns of a daily newspaper. Iron destroys hemp and other vegetable substances, in consequence of its forming several oxides. The higher oxides part with a portion of their oxygen to vegetable matters, and absorb it again from its solution in water or damp air. Thus they act as carriers of oxygen to burn and destroy such matters. Arguing from this well-known fact. I said there could be no surer method of destroying rapidly a hemp cable than by enclosing in it an iron wire. To this Professor Fleeming Jenkin answers that this is not found to be the case in submarine cables; that they will last for twenty years when the iron surrounds the hemp. This is possibly correct, and the reason is obvious. For in many parts of the deep sea there seems to be but little oxygen. This little in the parts surrounding the cable is absorbed by the outside of the iron wires, and so prevented from acting on the inside, where the iron is in contact with the hemp; and where the iron is covered with sand or mud, of a kind which does not injure the iron, the access of fresh supplies of water with fresh oxygen is hindered, and even the outside of the iron is acted on very slowly. But in the Atlantic cables the iron wire is in the centre of the hemp, and therefore wherever it becomes oxidised, it acts immediately on the hemp and consumes it. Now, if there are only a few places in the bed of the Atlantic where there is a sufficient supply of oxygen, in these few places the sheath must quickly perish, and the core be in imminent danger. I trust that such places may not be sufficiently numerous to prevent the cable of 1865 from being raised and repaired.—I am. &c., H. Highton.

Putney, March 24th, 1873.

THE MOSCOW EXHIBITION.

Sir,—I regret exceedingly that business arrangements rendered it impossible for me to be present at Professor Leone Levi's lecture on Russia (December 18th, 1872), and as I have visited the Moscow Exhibition myself, I felt anxious to read an authentic and trustworthy report, and see how other persons were treated by the Russian officials, and compare such treatment with my own. I can assure you I was much pleased with the report of the discussion following the lecture, and with the very pertinent remarks made by Mr. Christopher Cooke.

Now, it so happens that I was not invited to Moscow by Imperial authority, but went specially on business purposes, and met with uniform civility the whole journey, until my arrival at Eydtkunen, where I had to give up my passport; and submit to my pockets being emptied of all papers; even an old *Times*, in which was wrapped some shirt fronts, was taken out of my knapsack, so that when I left the searching room at Eydtkunen station, I had not a single line of printed English matter to beguile away a journey of 2,000 miles. On my arrival at the bureau of the Exhibition at Moscow, I received at the hands of Prince Servina Golitzen great kindness and assistance, but when I went to the Custom-house to obtain my carriages, for three days every possible obstacle was thrown in my way, on one plea and another, and although they had been dispatched six weeks before I left England, it was only when I got into a temper, and spoke in rather strong terms, that they would grant me permission to see and take them away. The Committee had guaranteed shelter and accommodation, free of expense, for goods to all exhibitors; they, after a long and serious consultation, after I had read the rules over to them several times, politely informed me that I might stow them in the powder magazine of the Kremlin, and would have to pay for standing room, as the place where they were to be exhibited was not ready—a request I politely and steadily refused, demanding that they should keep to the specified rules. Before I left Moscow I obtained from Mr. Singer, the secretary, two papers to clear my railway expenses to the frontier, and after some trouble, although assisted by a Russian, I obtained a ticket for St. Petersburg, but the station-master at St. Petersburg would on no account pay any attention to my second pass, and I was compelled to pay my fare back to the frontier. The Moscow-Brest Railway also refused to take off the promised and guaranteed reduction of 50 per cent. on transit of my exhibits, which I have instructed my agent to pay in full under protest. Throughout my journey I found it impossible to proceed from Moscow to St. Petersburg, and thence to the frontier, without giving up my passport to the police, and paying expense of stamps, &c., which I consider exhibitors ought to be exempt from. I give you a simple statement of facts, in the hope that I may meet with those who will assist me in my having the rights granted to me as they were guaranteed by the Russian government to all exhibitors at Moscow Exhibition, as set forth in the printed rules of "The Moscow Polytechnic Exhibition." I am sure that such impositions as those carried on by the Russian officials and railway companies, in refusing to carry out their printed terms, together with the enormous expense of transit, &c., are quite sufficient to deter many persons who would exhibit under more favourable circumstances from so doing; and unless a guarantee can be given by the government that such will not be repeated, I fear the number of English exhibitors will readily decrease at foreign exhibitions.—I am, &c.,

C. S. Windover.

ECONOMIC STOVES.

Sir,—The suggestion of Mr. T. Clark, C.E., to introduce fresh air to the stove through a tube communicating with the air outside, and terminating in a pierced rose end under the grate, is undoubtedly the proper thing, and has been put in practice on very solitary occasions ever since the time of Count Rumford, but unfortunately has never acquired favour with the public. The objection to the proposal is that the inmates do not want cold air brought into the house, and it makes them shudder only to think of it.

There is another appliance required to make healthy homes, which also meets with no favour from the public, and that is a ventilating pipe, reaching to the roof, in every cesspool, water-closet, dead well, or sink-hole, in order to allow the fetid air to escape as the fluid or semi-fluid pours in. Otherwise, as is almost universally the case, these foul airs have no exit except by leaking into the house through innumerable small fissures, and thus poisoning the inmates with pestilential sewage gas.—I am, &c., Henry W. Reveley.

Reading.

GENERAL NOTES.

England and Central Asia.—An interesting illustration of the paper lately read before the Society by Mr. Shaw, on "England and Central Asia," will be found in the Yarkund and Tibet Court at the Crystal Palace. In the journey undertaken by Mr. Commissioner Forsyth to Yarkund, he collected together a series of objects illustrating the manners and customs of the inhabitants of this little-known country. Dr. Cayley, long resident at Ladak, has also lent to the company a collection of specimens chiefly in illustration of the religion of the Lamas. In addition to these, Dr. Campbell, for a considerable time H.M. Resident at Darjeeling, has also contributed a similar series. All these have been arranged by Dr. David S. Price (of the Crystal Palace Technological Museum), so as to form an ethnographical study, particularly interesting at the present time. Apart from the specimens in the cases, two groups are represented, one showing a Lama priest sitting at the door of his tent, receiving a visit from a male and female Thibetan peasant, and the other Yarkundis halting on the journey. The background to the group is a large painting from a sketch by Dr. Cayley, of the Lama monastary of Ladak. The whole forms a remarkable life-like representation of the scenes frequently witnessed in these countries.

Preservation of Meat.—Mr. Brookes, of Leadenhall-market, has lately received a large consignment of Swedish and Norwegian game, brought over in a fresh state solely by means of cold. The birds were packed in a cold atmosphere, and were closely surrounded on every side by a thick layer of skins. The result was that they came over here uninjured, and were found, after being packed for a month or so, as fresh as when they were killed. The cold in the high latitudes where the birds were killed was sufficient to freeze the bodies, and when unpacked here they were still frozen and ice-cold. The idea originated, we understand, with some Swedes, who were anxious to open up a trade with England, and had found that meat and game, packed in skins or other non-conductors, could be transported for long distances in Norway and Sweden. The simplicity of the process is remarkable, but it appears only available in countries where the natural temperature is very low. The flesh, we are told, is as good as that of recently-killed birds. Some beef was also brought, and this, though of poor quality, was certainly quite fresh. Of course the skins in which the game, &c., was packed were valuable, so that there was no loss on this part of the importation.

Prizes for Painting.—The Painter Stainers' Company, with a view to promote the important subject of technical education in connection with the art and mystery of painting, have determined to invite competition and offer prizes in the following subjects:—1st, Decorative painting in ornament, £5 and £3; 2nd, Painting from natural foliage or flowers, £5 and £3; 3rd, Freehand drawing and design, £3 and £2; 4th, Marbling and graining, £3 and £2, with the addition to the 1st prize in each class of the company's silver medal, and to the 2nd prize in each class of the company's bronze medal. The prospect of the freedom of the company is also held out, on such terms as the court may think fit, to any competitor showing an amount of talent sufficient to justify such reward. The prizes will be open to young men under the age of thirty years. The subjects of "Painting from natural foliage or flowers," and also of "Decorative painting," to be executed in oil or tempera. The subject of "Freehand drawing" to be a copy from casts or natural objects in pencil, chalk, or shaded in water colour. The specimens must be sent to the hall beeween the 18th and 25th of May, inclusive, and must bear a private mark or motto, and be accompanied by a sealed envelope containing a similar mark or motto, with the name and address of the competitor, his age, a certificate or declaration that he is in the trade, and that the work is by his hands only. The envelope will not be opened till after the judges have made their report. The specimens will remain the property of the competitors, but the company will not hold themselves responsible for the safety of, or damage to, such specimen. The prizes will be awarded by the company's trade committee; and after the award the prize specimens may be publicly exhibited at such place as the company may select. Each competitor must remove his specimen, at his own cost, within one week after notice sent to him by post.

NOTICES.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. The following meetings have been arranged:—

April 2.—"On Economy of Fuel for Domestic Purposes." By Capt. Douglas Galton, C.B., F.R.S.

April 9.—*No Meeting.*

April 16.—"On the British Settlements in West Africa." By His Excellency Governor Pope Hennessey, C.M.G.

April 23.—"On Silkworm Grain." By Mons. Alfred Roland (Orbe, Switzerland). On this evening Andrew Cassels, Esq., will preside.

April 30.—"On the Condensed Milk Manufacture." By L. P. Merriam, Esq.

CANTOR LECTURES.

The Third Course of Cantor Lectures for the present session will be "On Wines; their Production, Treatment, and Use," by J. L. W. Thudichum, Esq., M.D. The Course will consist of six lectures, the first of which will be given on Monday evening, the 21st of April, the remaining five on the Monday evenings succeeding.

INDIA COMMITTEE.

A Conference will be held this evening (Friday), 28th inst., at 8 p.m., when a paper will be read by W. T. Blanford, Esq., of the Indian Geological Survey, on "The Mineral Resources of India." Sir Louis Mallet, C.B., Member of the Council for India, will preside.

Members are entitled to attend these Conferences free, and to admit two friends to each of them.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Stationers' Company, 7½. Technical Lectures. Mr. Ellis A. Davidson, "Printing, its History and Practice."
Medical, 8.
London Institution, 4. Prof. Thiselton Dyer, "Fungoid Organisms in their Relation to Mankind."
Chemical, 8. Annual Meeting.
Actuaries, 7. Mr. J. R. Macfadyen, "On a General Formula for the Value of Present or Future Benefits, whether free or burdened with charges, and on the Application of the Formula to determining the Surrender Values of Life Policies."

Tues. ...Asiatic, 3.
Civil Engineers, 8. 1. Discussion, "The Mont Cenis Tunnel." 2. (time permitting) Mr. John Head, "On the Rise and Progress of Steam Locomotives on Common Roads."
Royal Colonial Institute, 8. (At the House of the Society of Arts.)
Pathological, 8.
Anthropological, 8.
Royal Institution, 3. Prof. Rutherford, "Forces and Motions of the Body."
Zoological, 8½.
Biblical Archæology, 8. 1. Mr. Henry Fox Talbot, "On the Religious Belief of the Assyrians—Part III." 2. Rev. A. H. Sayee, "On the Identification of Nimrod from the Assyrian Inscriptions." 3. Rev. Basil Henry Cooper, "On a Triple Synchronism in Egypto-Assyrian History."

Wed. ...**SOCIETY OF ARTS, 8.** Captain Douglas Galton, C.B., F.R.S., "On Economy of Fuel for Domestic Purposes."
Microscopical, 8.
Pharmaceutical, 8.
Obstetrical, 8.
London Institution, 7.

Thurs...Institution of Naval Architects (at the House of the Society of Arts), 12. Evening at 7.
Royal, 8½.
Antiquaries, 8½.
Linnæan, 8. 1. Surgeon-Major F. Day, "On New Indian Fishes." 2. Rev. M. J. Berkeley and Mr. C. E. Broome, "On the Fungi of Ceylon."
Chemical, 8. 1. Dr. H. Sprengel, "A Way of Exactly Determining the Specific Gravity of Liquids." 2. Dr. C. R. A. Wright, "On Cymene from Various Sources." 3. Dr. L. H. Gladstone and Mr. Tribe, "Researches on the Action of the Copper Zinc Couple on Organic Bodies II on the Iodide of Amyl and Methyl." 4. Dr. H. E. Armstrong, "Contributions from the Laboratory of the London Institution. No. XI. Action of the Acid Chlorides on Nitrates and Nitrites."
Royal Society Club, 6.
Royal Institution, 3. Mr. Vernon Harcourt, "Coal and its Products."

Fri ......Geologists' Association, 8. 1. Mr. G. C. Cooper, "On the Diamond Fields of South Africa." 2. Mr. John William Wetherell, "On some Fossils from the Margate Chalk."
Philological, 8½.
Royal Institution. 9. Professor Tyndall, "Some Observations on Niagara, made during a Visit to the United States."
Royal United Service Institution, 3. Capt. H. Toynbee, "The Meteorology, Sea Temperature, and Currents of the Ten-Degree Square of the Atlantic which lies between the Equator and 10° north latitude, and from 20° to 30° west longtitude."
Architectural Association, 7½. Mr. Banister Fletcher, "Dilapidations."
Institution of Naval Architects (at the House of the Society of Arts), 12. Evening at 7.
Archæological Institute, 8.

Sat ......Royal Institution, 3. Professor Max Müller, "On Darwin's Philosophy of Language."
Institution of Naval Architects (at the House of the Society of Arts), 12.

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FRIDAY, APRIL 4, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

MUSICAL EDUCATION COMMITTEE.

This Committee held a meeting at Clarence House on Thursday, the 3rd inst., present:—H.R.H. the Duke of Edinburgh, in the chair; Mr. Henry Cole, C.B., Mr. A. S. Cole, Major Donnelly, R.E., Lord Gerald Fitzgerald, Mr. C. J. Freake, Sir John Harington, Bart., Mr. Chandos Wren Hoskyns, M.P., Mr. Frank Morrison, Mr. J. F. Puttick, Mr. Samuel Redgrave, Mr. Seymour Teulon, and Mr. E. Carleton Tufnell, with Mr. Le Neve Foster, Secretary. The Committee were of opinion that it was desirable to erect a building at a cost not exceeding £20,000, suitable for the purposes of a Training School for Music in connection with the Society of Arts, and it was referred to a sub-committee to consider on what terms and on what conditions such sum could most readily be raised.

INDIA COMMITTEE.

A meeting of the Committee was held on Wednesday. Present—Mr. Hyde Clarke, in the chair, General Sir Arthur Cotton, Colonel Gawler, Sir Rutherford Alcock, Dr. Campbell, Messrs. A. Cassels, W. T. Fitzgerald, W. S. Fitzwilliam, W. Maitland, Brian H. Hodgson, T. Briggs, T. T. Cooper, S. Ward, and Robert B. Shaw. The Committee took into consideration and decided on the draft of a memorial for presentation to the Secretary of State for India on the subject of facilitating our commercial intercourse with Eastern Turkistan from India.

TECHNOLOGICAL EXAMINATIONS.

The Programme of Examinations in the Technology of some of the Arts and Manufactures of the country is now ready, and may be had on application to the Secretary.

The subjects selected for 1873 are Cotton, Paper, Silk, Steel, and Carriage-building. Those desiring to become Candidates, should apply for the programme without delay.

The following Prizes are offered by the Society of Arts in each of the five subjects mentioned above:—

To the best candidate in Honours, £10.
To the best candidate in the Advanced Grade, £7.
To the best candidate in the Elementary Grade, £5.

In order that these Examinations may really be successful in promoting technical education in this country, it is desirable that encouragement should be given to candidates by the offer of additional prizes and scholarships. With this object the Council appeal to the Companies of the City of London, to merchants and manufacturers, and to members of the Society generally, to aid them by contributing to the Prize Fund.

The following special additional Prizes are offered:—

By Wyndham S. Portal, Esq., to the Second and Third best Candidates in the Elementary Grade, Paper Manufacture:—

A Prize of	£3
A Prize of	2

By G. N. Hooper, Esq., to the Second and Third best Candidates in the Elementary Grade, Carriage Building:—

A Prize of	£3
A Prize of	2

By the Worshipful Company of Spectacle Makers, to the Second-best Candidate in Honours, in the Advanced Grade and in the Elementary Grade respectively, in the Manufacture of Steel:—

A Prize of	£5	5
A Prize of	3	3
A Prize of	2	2

The Council beg to announce the following contributions to the Prize Fund:—

The Worshipful Company of Fishmongers	£52	10	0
The Worshipful Company of Mercers	26	5	0
The Worshipful Company of Vintners	10	10	0
The Worshipful Company of Salters (annual)	10	10	0
Dr. Crace Calvert, F.R.S. (annual)	5	5	0
Sir Daniel Cooper, Bart.	5	0	0
R. L. Chance, Esq.	5	5	0

The Council invite the aid of masters and managers in promoting these examinations by encouraging their workmen to take advantage of them. An explanatory handbill, suitable for being suspended in factories and workshops, may be had on application to the Secretary of the Society of Arts, Adelphi, London, W.C.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal early in May next. This medal was instituted to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty the Emperor of the French, "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

The Council invite members of the Society to forward to the Secretary, on or before the 12th of April, the names of such men of high distinction as they may think worthy of this honour.

ECONOMIC USE OF COAL FOR DOMESTIC PURPOSES.

With reference to the sum of £500 placed at the disposal of the Council, through Sir William Bodkin, by a gentleman who does not wish his name to appear, for promoting, by means of prizes or otherwise, economy in the use of coal for domestic purposes, the Council have decided to offer the following prizes :—

1. For a new and improved system of grate, suitable to existing chimneys as generally constructed, which shall, with the least amount of coal, answer best for warming and ventilating a room.—*The Society's Gold Medal and Fifty Pounds.*

2. For a new and improved system of grate, suitable to existing chimneys as generally constructed, which shall, with the least amount of coal, best answer for cooking food, combined with warming and ventilating the room.—*The Society's Gold Medal and Fifty Pounds.*

3. For the best new and improved system of apparatus which shall, by means of gas, most efficiently and economically warm and ventilate a room.—*The Society's Gold Medal and Fifty Pounds.*

4. For the best new and improved system of apparatus which shall, by means of gas, be best adapted for cooking, combined with warming and ventilating the room.—*The Society's Gold Medal and Fifty Pounds.*

5. For any new and improved system or arrangement not included in the foregoing, which shall efficiently and economically meet domestic requirements.—*The Society's Gold Medal and Fifty Pounds.*

The Council reserve to themselves the right of withholding all or any of the above prizes, as the judges appointed by them may determine.

The competing articles must be delivered not later than the 1st of December, 1873, with a view to their being tested, and subsequently shown in the London International Exhibition of 1873.

Further particulars, as to place of delivery and other arrangements, will be published as soon as they are finally settled.

PROCEEDINGS OF THE SOCIETY.

SEVENTEENTH ORDINARY MEETING.

Wednesday, April 2nd, 1873, Edwin Chadwick, Esq., C.B., Vice-President of the Society, in the chair.

The following Candidates were proposed for election as Members of the Society :—

Fox, Theodore, Newport Rolling-mills, Middlesborough.
Glover, Samuel, 3, Harrington-square, N.W.
Head, Jeremiah, Newport Rolling-mills, Middlesborough.
I'Anson, J. Coventry, Darlington.
Maples, Jarvis, the Crown Tavern, Clerkenwell-green, E.C.
Mayhew, Rev. Samuel Martin, New Kent-road, S.E.
Richardson, Charles Fletcher, 8, Great Winchester-street-buildings, E.C.
Scott, Dugald, the Moorland, Kersal-edge, Higher Broughton, Manchester.
Shaw, John, South Eastern Railway Company, London-bridge, S.E.
Thorn, William Thomas, 19, Great Portland-street, Oxford-street, W
Tucker, Edwin, Derrystone, Abergavenny.
Winterbourne, Sydney, 13, Forbes-road, Penge, Surrey.

The following Candidates were balloted for and duly elected Members of the Society :—

Alexander, E., Middleton Ship-yard, Hartlepool.
Cobbett, Edwin, 76, Jermyn-street, St. James's, S.W.
Cotton, Major-General Sir Arthur, K.C.S.I., Dorking.
Eagle, Vincent, St. George's-wharf, Grand Surrey Canal, Camberwell, S.E.
Fraser, John Henry, St. George's-wharf, Grand Surrey Canal, Camberwell, S.E.
Goff, Captain Robert, 81, St. Thomas-street, Portsmouth.
Hodgson, B. H., 36, Onslow-square, S.W.
Langdon-Davies, Charles, 20, Threadneedle-street, E.C., and Widford, Herts.
Vaughan, General John Luther, C.B., 30, Pembridge-villas, Bayswater, W.

The Chairman said for years we have been endeavouring to obtain attention to the waste of fuel, and to the means of its prevention. It has been proved experimentally that the greatest waste has been in our domestic fireplaces, where five-sixths of the heat are discharged unapplied, and yet people are greatly affected with ailments, the results of unregulated temperature. Some time ago I got out an estimate that the washing-bill of the metropolis was upwards of six millions per annum, of which more than a third was caused by the excess of soot. The disregarded waste in large furnaces has been enormous from utter recklessness. When Lord Palmerston sanctioned some measures against them, we sent out letters of inquiry to three hundred manufacturers, who used what were called smoke-consuming furnaces, to ascertain, in the way of example, what their gain had been; but we found that there was not above one in three who had been at any pains to observe what the results were. As a rule, I found that there was only serious effort at economy where the price of coal was high. Thus in Cornwall, where the price of anthracite coal was 40s. per ton, as much duty was got out of one pound of coal as from four or five in the North, where the price of coal was eight or nine shillings. I found too, that in Paris, in some well-ventilated hospitals, the warming was effected even more cheaply than in Manchester, where the cost of coal was not one-third the price of the same coal in Paris. As a rule, therefore, there is little improvement except under the pressure of necessity. I have, therefore, been favourable to a good seriously pressing coal-tax, because it was a tax that people by exertion fully save. I have for the same reason, and on sanitary grounds, viewed with equanimity the present high price of coal, for I believe it may be productive of important economical results. It will give us some chance of a befitting attention to the topic which is brought before you to-night, and may lead to the adoption of improvements in the methods of producing coal, and in the condition of the producers. The present condition should be regarded as encouraging to labourers in this special subject of sanitary reform, of whom one of the foremost and most successful now claims attention which will be gladly given to him to-night.

The Paper read was—

ON THE ECONOMY OF FUEL FOR DOMESTIC PURPOSES.

By **Capt. Douglas Galton, C.B., F.R.S.**

(Director of Works and Public Buildings).

There is no question of domestic economy so worthy of the attention of the public at the present time as that of the consumption of coal, and the subject has derived increased importance from the very high price to which coals have recently risen.

The high price of coals, however, whilst very disagreeable to the householder in its immediate effects, will have a very valuable effect on the well-being of the nation, if the result should be to induce greater care in the management of domestic fires, and greater economy in the use of fuel.

The total quantity of coal now annually consumed in the United Kingdom is stated by Sir W. Armstrong to be about 110 millions of tons. The Coal Commission estimate that the consumption of coal may be roughly divided into three parts, one-third being used in manufacturing processes, one-third in steam-engines, and one-third for domestic purposes. On this assumption, therefore, the latter may be assumed at nearly 37,000,000 tons in the year. This means a consumption of about one and a fifth tons per head of the population. I am, however, inclined to think that the amount is over-stated, and that probably even one ton per head of the population of the United Kingdom would be somewhat in excess of the average. The increase in the price of coal, of from 25s. to 30s. a ton, which we have recently experienced, is thus equivalent, on this assumption, to a tax of from £1 5s. to £1 10s. a head. It is, however, manifest that while this is the average consumption of coal, a very much larger proportionate consumption takes place in large households as compared with small ones. It may be assumed that three tons per head in the year is not much in excess of the quantity burned in what may be called the better class houses.

Sir W. Armstrong has, I think, shown conclusively, in his address to the Mining Institute at Newcastle, that, whatever may be the fluctuations of the market, we must assume that a much higher price for coal will rule than has hitherto prevailed, and those to whom such increased price is a matter of serious import must meet the increased cost by diminished consumption.

My endeavour will be to show that there may be obtained, from a much diminished consumption of coal in fireplaces used for domestic purposes, all the advantages which have hitherto resulted from the wasteful expenditure which has prevailed.

I have no expectation of stating anything that is actually new, because the functions and the attributes of heat and combustion have long been thoroughly discussed in their application to industrial objects. I hope, however, to draw attention to important considerations which govern the application of heat, and which are very generally neglected in fireplaces, in kitchen ranges, and in most warming apparatus.

I think, I may say without hesitation, that the quantity of fuel now absolutely wasted in our houses amounts to at least five-sixths of the coal consumed. That is to say, if the greatest care and the best method of applying the heat were in all cases adopted, we could effect in heating and cooking all that we now effect, with one-sixth of the coal we now use; and if, in the construction of our fireplaces and cooking apparatus, simple principles were recognised and ordinary care was used, we might without difficulty save from two-thirds to half of the coal consumed. Therefore, instead of consuming 32,000,000 tons per annum for domestic purposes, we should not consume, if coal were fully economised, above 5,000,000 tons, and, if even only moderate economy were practised, from 12,000,000 to 16,000,000 tons only need be used. Thus, this economy in the household consumption of coal would enrich the nation to the extent of from £20,000,000 to £30,000,000 annually.

In my remarks on this question I intend to confine myself rather to the enunciation of the principles which should govern the application of heat for domestic purposes, than to give descriptions, except in a general way, of special appliances.

The inventors of apparatus for warming and cooking are so numerous, and the merits of a large number of inventions which have come into common use are of so negative a value, that it would not be fair to single out some individual instance for condemnation, and leave unnoticed other apparatus which possess equal defects and may be in equally extensive use. Mr. Edwards's very interesting and instructive treatise on domestic fireplaces clearly shows with what persistent perverseness the inventions which possess real merit have been almost invariably passed by. This result, I fear, is due mainly to the fact that architects and builders have not been penetrated with sound principles on the warming of our dwellings, and have encouraged the adoption of showy grates, based on false principles, instead of taking the trouble to make new designs of pretty grates based on sound principles of warming.

The question of the consumption of coal for domestic purposes divides itself into two branches:—

1st. The quantity required for warmth.
2nd. The quantity required for cooking.

The former is required only for the winter months, the latter is a permanent quantity during the year.

The waste of coal in domestic fireplaces is, however, no new question. It is fully 80 years since the subject was most fully treated of by Count Rumford, and afterwards by Mr. Sylvester. They showed conclusively what enormous savings in fuel for heating, cooking, and drying were possible. Count Rumford's principles have never been generally applied, because the price of coals has ruled so low that householders have not much cared for economy. We hear Count Rumford's axioms now and then quoted by rival manufacturers in support of their newly-devised grates or kitchen-ranges; but in many cases the manufacturer, in the article he supplies, seems to be endeavouring to violate, rather than to follow, every axiom which Count Rumford ever laid down.

I do not mean to say that improvements have not taken place since Count Rumford's time, but the progress in the direction of economy has been very small, when we consider the great ingenuity displayed in devising new forms of apparatus. In respect of our fireplaces our chief talent has been expended on providing a means of warming the outside air, and of polluting it by the smoke and soot we project into it.

The methods which have been adopted for warming houses fall under the several heads of—

1. Open fireplaces.
2. Close stoves (the German plan).
3. The Roman hypocaust, or floors warmed by direct action of fire.
4. Hotwater pipes, without ventilation.
5. Hot air warmed by a cockle or by hot-water pipes.

The class of apparatus to be adopted in any country will vary with the climate. In England the climate is of so very changeable a nature, that the amount of heat required for comfort in a house varies from day to day. There are many days in the middle of winter when it is quite possible to sit in an unwarmed room; or sometimes a warm morning is followed by a cold afternoon, when the sudden application of heat is desirable. It is probably for this reason that in England the open fireplace has, as a rule, held its own against all the proposals for warming houses by means of one central fire.

The open fireplace in ordinary use warms only by means of the direct radiation of the flame into the air of the room. It is the most primitive mode of warming, derived from the days when our ancestors inhabited caves. But these ancestors, by placing the fire in the centre of the floor of the cave, derived from it a larger portion of heat than we generally do, who place it against the wall of the room, and carry off the greater part of the heat up a flue separated from the room. The earlier fireplaces consisted of a large square brick opening with a chimney carried up for the escape of smoke. The large square fireplace was adverse to the direct radiation into the room of the heat generated, and the large chimney removed from the room a very considerable quantity of air, which had necessarily to be replaced by cold air flowing into the room through all available apertures, and this created strong draughts.

Franklin, Count Rumford, and Sylvester are the most prominent names of those who at an early period contributed improvements to the warming of our houses. The main principle of fireplace construction advocated by Count Rumford, 80 years ago, was that the heat radiated from the fire directly into the room should be developed to the utmost. He brought the back of the fireplace as prominently forward as possible; he sloped the sides so as to reflect heat into the room; he advocated the use of fire-brick backs and sides instead of iron; he reduced the size of the chimney opening, so as to prevent the chimney carrying off the large quantity of warmed air it used to remove in his time. Our manufacturers of fireplaces have continued in the same groove. They have undoubtedly, in some cases, largely developed the use of radiant heat. There are fireplaces eminently successful as radiators of heat of a circular or concave form with polished iron sides, the fire being placed against a fire-brick back forming the apex of the concavity. So long as the concave surfaces are bright, the heat thrown out by them when a clear flame is burning is very great, but the gases from the flame pass directly off into the chimney while they are still at a very high temperature. The heat of the flame at that part will often be between 1,200° and 1,300° Fahrenheit, and a very large proportion of this heat, to the extent of at least nine-tenths of that generated by the combustion of the fuel, is carried directly up the chimney.

One pound of coal is capable, if all the heat of combustion is utilised, of raising the temperature of a room, 20 feet square and 12 feet high, to 10 degrees above the temperature of the outer air. If the room were not ventilated at all, and the walls were composed of non-conducting materials, the consumption of fuel to maintain this temperature would be very small, but, in proportion as the air of the room was renewed, so would the consumption of fuel necessary to maintain that temperature increase. If the volume of air contained in the room were changed every hour, one pound of coal additional would be required per hour to heat the inflowing air, so that to maintain the temperature at 10 degrees above that of the outer air during 12 hours would require 12 lbs. of coal.

The principle of the ordinary open fireplace is that the coal shall be placed in a grate, by which air is admitted from the bottom and sides to aid in the combustion of the coal; and an ordinary fireplace, for a room of 20 feet square and 12 feet high, will contain from about 15 to 20 lbs. at a time, and, if the fire be kept up for 12 hours, probably the consumption will be about 100 lbs., or the consumption may be assumed at about 8 lbs. of coal an hour.

One pound of coal may be assumed to require, for its perfect combustion, 150 cubic feet of atmospheric air; 8 lbs. would require 1,200 cubic feet; but, at a very low computation of the velocity of the gases in an ordinary chimney-flue, the air which would pass up the chimney at a rate of from 4 to 6 feet per second, or from 14,000 to 20,000 cubic feet per hour, with the chimneys in ordinary use, and I have often found a velocity of from 10 to 12 feet per second giving an outflow of air of from 35,000 to 40,000 cubic feet per hour. This air comes into the room cold, and when it is beginning to be warmed it is drawn away up the chimney, and its place filled by fresh cold air. A room 20 feet square and 12 feet high contains 4,800 cubic feet of space. In such a room, with a good fire, the air would be removed 4 or 5 times an hour with a moderate draught in the chimney, and 6 or 8 times with a blazing fire; the air so removed would be replaced by cold air. The atmosphere of the room is thus being cooled down rapidly by the continued influx of cold air to supply the place of the warmer air drawn up the chimney. The very means adopted to heat the room produces draughts, because the stronger the direct radiation, or rather the brighter the flame in open fireplaces, the stronger must be the draught of the fire and the abstraction of heat. The only way to prevent draughts is to adopt means for providing fresh warmed air to supply the place of that removed.

The most natural way of providing warmed air is to utilise the excess of heat which passes up the chimney, beyond what is required for creating an adequate draught, and to use this heat to warm fresh air; and the warmed air should be admitted into the room in such places as will enable it to flow most easily into the currents prevailing in the room.

These considerations led to the construction of the ventilating fireplace, which has been so extensively used in barracks. This fireplace will keep a room at a given temperature with one-third of the quantity of fuel usually required in most ordinary fireplaces, and with less than one-half the quantity required in the very best constructed radiating fireplaces.

The open ventilating fireplace, if properly constructed, is the simplest and most effectual means of warming and ventilating a single room, because it absorbs all spare heat from the chimney beyond what is necessary to create a draught; and, whilst it admits warmed air into the upper part of the room in an imperceptible current, the action of the fire draws air from the lower part of the room, and thus provides for a circulation of the warmed air towards the floor of the room.

The ventilating fireplaces invented by me, and now called by my name, but which have never been the subject of a patent, were a consequence of the efforts made by the late Lord Herbert and Miss Nightingale to improve the health of the army. The death-rate of the soldiers, when this question was taken up, was found to be larger than that of many unhealthy civil populations. Soldiers are, however, a body of men picked out as the healthiest members of the nation; they should, therefore, have had an exceptionally low death-rate in peace time. A main element in the improvement of their health lay in improving the ventilation of their barrack-rooms. But soldiers, whenever they became aware of the existence of any fresh air currents, insisted on closing the inlets. It was also made a *sine qua non* by the government that the barrack-rooms should be warmed by open fireplaces, and, moreover, the Government required that the increased amount of ventilation declared to be necessary on medical grounds should be provided without any increase in the amount of fuel allowed. By the adoption of these fireplaces, and by the introduction of simple and improved arrangements for cooking the soldiers' food, the Government were enabled to effect a saving on the fuel supplied, instead of being obliged to incur a large increased expenditure on account of the additional ventilation introduced into the barrack-rooms. The manufacturer of these fireplaces informs me that he has supplied between 9,000 and 10,000 to the military departments up to this time.

The principle of warming by means of an open fireplace, or by means of a German stove or a Gill stove, is applicable to single rooms, that is to say, each room must have its own appliance, and each room may be self-contained as far as regards its heating and ventilation.

The close stoves employed in Germany use less fuel in warming the room than any open fireplace, but they are economical because the heat generated is not removed by the frequent renewal of the air. This element of their efficiency in warming, however, makes them most unhealthy.

The most recent improvements in the use of the German stove for warming have been introduced by Dr. Bôhm, in the Rudolf Hospital at Vienna. He there warms fresh air by means of passages constructed in the fire-clay stoves, placed in the ward, and the fresh warmed air passes into the ward from the top of the stove. He provides flues of a large size, and proportioned to the size of the ward, from the level of the ward floor to above the roof, and the difference of temperature between the air in the ward and the outer air causes a sufficient current in these flues to ventilate adequately the ward. By this means the fresh warmed air, instead of passing off to the upper part of the ward and then away by flues there, is made to circulate towards the floor of the ward, thus bringing into action the principle by which the open fireplace is useful in ventilation. But this arrangement destroys one element of economy in the German stove, because the heat generated, instead of being left to pass slowly off into an unventilated room, is removed rapidly by the fresh air passed into the ward, and has, therefore, to be renewed at intervals, instead of, according to usual custom, the stove being left shut up for 24 hours to give off its heat slowly. The larger the supply of warmed air, the larger must be the consumption of fuel; and, if the heat is to be supplied economically, it must be through a good conducting medium; but the material of the German stove is a bad conductor of heat.

The old Roman system of warming by means of a fire under the floor produced a most agreeable and equable temperature, but it did not assist the ventilation, and it was not economical, in that the floor, being of tiles, was of a bad conducting material, and much of the heat was absorbed in the ground or surrounding flues. According to Pliny, the smoke was carried to the wood-house to be used in drying the wood for burning. I recently made an experiment to compare the effect of warming by means of a heated floor with the heating effect of a ventilating fireplace; the experiment lasted, with each mode of warming, for two days. It showed that, in the case of the warmed floors, the room was maintained at a temperature of about 18 degrees above the temperature of the outer air with an expenditure of 56 lbs. of coal and 112 lbs. of coke, whilst with the ventilating fireplace the expenditure was only 75 lbs. of coal; the cost being 3s. 4d. for the warmed floor as compared with 1s. 4d. for the ventilating fireplace.

A more complete plan of warming a building is by means of a fire from which the heat is conveyed, either by hot-water pipes or hot air, to the various parts of the building.

Warming by means of air conveyed by flues to various parts of the building, will answer, as a rule, in ordinary existing houses, best in connection with open fireplaces, which draw in the warmed air to the various rooms, because there must be some means of forcing or drawing the warmed air into the house, and it would not be convenient to keep a steam engine in an ordinary house to pump in the warmed air. These open fireplaces would then, however, be wasting the spare heat which each fireplace sends up its own chimney; but, on the other hand, very much smaller fires would be needed to keep the rooms warm, than when the rooms are not supplied with fresh warmed air. Theoretically, however, it can be shown that if we are prepared to give up open fireplaces, and arrange our houses on the plan of having flues which would draw off the air from near the floors of our rooms, and which would also warm fresh air, heated from a central fire, to be constantly admitted near the ceilings, and if the climate were such as to make us desire to have the system in continuous operation, such a system would probably be by far more economical of fuel than open fireplaces, because the fuel used could then be made to do its full duty. The variations of our climate, and the low price of fuel which have hitherto prevailed, have prevented such systematic arrangements from being adopted in this country.

The plan of carrying the heat from the fire to the air to be warmed by means of hot-water pipes affords also a very economical method of warming air, because the best constructed hot-water apparatus will enable the full heating value to be got out of the fuel. Fuel may be consumed to far greater advantage in a close furnace than in any open grate, because the admission of air for the combustion of the fuel can be regulated to any required extent. The heating surface of the boiler may also be so arranged as to absorb a very large proportion of the heat generated by the fire.

But in deciding on the amount of heat in hot-water pipes which is most favourable to economy, the following considerations occur:—At least twice the quantity of air which is strictly necessary by theory passes through the fire in the best constructed furnaces. In an ordinary grate this consumption is enormously increased. Each part of oxygen supplied by the air and necessary for combustion is accompanied by four parts of nitrogen, which is of no value for combustion. Consequently, if twice as much oxygen passes through the fire as is strictly necessary, we have one part which combines with carbon and produces combustion, and nine parts which, being inert, must act, in the first place, to lower the temperature of the fire, and, secondly, to carry a larger amount of unutilised heat up the chimney. Moreover, when water is heated sufficiently to generate steam, each particle of water converted into steam absorbs or makes latent 960° Fah. of temperature. In experiments on the evaporation of water, the temperature of the gases passing off in the chimney was ascertained to vary from 430° to 530°, diminishing to 415° at the top of a flue 35 feet high, with the dampers open; and about 380° at the bottom of the flue with the dampers closed. With a boiler of which the temperature of the water is maintained at 200° without evaporation, the temperature of the flue need not exceed from 230° to 240°.

It is clear from these considerations, that, in order to ensure the maximum effect from the fuel, the heating surface of the pipes should be sufficiently large to warm all the air required without its being necessary to raise the temperature of the water in the boiler to any great extent, and the proportion between the boiler surface and the pipe surface, that is to say, between the surface which absorbs heat, and the surface which gives out heat, should be such as to render it unnecessary for the fire to be forced, because the lower the temperature at which the gases from the fire pass off up the chimney, the greater will be the economy.

In order to show the waste which results from forcing the boiler, *i.e.*, from passing the gases into the flue at a high as compared with a low temperature, I will give an instance of one experiment. The proportion of heating surface in the boiler to the heating surface of the pipes is assumed by some manufacturers as 1 to 100, or, when great heat is required, 1 to 40. An experiment made on 4,000 feet of pipe, heating certain greenhouses by a wagon-shaped boiler with 40 square feet of heating surface, showed that a certain temperature was kept up for 8 hours with 8 bushels of coal; but when, by the addition of another boiler, the heating surface of the boiler was increased to 80 square feet, the temperature could be maintained for the same period with 4 bushels of coal. The outer temperature was the same on the two days.

On these grounds it is not so economical, so far as the consumption of fuel is concerned, to use steam instead of water, either water heated to a high temperature under pressure, or to heat air for warming purposes, because the gases from the fire employed to produce the higher degree of heat will pass off at a high temperature, and the heat they contain be wasted. On the other hand, the capital outlay required where highly-heated pipes are used, is smaller than with hot-water pipes, because a smaller heating surface, and therefore smaller pipes, will suffice when the temperature is high; and, moreover, a very small pipe will convey steam to any required place, whereas with hot water, at a relatively low temperature, much larger pipes are required. It follows that where the price of fuel makes it necessary to reduce the permanent annual expenditure, the original capital outlay must be increased. There is a further consideration in regard to economy with hot-water pipes, steam-heating, and all appliances for warming buildings from a central fire, viz., that if the heat has to be conveyed for long distances before its useful application comes into force, very much heat is lost, and consequently fuel is wasted. On the other hand, against the saving which would result from a more immediate application of the heat to the place to be warmed, there is to be weighed the diminished expense of attendance consequent upon the use of one fire instead of several fires, each with its attendance and supply of fuel. There remains one source of economy to be applied to close grates used for heating water, which has not yet been adopted. I mean the application of some of the heat which is passing into the chimney to warm the air which feeds the fire. Theoretical considerations show that an advantage of from six to nine per cent. might be obtained from this source, and the experiments which I have made bear out this result.

But, after we have designed the most effective arrangements for economising the fuel which warms our dwellings, if that object is to be fully secured, we must arrange to retain the heat in our houses. The architect should devote to these considerations the same care which he now is frequently satisfied with bestowing upon the beauty of the design for a building. The arrangements of the plan should be adapted to the retention of heat. All portions of houses exposed to the air should be formed of materials which are found to be the slowest conductors of heat. Whatever may have been the *lâches* of the manufacturers of fire-grates or kitchen-ranges, the nation has latterly very much disregarded the means of retaining heat in the house. The uniform model house of the speculating builder is constructed with thin walls, thin glass windows, ill-fitting casements, and a roof of slates, with nothing under them. The old half-timbered house was warm, because it had an air space between the inner and outer skin; the brick-built, stone-faced house is warm because it has, so to say, a double wall. In modern houses it has long been shown that, without much increased expense, the use of walls built hollow will keep the rooms effectually warm and dry, and yet this mode of building is the exception rather than the rule, possibly because it gives the architect or the builder a little additional trouble. A slated roof, if ill-constructed, is a material agent in allowing of the escape of heat, because there is necessarily an inlet for air where the slates overlap. The old thatched roof, although most dangerous in cases of fire, was a great preserver of heat. In well-built modern houses the slates are laid on felt, which is laid on close boarding, and this arrangement keeps the house warm in winter and cool in summer. As regards the windows, glass ranks high as a non-conductor of heat, and the effect of using thick glass, instead of the very thin glass so often seen, is very largely to economise the heat. Evidence of the cooling effect on the air of a room of a window of thin glass is afforded by the cold draught which anyone perceives when sitting on a cold day near a closed window of thin glass. Proposals have been often made to glaze a window with double panes, and no doubt such a plan is a good means of retaining heat in the room, but the inside of the glass between the panes will in time become dirty, and then it can only be cleansed by removing one of the panes. A more convenient, but more expensive, plan is to adopt the system, which prevals universally in the northern parts of Europe, of a double casement.

It is not, however, my object here to give a treatise on building. The conclusion which I would draw from these various considerations is, that if we desire to economise to the utmost the daily expenditure of fuel, we must increase our outlay of capital. So long as coal was cheap, it may have been better worth the while of the individual consumer to employ coal wastefully rather than spend money upon the arrangements for economising heat. On the other hand, when coal is dear, the daily expense from the waste of fuel will induce a capital outlay to secure economy of heat.

The question of saving fuel for cooking purposes is even more important than economy in warming; because cooking is an operation required every day in the year, and the waste of fuel in cooking is even more considerable than in warming.

An ordinary cooking-range in houses which, for convenience, may be designated middle-class houses, is derived from the time when the same fire was used for cooking and for warming. It is interesting to consider Count Rumford's remarks on this question. He largely developed the use of steam for cooking in large establishments, but in considering private kitchens he showed that 9-10ths of the heat produced in cooking operations was wasted, and only one-tenth utilised in cooking, by the use of open fireplaces. He laid down the following principles on fireplace construction:—

1. Each boiler, kettle and stewpan should have its separate fireplace.

2. Each fireplace should have its grate on which the fuel must be placed, and its separate ash-pit, which must be closed by a door well fitted in its frame and furnished with a register for regulating the quantity of air admitted into the fireplaec through the grate. It should also have its separate canal for carrying off the smoke into the chimney, which canal should be furnished with a damper or register. By means of this damper and of the ash-pit door, the rapidity of combustion and generation of heat is regulated, and on the proper use of the two registers the economy of fuel will much depend.

3. In fireplaces for all boilers which are too heavy to be easily lifted with the hand, an opening just above the level of the grate should be made for introducing fuel to the fire, which opening must be closed by a close-fitting stopper or door. In fireplaces constructed for small stewpans this opening may be omitted, and the fuel be introduced through the opening into which the stewpan is fitted, by removing the stewpan occasionally for the purpose.

4. All portable stewpans should be circular, and suspended in their fireplace from the circular rim. The best form for large fixed boilers is an oblong square, broad and shallow rather than narrow, and deep, and it should be of thin metal.

5. All boilers and stewpans should be fitted with covers to render them well adapted for confining the heat. The best arrangement is to make the covers of thin sheets of tinned iron, and double, that is, with an air space between the outer and inner cover.

We have, during the last twenty years, introduced, as a rule, close ranges. They are certainly cleaner and more convenient for cooking, and, if great care is exercised in the use of the dampers, they will be found more economical than open fires.

But, as a rule, they are based on the principle of making one fire perform a variety of operations. Independently of the question of a combined fire, as compared with the separate fires advocated by Count Rumford, a consideration of the form of modern kitchen-ranges will show that most of the principles laid down by him have been entirely neglected. The doors of the fireplace and ashpit seldom fit close; the boilers are rather deep and narrow than broad and shallow; the use of the hot plate prevents the stewpans from being suspended from the rims for the fire to play round them; the use of double covers for saucepans and boilers is rather a rarity than a usual arrangement.

To realise the question of economy of fuel, it is necessary to consider, in the first place, what a given quantity of fuel is capable of doing. As regards hot water, if water is kept at a temperature of 200°, or from that to 210°, the gases from the fire can, after communicating the heat to the boiler, pass off into the chimney at a temperature of little beyond that point; but if the water be allowed to boil, in the first place a large amount of latent heat is absorbed by the steam, which is lost if the steam passes off into the air or the chimney, and in the second place it will be found that the gases, after they pass off from the boiler, will have a temperature of as much as 300°, 400°, and even 500°. Unless, therefore, water is required to be actually boiling for use, if the water is permitted to boil, a great quantity of heat is wasted up the chimney For household purposes it is never necessary that the water in the boiler should exceed 200°. Tea, to be good, should be made (as clearly shown by Mr. Francis Galton in his "Art of Travel") with water of a temperature of from 180° to 200°. Very few culinary operations require the water really to boil, and when boiling water is wanted, it is required in a saucepan standing on the fire. All operations of cleaning, &c. (except washing clothes), require water at a very much lower temperature than 212°. If, however, water at a higher temperature is wanted, it can be supplied up to about 230° without the generation of steam, by heating it under pressure; this can be attained by having a close boiler fed from a cistern placed at the top of the house. For the preparation of preserves and some other cooking operations, such a system is is most convenient.

One pound of coal should raise from fifty to sixty gallons of water from 45° to 212°, and, when raised, very little fuel is required to maintain it, in a properly constructed boiler, at that temperature. The total amount of water, at such a temperature, used daily in an ordinary middle-class house, does not exceed 30 or 40 gallons, and, therefore, if the boiler were made so as to absorb as much heat as possible, the hot-water used in an ordinary middle-class house, with a family of 10 or 12 persons, ought not, with thorough economy, to consume more than one-sixth of a ton of coals in the year. Count Rumford shows in his treatise that 25lbs. of bread ought to be baked with one pound of coal, and that 100lbs. of meat should be cooked with $2\frac{1}{4}$lbs. of coal. If, therefore, we fully utilised our fuel, it is clear that in the preparation of our food and hot-water for domestic purposes, $\frac{1}{4}$lb. of coal per head of the population ought to be a sufficient daily allowance, which would be equivalent to one-twelfth of a ton per annum, and in large households even less than that quantity ought to suffice. I do not suppose we should ever attain to this minimum of consumption, but it is well to consider what the standard is, so that we may not rest satisfied till it has been much more nearly approached than hitherto.

Economy has, as I before observed, latterly been sought in combined apparatus. Where large numbers of persons have to be cooked for, and where, consequently, a carefully constructed apparatus is always worked to its full extent, the results which have been obtained show a very moderate consumption of fuel; but the same apparatus, when used for smaller numbers of persons, gives results not favourable to economy.

The boilers in use in barracks, when I first took up the question, required from 16 ozs. to 20 ozs. of coal per head to supply water for breakfast and tea and washing up, and to make soup for dinner for 50 or 60 men. The boilers I introduced would perform the same duty with from 3 to 4 ozs. of coal for each person cooked for, provided the number amounted to 50 or 60 persons. The ovens for roasting, which I introduced into barracks, would roast and bake with 1 oz. of coal for each person cooked for, when cooking for the full number for which the oven was designed, and for such numbers as 200 to 400 persons; smaller ovens would require 2 ozs. per head when cooking for 50 men. Of course to produce these effects great care was required.

Messrs. Benham introduced cooking apparatus which, when cooking for the full number of 300 soldiers, would perform the total daily cooking and supply of hot water in barracks, with from two to three ounces of coal per person cooked for.

Captain Warren constructed an apparatus to boil, bake, steam, roast, and fry, and provide hot water, which, when cooking for about 100 men, required somewhere about $2\frac{3}{4}$ ozs. for each person cooked for, but when cooking for 40 men required 6oz. per head, and when cooking for 16 men the average of several days amounted to 9 ozs. or 10 ozs. per man cooked for, but on one or two of these days the consumption did not exceed 5 ozs. for each person cooked for.

These apparatus supplied to the men all the cooking and hot water necessary. The results show what degree of economy has been reached in ordinary practice with soldiers, who are not proverbial for care, and what, therefore, should be the standard of economy to which we have a right to expect to attain. No doubt private houses containing 16 persons might require more hot water or more cooking, but according to these facts, as to ascertained consumption of fuel, the expenditure of fuel in the kitchen for a family consisting of 16 persons might easily be reduced to $1\frac{1}{2}$ or 2 tons a year, and in all these apparatus further elements of economy remain to be developed.

The conclusions, however, to which I have been led in my consideration of this question are, that with these apparatus, and, indeed, with all kitchen ranges in use, the waste of heat lies in the number of functions the fire has to perform. It must warm water, it must heat the oven, it must stew, and grill, or toast, and sometimes roast at the open fire, and each of these processes requires a different condition of heat. Hot water requires a temperature of 200 to 210 degrees, a roasting oven about 450 degrees, a baking oven probably 350 degrees; grilling is performed on a clear flame, the temperature of which is probably 1,300 degrees. Now, when the fire is in an efficient condition to perform one of these functions, it is also in an efficient condition to perform the others, and although, by means of dampers, it may be somewhat checked in the performance of its full functions in certain directions, there is no doubt that an enormous amount of heat is wasted through the agency of those parts which are not wanted to be in operation. Where the oven is not wanted it is affording a means for the heat to escape rapidly, especially if ventilated as a roasting oven. The boiler is supplied with heat beyond its requirements, and generally abstracts a large quantity of spare heat, which passes off in the shape of steam. I assume that the cook closes the dampers in order, as far as possible, to limit the action of the fire when cooking is not going on, but in practice this is difficult to ensure. With these combined apparatus, the fuel consumed will be in proportion to the various operations which the fire is arranged to perform, and not in proportion to the limited work required when only one or other of the operations are wanted. When, for instance, the fire is only wanted to heat water, a great waste of heat will be going on from the heat passing off from the oven, hot-plate, and front of the fire. For this reason the combined apparatus can never be so economical in fuel as separate apparatus; whilst, however, apparatus of this class, if not very carefully worked, waste fuel, they, to some extent, save trouble to the cook.

I have already mentioned several points of detail where fuel could be saved in our kitchen-ranges, viz., by great attention to the close fitting of the ashpit and fire grate doors, the use of double covers to saucepans and boilers, the use of sand on the hot-plate to prevent the escape of so much heat from that part; and beyond these an important point in securing economy is the separation of those culinary processes which require different gradations of heat. The three main parts of the ordinary cooking apparatus are the oven, for baking and roasting, and the boiler, and the hotplate. If the boiler is to be of the form most effectual in saving fuel, the flame and gases from the fire should play under and round every part of it; the water should be kept at something under 212°, so that the gases, after leaving the boiler, may not enter the flue much above that temperature, and, inasmuch as that is a higher temperature than is necessary for the purpose of producing a sufficient draught in an ordinary chimney, the heat in these gases should be still further utilised. In the first place they should be used to warm the water which will be required to replace what is drawn off from the boiler; and, in the second place, an economy can be obtained by employing the gases, which pass off into the chimney at a temperature above what is required for creating an efficient draught, to warm the air supplied to the fire for purposes of combustion. The experiments which I have made on the supply of warmed air to feed the fire, have, unfortunately, not been worked out sufficiently to enable me to give them in a clear form with exact results; but an economy of from six to nine per cent. might be obtained from this source.

Then as regards the oven. The baker's oven, of firebrick, in which the fire is made inside the oven —and the whole heat retained in and reflected back from the sides and top and bottom, is a very economical instrument when in continual use. With iron ovens attached to a kitchen range, the case is different. An oven which roasts requires a temperature of from 400 deg. to 450 deg. at least. Therefore, to maintain this temperature the gases must pass off into the flue at a temperature even higher; when the oven is a roaster a considerable volume of air is being continually passed through it to carry off the steam from the meat. This air, if admitted cold, as is the case with many ranges, acts so as to cool down the interior, and therefore additional fuel has to be consumed to counteract this cooling down process. Now, however good may be the conducting power of the material used for ovens or boilers, a coating of soot diminishes the conducting power very rapidly, and consequently the temperature of the flue conveying heat to the oven will always exceed that of the inside of the oven. It is, therefore, of great importance to remove any causes which tend to lower the inside temperature. Hence it is desirable to utilise some of the heat which passes off, at above 450°, into the flue, for the purpose of raising the temperature of the air to be admitted into the oven. As a general rule, however, and except in some apparatus, under present arrangements all this heat is wasted, and it certainly cannot be utilised properly so long as one fire is retained to perform so many separate operations.

The hot plate is the third important part of the modern close cooking range. Count Rumford proposed that the top of a hot plate should be covered with sand, and the sand cleared away only under the saucepans. In its present shape the hot plate wastes an enormous amount of heat. It is wasteful, because it radiates the heat largely; because the application of heat to the saucepans is only through the bottom of the saucepan, and the bottom of the saucepan is not always in immediate contact with the flame, but is frequently allowed to receive the heat through the medium of the cast-iron hot plate, which is a very moderate conductor of heat. Just consider what the difference of effect is. The heat of the flame, if directly acting on the bottom of the saucepan, would be 1,200 degs. Fahr., but unless the hot plate is red-hot, probably not above 450 degs. will pass through, but the heat in the flue which heats the hot plate will be at 1,200 degs., and the spare heat from the flame will be wasted up the chimney. The hot plate should be dispensed with, if economy is to be made paramount, and charcoal burners substituted for it. Where gas is available, the hot plate can be dispensed with without extra trouble to the cook. The gas-burners should be properly protected in sunken holes, with side of fire-clay, and the saucepans should be dropped into the holes, so that the full effect of the heat shall be concentrated on them and round their sides, and the gas should be only kept lighted so long as the operation to be performed is going on. It may be assumed that 1lb. of coal is equivalent to from 28 to 30 cubic feet of gas, hence as permanent fuel gas would not be economical; but the simplicity of its application makes it a very convenient fuel in cooking, and economy is obtained from its use, because the full effect of the combustion can be utilised as soon as the gas is lighted, the flame can be regulated to any required extent, and the gas be extinguished as soon as the required operation is performed.

I have endeavoured to enumerate briefly the economical conditions which should regulate the consumption of fuel for domestic purposes. By economy it is meant that, whilst all necessary operations of warming and cooking continue to be performed, the fuel employed should be utilised to the utmost. In the kitchen the daily consumption of fuel, in small establishments, should not exceed half-a-pound of coal for each person cooked for, and in large establishments the proportion should be smaller. In the consumption of fuel for warming, so many conditions have to be considered that no standard can be laid down beyond the broad fact already stated—that one-sixth of the coal we usually now use would suffice for all our requirements if it were properly utilised. I do not, however, anticipate that much progress will be made in economy, unless the price of coals should remain at a figure which will induce the householder to make himself thoroughly acquainted with the principles on which the apparatus for warming and cooking should be constructed and worked; for there is no apparatus which can be invented which will not depend to a considerable extent on the manner in which it is attended to.

The principal conditions which I have enumerated have long been known. There is an old saying in South Staffordshire, that "he who lives longest must carry coal furthest," and acting on this we have year after year simply wasted millions of tons of coal in our domestic fireplaces, because the coal was provided at a small cost; and we have had no thought for posterity.

George Stephenson once said, very happily, that coal represented the accumulated rays of the sun laid up in store in bye-gone days. When this store is gone, the world will have lost the most convenient and economical means of generating heat. It is therefore a duty, which every man owes to posterity, to do his utmost to husband this great store.

I have endeavoured to do my part by explaining the conditions which should govern the arrangements devised for regulating the consumption of fuel for domestic purposes. It remains for the public to insist on having these principles applied to the various apparatus which they adopt.

DISCUSSION.

Mr. F. J. Bramwell must confess he was surprised at the figures which Captain Galton had brought forward as representing the total quantity of coal consumed in England for domestic purposes. When last autumn he (Mr. Bramwell) was collecting information on this subject for the purpose of his address to Section G of the British Association, he had found the proportion stated as only one-fifth of the total quantity retained for use in the United Kingdom, or about one-fifth of 95 millions of tons, or 18½ to 19 millions of tons, and not the 37 millions of tons suggested by Captain Galton. In considering the question of the use of coal for domestic warming (not for cooking) three points had to be borne in mind—the giving of warmth, the obtaining healthy ventilation, and the doing those two things comfortably. In a room heated by a German stove the temperature was high, the room well warmed, and very little coal was burnt, but ventilation was quite negelcted, and any Englishman in such a room would probably have a headache, and would suffer other discomforts. Therefore, however economical German stoves might be, he thought it was undesirable that we should resort to them. What was wanted was an apparatus by which ventilation as well as warmth could be obtained. But directly you admit, as you must admit, that constant renewal of the air in a room was necessary, you might increase the consumption of fuel to a very large extent in proportion to the quantity of air you considered necessary for health and comfort. Captain Galton had told them of the great benefits arising from an increased ventilation. For instance, when the house of the Institute of Civil Engineers was built, it was determined to give 1,000 cubic feet of air per hour for every person. The room was calculated for 400 people, and thus provision had to be made for 400,000 feet of air per hour, and the only manner in which this large quantity of air could be got in, without the inconvenience of local draughts, was by building the walls double and by making numerous inlets of such an aggregate area as to admit of the air coming in without appreciable current. But in getting air within a room for ventilation, there was always the danger, on the other hand, of persons getting cold therefrom. In order to get in air so as to bear it without inconvenience, the current must be reduced to not much more than a mile an hour, or 1½ feet per second. But to do that an enormous area of inlet was required, which it was nearly impossible to provide. Captain Galton, in his paper, had touched upon various modes of obtaining warmth in dwellings. He had spoken of the use of hot air flues, of steam pipes, of hot water pipes, of the closed stoves of the Continent, and of open fire-places on a system of which Captain Galton was the inventor. Even if by careful construction proper ventilation were obtained along with the closed stoves, he still believed no Englishman would ever put up with anything that was not an open fireplace. Now there was no reason, as Captain Galton had shown, why the open fireplace should be the wasteful thing it was. Captain Galton had shown how the outgoing heated air could be made use of, instead of being wasted up the chimney, and he thought that Captain Galton by having taken our cheerful open fire out of the category of wasteful heating implements, had become a public benefactor. Mr. Bramwell then proceeded to describe the system by which Captain Galton, attained the object in view. By Captain Galton's invention, not only was fuel economised, but full ventilation was obtained, and thus there was a full supply of air to the fire, and the horribel nuisance of a smoky chimney was got rid of. There was one position taken up by Captain Galton which he could not follow. He understood Captain Galton to say in effect that warming by steam pipes must of necessity be more wasteful of fuel than warming by hot water, because when water was heated to the boiling point only, the products of combustion might escape at only a few degrees above the temperature of the water itself, but that when the heating was carried only a a few degrees higher, viz., to just above the boiling point, so that steam was produced, the temperature of the escaping products of combustion must at once be raised by some 200 or 300 degrees. He (Mr. Bramwell) could not concur in these statements; he did not see any reason why the escaping gases should not be as near to the temperature of the water within the boiler when steam was being generated from it, as when steam was not being generated. Experiments made with engines, tried at the Royal Agricultural Show at Cardiff, had borne out these views, and moreover it had been proved that a given amount of heat-conducting surface could transmit from two to three times the number of units of heat when ebullition commenced, that it could transmit before ebullition had been set up, and thus in any particular boiler the effective ratio between the absorbing surface and the amount of heat-producing power of the grate was increased when steam was raised, and thus the effect of setting up ebullition ought to be a reduction in temperature.

Mr. Edwards quite agreed with Mr. Bramwell, that in this country open fireplaces would never be given up, and that Captain Galton was doing great service in agitating the question, because the public mind would see what he was doing, and would, no doubt, take the subject up. His (Mr. Edwards') firm had manufactured a smoke-consuming apparatus for some years, which he was prepared to say was decidedly the most economical and the most efficient kitchener that he had ever been acquainted with; but they had been obliged to discontinue the use of it or to recommend it in consequence of the cooks not understanding it. Unless cooks were taught and made to understand the system of economising fuel, they would never get a smoke-consuming kitchener to be a great success. If that were done, the kitcheners might be used, thus saving a great quantity of fuel and the necessity of sweeping the chimneys, for the chimney would go three or four years without any sweeping at all. In reference to Count Rumford's hot-plate, when that was introduced the principle of conveying steam from boilers for purposes of cooking was not understood, and though the principle which he introduced was very sound indeed (and he had a high respect for the memory of Count Rumford, for he did so much good in his day), yet he was afraid those principles were not adapted for present wants, in consequence of our being able to accomplish so much by the use of steam, which economises the fuel. He believed the time was coming when everyone interested in the question would have an opportunity of submitting the best cooking apparatus and grates for inspection, and of showing what could be done in that respect, and that would be the best time for testing the most efficient of the various experiments and of ascertaining what could be done. As to what Captain Galton had said respecting the heating of hot-water for kitcheners, he was glad to be able to say, from long experience, that that could be done at a very small expense indeed.

Mr. Robert Rawlinson, C.B., made a few practical remarks on grates as they are and as they ought to be. Grates as they are, in 19 out of 20 instances, were simply the worst possible forms that could be made for the purpose of warming a room economically without giving smoke. The very means adopted to compel a draught up a chimney were the very forms which ought not to be adopted, because they narrowed the entrance—they radiated the sides of the grate and they projected the bars, so that there must be a current out of the room to bend the flame at an angle of 45 to get it up the chimney. The perfection of a grate was when the sides were placed at an angle of 45, the back rising vertically, slightly leaning forward, and the front plate of the chimney a semicircular top with the front bars of the grate in a vertical line with the throat of the chimney, so that the smoke and the flame might rise quietly up the chimney, and the heat be radiated from the two sides and from the back. Then there was a very simple method of economising fuel which had been practised some 25 years ago, and consisted in closing the bottom bars of the grate, by laying in the coals and making the fire on the top, compelling it to burn downwards. He had over and over again had a drawing-room fire lit in this way, and the fire which had been lighted at 10 o'clock in the morning, and had not received an atom of fresh fuel during the day, was a good fire at 11 o'clock at night. That system of economising fuel had, however, not been much used, and indeed had been almost abandoned, because it was impossible to get servants to light the fire in that way. Then another method was by closing the bottom portion of the grate with a thin sheet of iron, the fire being made in the ordinary way. He had been told by one or two ladies that this made a dead fire, and that they could not keep the fire cheerful and comfortable. But he thought what he could do others might do, and certainly the fires in his house were as bright and cheerful and as comfortable as in any house in London. There really was no difficulty whatever in it. The philosophy of the matter he assumed to be, that with the open bottom permitting the oxygen to come in underneath and through the flue, and combining rapidly with the carbon it carried it away before it could give out or radiate into the room the heat that was generated. And if the current was stopped it was reduced, and the life of the fuel was prolonged, for, practically speaking, a fire with the bottom closed, in an ordinary house grate, would consume something like half the coal the same grate would do if the bottom were open. But 19 out of 20 grates would not enable this to be done, because their form was so bad, and the current necessary to force the flame and smoke up the chimney would be stopped. He then proceeded to show by illustration what he considered the best form of grate. Speaking of smoky chimneys, he said there were many reasons why a fire smoked, and the true remedy was to have the front bars so arranged that they were within the breast of the fire. Then rooms smoked because they were made air tight; for to such a pitch of perfection had house-building come that the entrance of air was absolutely precluded. There must be a certain amount of air to feed the fire, and if it could not get in in any other way there would be a back draught down the chimney and that would cause the chimney to smoke. He had sometimes cured a smoky chimney by removing the wood over the lintel of the door for about one inch in width, and so admitting air. Another cause of chimney-smoking arose from the abominable form in which chimneys were made. The smoke ascending up the chimney only required a very small outlet indeed, and not the large flues which were generally made, and on which those cowls which so disfigured London had to be placed. Many houses in London were built without chimney pots. Marlborough House was an instance of this, so was the War Office and a portion of the Treasury Buildings. Somerset House and very many private houses were so constructed now. He concluded by describing the principle on which chimneys ought to be constructed.

Mr. Bartley described an invention of his own. In it a passage is provided, by which, as in the ordinary arrangements of register fireplaces, the smoke and products of combustion, together with all the cooled air, may pass direct to the chimney. That passage is formed to be closed, and a separate passage in front of it is provided by which the smoke, &c., will then be immediately conducted to a channel formed for the purpose down the inside of one front side plate of the fireplace, and thence by a channel or channels formed in or upon the hearth to the inside of the opposite front side plate, and thence to the chimney. When the fire is lighted the ordinary register is left open, and directly the draught has set in up the chimney this is closed. The heated column of air in the chimney has a tendency to ascend, and, in so doing, tends to produce a vacuum over the fireplace; and as the fireplace is carefully fixed with cement into the chimney-piece, the only way in which this can be supplied is by drawing the smoke and products of combustion down the side flue, across the hearth and up the other side. In a short time all these parts become heated and radiate the heat into the room.

Mr. Fordred thought the tendency of the paper and of the observations which had been made were pointed rather to the use of fire-grate manufacturers and of builders. The *Times* had recently asked what was the British householder to do? and hinted at the need of some simple remedy immediately applicable to meet the present state of things. He thought the great error of fire grates was in their construction,—in their being too capacious. The amount of fuel was unnecessarily large for the purpose it had to fulfil. He thought by the adoption of the plan he would suggest, a saving at once, even to the extent of two-thirds, would be effected. What was wanted was simply surface. It was simply the radiation for about three inches of the surface of each fire that really passed into the room. The great mass of fuel in the fireplaces did not benefit the room at all,—the heat either went up the chimney or disappeared in some shape, without affording any benefit. To remedy this was the great need. As to filling up the bottom of the grate with a plate, there were two objections to it, one of which, and the most potent of all, had been mentioned,—that if anything was suggested giving servants any extra trouble, or more dirt or annoyance in any way, it would not be carried out. If the back of the fireplace was filled up with fire clay it could scarcely be imagined to what an extent the fireplace might be reduced. In a room very nearly the capacity mentioned by Captain Galton, measuring 20 feet by 14, in the ordinary fire grate, measured from the front to the back, there was a depth of 9 inches. That could be reduced instantly to 5 inches in the widest part, and it might be curved off so as to be nothing at the sides, and there would be amply sufficient surface for all purposes in a properly curved back of fire clay, which would reduce the consumption of coals one-half, and always give a cheerful fire. In the ordinary grates the fire falls away, but with a back of fire clay it was supported, and gave out more heat. These fire clay backs could easily be fitted up and at a very small cost, in every grate, and it was astonishing the small amount of coal which was consumed, and what a good fire could always be kept up. This principle had not been sufficiently brought under the notice of grate manufacturers. In the Report of a Royal Commission, which was appointed in 1856 to investigate this subject, the whole of the recommendations of the Commissioners seemed to culminate in the important remark, "A good frontage of fire surface should be exposed."

Mr. Copperthwaite gave an account of an experiment which he had tried in a small apartment consisting of four rooms, where the windows were all made of cast-iron, and external air excluded, the admission of air to feed the fire being by means of a tube of four inches in diameter behind the principal fire in the apartment, and thus the heat from one fire was made sufficient to heat the whole cottage.

Mr. George Lamport advocated the collection of the various gaslights in a room in a gaselier, and otherwise into an ordinary sunlight, with a wide flue pipe for ventilation, and the carrying up of the pipe, by a coil or other means, in order to rob the heated air of some of its caloric. By this means it was hoped to obtain three advantages—the ventilation of the lower room, the lighting of it, and the warming of an upper room, a bedroom or other. He also thought that the use of coke in kitchen ranges would be a most important item in the saving of domestic fuel, as the heat from coke was quite as great or more than the lavish and imperfect combustion from coal would give in an English range. Captain Galton's invention was simply an arrangement for a stove which, in some cases, might, with greater economy, be brought a little further forward into the apartment. The advantages arising from it were, that he could diffuse the heat and disperse it in a different way. But he joined issue with Captain Galton there, and said there was no economy whatever in a house from heating the air behind and throwing it into the room; and a remark which Captain Galton made himself he felt justified this criticism. It was in reference to the baker's oven—that the heat wss absorbed by the brickwork and afterwards given out. Now, he maintained that the brickwork at the back of his fire absorbed the heat and gave it out into the house without any loss whatever. His own house had every fire in the interior wall, and they had a radiation of heat always sufficient to warm the room. Captain Galton's arrangement was only an open stove pushed into the fireplace, instead of which, if the fire were brought out further, he might obtain greater heat.

The Chairman, in concluding the discussion, said that his colleague of the Institut, General Morin, the president of the Conservatoire des Arts et Métiers, was regarded as the foremost authority on warming and ventilation in France or Europe. He had experimented on the subject more, perhaps, than any one else, and his book was held to be a standard work on the subject. The General regarded Captain Galton's ventilating chimney as the foremost contribution to this branch of sanitary science in our time, and had proved experimentally that a saving of more than two-fifths of the chimney heat now wasted, and a more equable warmth throughout a room, was obtainable by it. In a cottage of his own, and in others, he (the Chairman) had seen very satisfactory results obtained by it. But the difficulties described by Mr. Bartley, of applying the principle in the form used by Captain Galton, had led Mons. Joly, the author of one of the most able works on warming and ventilation that had lately been produced, to experiment on the subject, and he had succeeded in producing an open fireplace, with a circulation of heat, that warmed a considerable amount of surface, which surface warmed a current of air, fresh air brought into the room to be discharged afterwards as vitiated air through the chimney as in Captain Galton's method. Mons. Joly stated that it had been proved experimentally that the air warmed by the new grate, which was advanced into the room, ascended to the ceiling and circulated in the same manner. It was to be hoped that we should have plans and working specimens of the improvement soon displayed here. But he trusted that M. Joly would be able to effect his warming with earthenware surfaces instead of with iron surfaces, which produced different and sometimes injurious results with the same heats. He (the Chairman) had conceived an introduction of the Chinese method of floor-warming, which was in principle the same as the Roman method of floor-warming, which was also successful. There was no method of applying heat so economically as applying it to the feet, for if the feet were kept warmed a colder air might be breathed. It was peculiarly applicable to schools and to workshops, and to places of sedentary occupations. It had been lately successfully applied to military hospitals in Paris and in America, not in opposition to the ventilating chimney, but in combination with it. He had not seen the experiment described by Captain Galton, but he had been informed that the floor was heated to an extent which made it disagreeable to stand upon. This was decisive that the floor was ill-constructed, or ill-used, for it should, if properly used, be only warmed to an extent not to feel cold and to give the mildest diffused warmth. The experience of its superior economy was decisive in China, for it was used where there was no coal, and where they were compelled to economise the use of any scraps of fuel they could get. He concluded by moving a vote of thanks to Captain Galton, which was passed by acclamation.

Captain Galton, in reply, said with reference to Mr. Bramwell's remarks on the temperature of the gas in the chimney, the experiments he relied on were those he made some years ago. No doubt there was great difficulty in observing the high temperature in the flues without a pyrometer like Siemens'. He had relied, as he said, partly on his own experiments and partly on the experiments made by the commission on coal, in which almost every case of evaporation of water the temperatures were given, and the flues were heated 350° and 400°. With respect to the gentleman who said the same amount of economy would be obtained through a fire-place brought forward into the room that was obtained for his ventilating fire-place, he would observe that if the fireplace was brought into the room there was still the element of cooling down, from the introduction of cold air brought into the room to replace that which was carried up the chimney. But if that gentleman had tried the temperature of the gases as they passed out of the top of the chimney, as he had, he would have found that a considerable amount of heat was carried up beyond the brick-work. In a London house almost every fireplace would warm one's neighbour's house, but not one's own. The fact of the gases passing out from the top of the chimney at a very high temperature was his answer to the objection. In his invention the object was to cause it to pass out at a lower temperature by abstracting a good deal of heat. He agreed with Mr. Fordred that one simple mode of economising fuel was to put into a fireplace some fireclay, for that radiates the heat out into the room.

COMMITTEE ON THE MEANS OF PROTECTING THE METROPOLIS AGAINST CONFLAGRATION.

The following evidence was given by Mr. J. Quick, C.E., engineer to the Southwark and Vauxhall and the Grand Junction Water Companies, before the Committee.

Q.—A good deal of the waste now is owing to the intermittent system?

A.—Yes. They leave everything open to receive all the supply of water that can come on.

Q.—You think, then, that, given good fittings, there would be less waste on the constant system than on the intermittent system?

A.—Yes; good fittings and waste-preventers to the water-closets, otherwise persons will leave the valve up, and there will be a constant waste.

Q.—You do not attach importance to the waste-preventers otherwise than in the water-closets?

A.—No.

Q.—Are the water companies in a position to be able to give a constant supply of water?

A.—As far as the trunk mains go; but it would be necessary to separate the higher portions of the district from the lower. You require to maintain the pressure to the houses on the rising ground, and if there were several thousand houses on a low level, they would take all the water away unless there were a separate main. That is one of the things which the companies are now doing.

Q.—The pressure is obtained by pumping the water to a certain height, when it flows by its own gravity?

A.—Yes.

Q.—So that under a high-pressure system you have to be constantly pumping the water up. You would form a reservoir above the level of the houses?

A.—That is one plan; or pump it up a stand-pipe, and maintain it there by constant pumping.

Q.—If the high-pressure system were the general rule you would require large reservoirs in the outskirts on high ground, from which the water would flow by its own weight?

A.—Yes.

Q.—While there are separate companies each would have to make its own arrangements, and thus much expenditure would be incurred, which, under a consolidated system, would be unnecessary.

A.—Certainly.

Q.—At the time the offer by the General Board of Health was contemplated, the capital required, in round numbers, was about £6,000,000. Since then it has been raised to £9,000,000 or £10,000,000. Would it be too much to say that about £2,000,000 of that might have been saved on a general system?

A.—There is no doubt a vast amount of it might have been saved; as, for instance, the 23 miles of pipe laid down from the east of London to Sunbury. The Chelsea Company are now proposing to extend their works separately to Thames Ditton, under a general system that would have been unnecessary, because the Lambeth Company went up there to the same spot only last year, and the two companies might have joined in making one culvert.

Q.—That is an example of what must happen to the separate companies in other districts, leading to like waste?

A.—Certainly; particularly in trunk mains and reservoirs.

Q.—In case of a constant water supply, do you propose to dispense with cisterns altogether?

A.—No; certainly not. We should maintain the present cisterns, but should not place them in new houses, unless required by the owner, as there is no necessity for it. It would be simply a matter of convenience for the house.

Q.—Is there any truth in the statement that under a constant-supply system there would be a danger of the pipes bursting in case of frost, and flooding the houses?

A.—I do not think so, because the pipes should be put below the influence of the frost, and in case of severe weather the water should be turned off at night.

Q.—Every house should be provided with a stop-cock to turn off its own supply?

A.—Yes.

Q.—Can you give any opinion as to the whole of the companies being willing to hand over their works to the government on receiving reasonable compensation?

A.—I think some of the companies would be willing to entertain such a proposal, if three years' average dividend was taken, and some such stock as the Metropolitan Stock given to the shareholders, equivalent to the amount they now receive in dividend.

Q.—That is to say, security for the existing dividends?

A.—Yes.

Q.—What might be the probable or possible expense of uniting the trunk mains of the eight companies, so as to enable the supply of the metropolis to be brought to bear, as suggested, on any point to arrest conflagration?

A.—I cannot answer at once, but I have a confident belief that it might be done at an expense under one thousand pounds certainly—possibly much less.

Q.—As a rule, does it pay to take up mains after they are once put down?

A.—Not 4 or 5 inch mains; it would 9 or 12 inch.

Q.—What is the life of a main?

A.—We have had some mains down for 60 years, and they are just as good as ever; in fact, they seem to improve; the iron seems tougher than the new pipes.

Q.—Will you explain how you expect the saving of £100,000 a year which you mentioned would be accomplished by a consolidation of the different companies?

A.—In a variety of ways—office expenses, engineers, solicitors, directors, secretaries, clerks, consolidation of works, turncocks going over each other's districts, taxes, and all sorts of things. Then there would be a great reduction in the quantity of water, requiring less pumping, which, at the present price of coal, is of great importance.

Q.—It would not be possible generally in London to obtain sufficient pressure from the hydrants to dispense with fire engines?

A.—It depends in a great measure on the size of the pipes. There are several miles of pipe in London where you can get a jet 100 feet high.

Q.—Would it be possible in many parts of the Southwark and Vauxhall district to dispense with fire engines if you had hydrants and a constant supply?

A.—In the Borough High-street and Tooley-street, and some of the main streets it would be so.

Q.—And in the Grand Junction district?

A.—The same thing applies wherever the leading mains are laid. In all other places fire engines would still be needed.

Q.—How many fire-plugs are there in London?

A.—70,000 or 80,000.

Q.—You consider that hydrants would be a great improvement upon the plugs?

A.—Yes; the only obstacle to their introduction is the cost.

Q.—Assuming this matter to be taken charge of by the government, would it not be necessary for them to have the control over the means of removing the waste water to prevent damp, &c.?

A.—It is equally desirable that there should be adequate means of taking the water out as of taking it in. Many poor people are put to dreadful inconvenience from having too much water in their houses.

Q.—Are you prepared with any suggestion for any mechanical means which could be adopted for supplying small householders with a constant supply of water, without occasioning waste to the companies, and without allowing the householder to be annoyed by too strong a supply on any particular occasion?

A.—I made a suggestion some years back of this kind—Assuming there to be a row of 20 houses of the same altitude, to put a cistern on the first house, and carry a service pipe up from the company's main to the cistern with an ordinary ball-cock, then to take a pipe from the cistern to the main beyond the stop-cock of the company, so as to keep the main charged from the cistern with a pressure only equal to the height of the cistern. If this were carried out, there would be nothing more required than a draw-tap on the service pipe in each house to afford the supply, and as the cistern would be charged from the water company's main, there would be little or no waste, and no undue pressure thrown on the lead pipes and fittings.

Q.—You before stated that whenever a fire occurred, and the water was put on full force, many persons turned on their cocks in order to prevent the pipes bursting?

A.—Yes, they let them run, to prevent the pipes being damaged by the extra pressure.

Q.—Could not they then have a constant supply without altering the present fittings?

A.—No, the fittings are in such an imperfect state that it would be absolutely necessary to make an alteration in almost every case. In the first place there is nearly a total absence of taps in the poor districts, and the pipes are so very defective that a certain sum must be expended on the fittings, and that is one of the great difficulties to be overcome.

Q.—You have the power now of doing it at their own expense, but you are of opinion that it is in fact impracticable?

A.—I do not think it could be done in poor neighbourhoods like Kent-street, Borough, which is one of the worst class of streets; and to begin to do anything there, unless under some public authority, would be almost an impossibility.

Q.—It has been stated that the actual cost of putting on a constant supply in Wolverhampton did not amount to more than sixpence per head of the population, and considering all things it might be done for about two shillings per head. You cannot hold out any prospect of similar economy in London?

A.—No; I think that was done under peculiar circumstances. Very few houses at that time were supplied, and I think the calculation must have been taken on the entire population, as the water was not supplied to more than 700 or 800 houses.

Q.—Do you think the cost of enforcing the constant supply should fall on the landlord and not on the tenant?

A.—It depends on how the property is held.

Q.—You mean that many persons have only the remainder of a lease of four or five years?

A.—Yes, that is very commonly the case in London. There are many people who have two or three or more houses, bringing in a few pounds a year, and it is almost impossible to get them to make any outlay on the property—in fact, they have not the money to do so.

Q.—Are not the companies at an extra expense in laying the water from the mains into the houses *de novo* on account of the paving expenses?

A.—Yes; the paving is a very serious item, and unfortunately the companies are called upon to pay two or three times as much as the work is contracted for in the same district. That is to say, the paving commissions get the work done for less than the companies.

Q.—If it were put on a public footing, what amount would be saved under that heading, supposing it could all be done at contract prices?

A.—I cannot say. It would be a very large sum.

Q.—How many junctions do you make in the year?

A.—The Grand Junction made 4,300 openings for repairs, alterations, and additions, in one year, and that in a very small district. You may probably take the average, by the whole of the companies, at 40,000 openings per annum, some large and some small, amounting to a very serious sum. The charge for making good the macadamised road is nearly the same as for paving.

Q.—If the work was done under authority, would the saving of £20,000 or £30,000 a year be effected?

A.—Something approaching it.

Q.—On the whole, at every point, there would be an economy in amalgamation, or putting the water supply on a public footing, as well as an increase of security?

A.—Certainly; an increase of economy in every point of view, as it is impossible for the companies separately to avoid a certain amount of wasteful expenditure. If a constant supply were carried out under the regulations passed last year, it could only be done at a very enormous outlay.

Q.—If you were not connected with a company, and had only the general public interest to consider, how would you carry out this charge—by a local administrative body or by a special body?

A.—I think by a special body.

Q.—You think a special body might take the machinery and put the parts together, and put the machinery in order and then hand it over afterwards to any administrative body that the Government might appoint for the general government of London?

A.—Yes, I think that is the only course.

Q.—One great objection to the Metropolitan Board of Works having jurisdiction would be that it does not cover more than half the ground covered by the companies' pipeage?

A.—That is so. I could point out on the map the exact districts covered by the different companies, and the area embraced under the Metropolitan Board of Works.

Q.—Do not some of the companies supply the water beyond their parliamentary limits?

A.—Yes.

Q.—For economy and efficiency are you of opinion that the whole matter must be taken up as a whole and not divided into separate districts?

A.—Certainly.

Q.—The Metropolitan Board have not the necessary functions for carrying out a work of this sort, have they?

A.—No, they have no staff, or powers of dealing with any of the mains or pipes of the companies.

Q.—The water companies did not consider the Board a very ineligible body to treat with?

A.—There were great difficulties on account of so much of the water companies' districts lying outside of their boundary.

Q.—Is there not another reason against the Board undertaking the work, that during the last 10 years it has been more abused than any other public body?

A.—They are not very popular with the public, I must say.

Q.—The present waste of water may be said to be 30 to 40 million gallons a day. Suppose you had to supply that quantity *de novo* to an outlying district, what would that represent at the usual cost of supply?

A.—A million and a half to two millions sterling.

Q.—Then it may be said that the waste now going on represents that amount of capital?

A.—I do not know that you can take it in that way. The saving to the companies would be merely the cost of coal and engine stores. They would require the same staff and the same supervision.

Q.—We understand there are rival claims for this jurisdiction on the part of the corporation, who came in and put forward claims on behalf of the general public. May it not be said that they have the conservancy of all the water district from which many of the existing companies draw their supply?

A.—The Thames Conservancy extends as far as Staines, and are part of the City authorities. The companies pay them now something like £8,000 a year for the privilege of taking the water.

Q.—Has not the corporation so managed their affairs that if the choice were with the inhabitants they would rather side with them than with the Metropolitan Board of Works?

A.—I think the public would have much more confidence in the City Corporation than in the Board of Works.

Q.—Do you think that the public will have to look, before long, to another source than the Thames for the water supply?

A.—I think that is a great question; the whole subject was gone into very carefully before the Royal Commission, and it ended in the Thames water, when properly filtered, being considered good water, wholesome and fit for drinking and trade purposes.

Q.—In your opinion has it improved or deteriorated of late?

A.—Improved, I think, very much, and when the Upper Thames is made more pure, there is no water more suitable for all purposes. The brewers and all large consumers prefer the Thames water. And it does not deteriorate by storing.

Q.—Have not many of the brewers artesian wells down through the chalk?

A.—Mostly for refrigerating purposes, not for brewing.

Q.—You have stated generally that the metropolis being now supplied as no other city is or can be supplied economically, in independent districts, with only the power of the district supplies to stay a great conflagration; that there is, as a rule, only a third of the mains and services in the whole metropolis under a constant supply; that there is an accruing waste of water, equal to the supply of nearly two millions of additional population, which might be prevented; that there is an accruing waste of expenditure in separate establishments of upwards of one hundred thousand per annum, which, if it were economised and skilfully applied, might effect the chief works immediately required. But that there is farther large waste impending on works to make each district supply complete in itself for the general works for the constant supply; and that there is, moreover, a large impending waste on the individual consumers to be incurred, under the present measure, which obliges them at once to provide separate internal fittings by immediate outlays of an aggregate extra expense of a million, or a million and a half. Now, with these conditions, by what administrative means do you consider that security may be obtained, and this great waste prevented?

A.—I consider that, the more it is examined, the more closely it will be perceived that what is required to be done with the least delay is to unite the works of the separate districts, to make the alterations required of the mains and private service pipes, which is a very special engineering work, requiring engineers practically conversant with the new system. This engineering work would be best done, and, indeed, can only be reasonably expected to be done, speedily and safely, by a special commission, comprising men of science, who are conversant with the work. After this had been accomplished by a special commission it might be given over to any representative body.

Q.—Then to refer the work to any general representative body in the first instance would, it might be said, be like referring to them the pieces of a steam-engine, of which they could have no practical knowledge, for them to put together; and that there would be, at the best, a great loss of time in getting them acquainted with it, and imminent danger of loss from mistake, as to the choice of hands into which it might be put?

A.—Of necessity it would be so.

Q.—Besides very special engineering work required to put the pieces, or the district works, together for joint action as one machine, it would seem, then, also that special technical or administrative service is also required, as that of accountants, to lay down a system of collection, and expenditure, and account, and to consolidate the eight independent establishments, for united action, as one piece of administration?

A.—Yes; but this has been in part commenced by Mr. Stoneham, the auditor appointed by the Board of Trade. He has simplified and consolidated the accounts, which are now printed by the Board of Trade. The next would of course be the reduction of the number of establishments and of officers, and the consolidation of the collection and expenditure, which would be technical work, to get the administration in working order as one machine.

Q.—Two local administrative bodies, the Corporation of the City of London and the Metropolitan Board of Works, presented themselves before the Board of Trade Commission in the position of representatives of the population of the metropolis, or as candidates to undertake the work. So far as you observed, did either appear to be aware of the practical principles involved, such as that for economy and efficiency and security the entire water supplies of all the separate districts must be united, and that the aggregate area of these districts went far beyond the area of their jurisdictions, nearly the double of that of the largest?

A.—They were certainly unprepared for this position when they appeared before the Commission, and I have not seen that the matter has been yet made clear how they would handle the difficulty. The extension of the jurisdiction would no doubt be a matter of very great difficulty for either body.

Q.—Assuming that the work of any provisional authority having been completed, it were expedient, without waiting for what has been sought for, the constitution of a new general metropolitan government, to give over the completed works to either of the existing local representative authorities, which do you think would be preferred, and would, in your own view, be preferable?

A.—Of the two most decidedly the Corporation of the City of London. It would have the most public confidence. It has an ancient jurisdiction over the Thames and its tributaries from Staines, and, indeed, beyond that, from Oxford down to the Nore light. The Corporation has also in its chamberlain and offices a more solid established working staff. I would press, however, that the immediate work to be done would require provisionally the undivided attention of a very special board.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

Her Majesty's Commissioners have decided that school children, in bodies of not less than 50, shall be admitted to the International Exhibition of this year at half price on any shilling day. One adult will be allowed to accompany every twenty children at the reduced rate. Tickets must be obtained at the Ticket-office, Royal Albert Hall, two days before the day of the visit, and paid for on delivery.

It is stated that Austria has come to an understanding with the other Governments that no decorations are to be given in connection with the Vienna Exhibition.

Extensive saltpetre grounds have been discovered in the great Atacama desert.

EXHIBITIONS.

VIENNA EXHIBITION, 1873.

A communication from Vienna in the *Debats* says:—"The rumours of a probable postponement of the opening of the Exhibition here are entirely devoid of truth. Other reports spread in different quarters about the extreme dearness of living, the dearth of lodgings, and the unfavourable sanitary conditions of the Austrian capital might indeed, if well founded, discourage foreign visitors. The information which we receive on this subject are of the most reassuring nature. The Austrian Government and the Vienna Municipality, which are most anxious to ensure the complete success of the undertaking, are taking all possible measures to provide largely for the wants and conveniences of the expected guests, and prevent every sort of imposition."

The Australian colonies will, it is said, be well represented at Vienna, and large consignments of goods are now *en route* thither. Victoria sends an ample display of pastoral and agricultural produce in the shape of meats, wools, wines, fruits, and grain, and a fine collection of minerals and ores. The Queensland court will be conspicuous for the series of coloured photographs taken by the Agent-General, which were displayed in the Queensland annexe in last year's International Exhibition. A huge block of malachite and a large gold nugget also accompany the collection. New Zealand will be represented by a series of ores and minerals contributed by the Mining Department of that colony; also woods, wools, and a cabinet of the bones of extinct birds, osteologically restored. South Australia shows cereals, wines, and other produce. The whole of the Australian exhibits are under the charge of Mr. G. Phillips Bevan, F.G.S., who has been appointed the Commissioner at Vienna for the Australian colonies.

An International Corn and Seed Exhibition is to be held at Vienna on the 4th, 5th, and 6th of August.

The following communication from the Chevalier de Schaeffer, Deputy Consul-General for Austria and Hungary, appeared in the daily papers of last week:—"I have received the official communication that the Universal Exhibition at Vienna will be opened on the 1st of May, 1873, by His Imperial and Royal Majesty in person. A central bureau has been established at Vienna, Liechtensteinstrasse No. 9, where visitors will always find apartments at moderate terms, from 2, 4, 6, to 10 florins per diem."

A remarkable specimen of bookbinding from London is to be exhibited at the Exhibition. It is a copy of the Doré Bible, in two volumes, bound at a cost of more than £300. The patterns are produced by inlays of different coloured leather, in one case separated throughout by a gold line, in the other not so. The change on the colours produced by the gold line is very interesting; it is difficult to believe that the colours are the same.

We understand that it is intended to take advantage of the approaching International Exhibition at Vienna to convene a Congress on the question of patent rights, the proposal being due to the initiative of President Grant. The Congress will meet on the 4th of August, after the juries have made their awards. It will be composed of manufacturers, scientific men, political economists, and other experts, and skilled workmen. Each Government will be represented by a special delegate, and must apply before the end of June for participation in the Congress. A committee will be appointed to prepare the materials for inquiry. The Director-General, Baron Schwarz-Senborn, will open the Congress, which will then from its own members elect a president and a bureau.

Exhibition of Life-Saving Apparatus.—At the meeting of the Northfleet Relief Committee, on Wednesday last, with reference to the forthcoming exhibition at the London Tavern of the various inventions for saving life at sea, Mr. Walker stated that 134 models had been sent in, 27 being those of life-belts, buoys, and mattresses, 11 of life rafts, 23 of lifeboats, 36 of appliances for lowering and detaching ships' boats, 25 of signals, 3 of rockets and mortar contrivances, and 9 of miscellaneous articles, in addition to 46 drawings and designs. The exhibition will be opened on Easter Monday, and will last until the following Monday. The admission to it on the first day will be by ticket, but on the other days it will be open to the public without such restrictions. For the convenience of working men three evenings have been set apart, and the exhibition will then be open from seven till ten. On the last day (Monday, April 21) it will close at four o'clock, and in the evening it is intended, if the Ranger's permission can be obtained, to make a trial on the Serpentine of the various inventions for signalling at sea. It was determined to ask his Royal Highness the Duke of Edinburgh to open the exhibition, but if he is unable the duty will be discharged by the Lord Mayor.

INSTITUTION OF NAVAL ARCHITECTS.

The 1873 session commenced on Thursday last, when a meeting was held in the theatre of the Society. The Secretary read the annual report of the Council, and an address was delivered by Sir John Pakington, Bart., M.P., &c. The meetings will be continued to-day and to-morrow.

PURCHASE OF RAILWAYS BY THE STATE.

The meetings of the Statistical Society have recently been occupied by this important subject. On Tuesday, March 19, Mr. R. B. Biddulph read a paper, in which the question was discussed, before the Society. Referring to the possession by the State of the post-office and telegraph-office, he strongly advocated its acquirement of the railways also. He pointed out the advantages that would arise from the entire system being under one management and one control, and showed that a uniform scale of fares for passengers and goods might be adopted, while extensions into poorly-populated districts, which now would not pay, might easily be made. Mr. Martin entered fully into the details of the scheme he proposed. The cost of the purchase would be about 600 millions, and to obtain this he would establish a stock to be issued at 90 per cent. and repaid at par. Mr. Chadwick, M.P., and Mr. Dudley Baxter, spoke in favour of the scheme, and the discussion was adjourned until the following Tuesday. On that day a second adjournment was made till last Tuesday, when Mr. Allport, general manager of the Midland railway, spoke against the proposal, urging the danger of throwing so much patronage into the hands of ministers, and suggesting that the profits would be much less than had been stated.

At the the last meeting Captain Tyler, one of the Government Inspectors of Railways, stated his views in a lengthy address, which he was careful to explain was given in his private capacity. Captain Tyler began by asking a question in which the whole matter was comprised, namely, what would happen in a few years if the State does not purchase the railways? Combination and amalgamation between companies would naturally increase, leading, sooner or later, to an absolute and universal monopoly, and the question therefore was, would the British public prefer, by State purchase, railway control and management by the State, or complete monopoly by a vast combination of railway companies. In his opinion everything pointed to the unavoidable necessity of the purchase of our railways by the State, and the sooner the transfer was effected the better. Captain Tyler then gave many details of the method by which the needful changes might be made, consistently with economy and other requirements. He was succeeded by Mr. H. Chubb, secretary to the Bank of England, who went into the financial aspect of the question, and showed the process of transfer might be effected with less difficulty than was generally supposed.

THE PATENT LAWS.

Few men were better qualified by experience to judge the present patent system, or to suggest needed reforms, than the late Wm. Bridges Adams.—We annex an abstract of the views submitted for publication by Mr. Adams, to Geo. Haseltine, LL.D., the well-known patent solicitor, which have a special importance of their own at the present time.

The grant of patents, he says, should be limited to actual inventors and their legal representatives, and this limitation is desirable, no less in the interest of the public, than in the interest of "true inventors," as distinguished from "first importers" of inventions. Though inventors have no natural rights, all rights being the creations of law and law the creation of superior power, yet it is wise in legislators to confer such rights on inventors as will stimulate them to exercise their inventive faculties, and, through self-interest, to make their inventions public. The original term of a patent should be at least twenty-one years, and should continue during the lifetime of the patentee, and in all cases an extension should be allowed as a matter of course if the invention has proved unremunerative by no fault of the proprietor. The term invention, he says, should be interpreted to include, not only what is absolutely new, but that which has been in abeyance for a given number of years and was unknown to the patentee. The patent fees should be sufficient to provide for the legitimate expenses of an efficient system, inclusive of the cost of a patent court in which all matters relating to the title in patented inventions would be determined. The patent should be granted at the option of the applicant, after receiving the opinion of the officials, who should be required to make an examination into the novelty and utility of the invention, and report any conflicting claims; and after the grant is made, the validity of the patent should be decided by the special court without costs to the individual patentee, the expenses being paid from the general patent fund. The title to the patented invention, when once confirmed, should be indisputable in other courts, and actions for damages would then involve matters of ordinary evidence, to the exclusion of expert or scientific evidence, which now renders patent suits so expensive. In determining the validity of the grant, the patent court might receive "expert" testimony, on such conditions, however, as would place the poor inventor on an equality with the capitalist, and competent counsel should be assigned to needy suitors, as in criminal cases, and the court should have power to punish infringers and the suppressors of evidence of infringement. The court being free, the patentee and the infringer would alike be deprived of the power of working an injustice by means of superior wealth. The inventor and the capitalist under such a system would become equally interested in the progress of inventions and the suppression of piracy, which would, in a great measure, cease.

When the legislature makes "patent-rights" a property as secure as other property, such as copy-right, these rights will be sought by intelligent capitalists as a safe and profitable investment, the inventive faculties, stimulated by a fair prospect of pecuniary success, will be largely developed, and the national prosperity immensely increased.—*Engineering.*

Recent advices from Melbourne state that in consequence of a strike coal has gone up to 70s. a ton, about three times its normal price.

ON THE ELECTRIC LIGHT.

By W. H. Walenn, F.C.S.

I.

Light is a subject which has not only engaged the attention, but has also raised the enthusiasm of men, from the most remote ages. Artists have illustrated, and poets have described, the beauties that belong to this manifestation of the Creator's fiat; it has gladdened darksome hearts, illuminated feeble imaginations, and, latterly, shed its rays abroad upon science and its applications. One of the first points was to devote experimental science at its birth to the investigation of the laws of light; thus light, one of the principal means of inquiry used by the modern physicist, was made to shed its first lustre upon the principles and essences which form its own entity. This turning of light inwards upon itself is like the sharpening the tools of the worker by means of the laws of their own nature. Taking this view of the subject, and illustrating it by another example—as the first thing a mechanical engineer does is to make sure that his lathes and his vices are all truly in position and firmly fixed, so with the experimental philosopher, his first care should be to ascertain that he has mastered the principles and practice which govern light, the sharpest and most searching of all the tools of the investigator.

Though the advent of science has been gradual, experimental science almost began with Newton and Boyle, towards the end of the seventeenth century. The sun's light has been eminently the object of research, and, starting from the emanation theory of Newton, it soon was its own expounder, and showed, by means of its searching and enlightening power, that (according to the view of Christian Huyghens) waves were the true means of propagation, just as much in the case of light as of sound. In short, that light is the impartation of a definite kind of motion or vibration to particles, both in speed and direction (or perhaps it may be said configuraation), is a definition which is satisfied by every effect which light produces.*

Sunlight is the grandest development of the subject of light in general; for all artificial light is but one instance of sunlight on a small scale, since each variety of artificial light may be said to be a kind of light forming one species, of which the sunlight affords all species, or nearly all species. The *intensity* of sunlight, which is the chief point we shall have to consider, is due to the *speed* of the vibrations; and any light that is able to do full justice to the substance supporting it, must have the speed of vibration of its particles increased to its maximum. When the sunlight leaves us, and we have to contend against night, the most perfect substitute for the sun will be the most perfect light. It is, perhaps, not possible to arrive at a definite conclusion respecting the forces that determine the light of the sun, but it may be safely assumed that chemical forces are accompanied or aided by electrical forces. This is stating the case generally, and it is all we can hope to do until the limits of our knowledge are widened; for we cannot employ our imitativeness to make an artificial sun, inasmuch as we neither know the detailed data, nor have we the means of exactly copying the sun on a small scale. It is a great deal, however, to know that (1) active chemical change and (2) electrical disturbance are the two causes, powerful in their character and conjoint in their action, that produce sunlight, and we cannot go wrong if we employ these agents or principles to produce artificial light.

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* The emission theory of Newton is sometimes called the Corpuscular theory. It supposes that the particles of light are material in their character, and are shot out from the source of light as a ball is out of a cannon, proceeding in straight lines throughout all space, and affecting the organs of sight by impact. On the Undulatory theory, advanced by Hooke, and taken up by Huyghens, a luminous body, by its vibrations, excites similar vibrations in the surrounding medium, producing waves which affect the eye; it implies that a substance, capable of receiving and transmitting these waves, pervades all space. The Corpuscular theory totally fails in explaining many of the extraordinary effects brought out by modern experiments; the Undulatory theory, on the other hand, fully explains the phenomena of polarised light and other remarkable results.

Ordinary artificial lights are the result of active chemical forces, so that a given material is changed in its nature or in its entity after it has been made the means of giving out light. For instance, common coal-gas, before burning, consists principally of carbon and hydrogen in the proportion to form olefiant gas (C_2H_4); after burning in air (or being combined with oxygen at a high temperature), it results in water and carbonic acid, as shown by the equation $C_2H_4 + O_6 = 2\ (H_2O) + 2\ (CO_2)$, and the change of state brought about by the uniting of oxygen with the constituents of coal-gas at the heat of the burning gas, initiates vibrations that result in light. The speed of vibration to be obtained by the change of state induced by or upon a given chemical substance, admits of a definite limit; and it may be said that there is a finite numerical value to the most energetic of all chemical combinations, thence to the speed of the molecular vibrations or undulations of the light-giving substance, and to the amount of light given out by it.

Collecting the data by which to establish a logical theory that is capable of pointing out the best method to produce artificial light, and bearing in mind that the higher the temperature of combustion the greater the amount of light evolved, because of the increase in the speed of molecular vibration thereby, it will be perceived that any power which will either raise a given substance to a great heat or induce rapid chemical change, or both, will afford the means of obtaining strong artificial light. Further, it is now evident that the intensity of the resulting light will increase with the heat and with the quickness of the chemical change involved in the combustion. With these principles in mind, we can profitably resume the consideration of the analogy traced out between sunlight and artificial light. In the ordinary artificial lights we have established the fact of chemical change resulting in illuminating power; it remains to supply electric disturbance of such a character as to cause the heat of combustion to be elevated—precisely in proportion as these two principles are brought to bear will be the approximation of the resulting light to that of the sun. In endeavouring to adapt this theory to practical lighting, we find that the electric light between charcoal points, as originally produced by Sir Humphrey Davy, about the year 1813, very nearly fulfils the requirements of the most intense light, as suggested by the above analogy.* This statement is only true of the simple *production* of the light, and it has yet to be ascertained whether continuity and constancy of illuminating power, as well as economical working, can be accomplished. In the apparatus for the production of the electric light, the destruction of zinc which takes place in the battery cells is the analogue of the chemical force of the constituents of the sun; the interruption at the luminous point in the electric circuit is the analogue of the electric disturbance. It happens, however, that, having only to imitate the sun's powers so far as light is concerned, and having the ability to separate the two classes of force (chemical and electrical) by instrumental means, we can do in respect to our light what is not done in the sun—namely, we can separate the chemically active and producing forces from the electrical results which they yield, and so have the source of light at a distance from its manifestation, thus utilising and bringing to bear all the chemical energy upon the light itself, and placing the light in any situation that may be convenient for the user. In the electric light there would also appear to be another peculiarity which has not yet received sufficient attention—the amount of light is dependent upon the battery power used, the area of the battery plates having a direct relation to the diameter of the carbon cylinders employed, and the number of cells in like manner determining the distance that the carbon cylinders or electrodes may be placed apart.

Boyle's name has been mentioned as having given great character to experimental investigations, and this is exemplified in electric science, for he was the first to fully realise the mechanical attribute of ordinary electric force; the reciprocal relation of the electrifier and the electrified body was established by him, and the idea then elucidated is exhibited in the convective discharge between charcoal points, for in this discharge there is absolutely a conveying over of particles from the positive to the negative electrode.

(*To be continued.*)

CORRESPONDENCE.

CHANNEL PASSAGE.

Sir,—After attending the Committee in April, 1872, to give evidence relative to an improved class of steam vessels for Channel service, I gave my attention to the subject, and, in connection with my friend Mr. J. D. Lee (of Northwood-park, Cowes) have produced a plan which we think meets the requirements, and have taken out a patent for the same.

In carrying out our ideas as to the plan of vessel, we have taken into consideration that great size would have great advantages in reducing the motion in narrow seas, where the waves are comparatively limited, but other circumstances have to be considered in carrying out a practical scheme for Channel service where we have to contend with a beam-sea, bar-harbours, and narrow entrances. Having taken these facts into consideration, we propose vessels of 250 feet in length, 33 feet beam, 1,385 tons, and to draw seven feet six inches of water, having a speed of seventeen miles per hour, as being sufficient to give all the accommodation required in saloons on deck, private cabins, and perfect ventilation below. In a commercial point of view vessels of this size would be a safe and paying investment.

To reduce as far as practicable the rolling motion in crossing a beam-sea, as well as pitching in going against a head sea, we have thought to secure these advantages by altering the form of mid-ship section now adopted in ordinary ships, from convex to concave, thereby throwing the buoyance on two sides or bulges, by which great stability is obtained, and the metacentre raised to the highest point. Ships of this construction may be said to saddle the water instead of sitting upon the rounded form, as in the old construction.

As regards navigable or steering properties, she will be much quicker than ordinary vessels in answering her helm. This desirable and necessary qualification is secured by the peculiar form of the bulges, which gives the bottom a considerable camber, the lateral resistance to turning being reduced by the bow or fore-body also being cambered, and the water having a clear and straight path to the rudder, formed by the concave bottom and bulges, instead of having to flow round the ship. This is of first importance in the special service for which these vessels are designed.

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* This light, the consequence of the convective discharge between charcoal or carbon points, called "the voltaic arc," was produced by means of the galvanic battery of the Royal Institution, which consisted of two thousand pairs of zinc and copper, each having a surface of thirty-two square inches, and charged with acidulated water. The account of the trial is as follows:—"The most striking effect of this kind is produced by placing pieces of charcoal, shaped like a pencil, at the two ends of the wires in the interrupted circuit, and bringing their points into contact. The appearances, when the experiment was tried by the powerful battery of the Royal Institution already noticed, were singularly beautiful. When the pieces of charcoal were brought within the thirtieth or fortieth part of an inch of each other, a bright spark was produced; and at the same time more than half the volume of the charcoal, which was about an inch long and one-sixth of an inch in diameter, became ingited to whiteness. By withdrawing the points from each other, a constant discharge took place through the heated air, in a space equal at least to four inches, producing a most brilliant arch of light, of considerable breadth, and in the form of a double cone."—(See Davy's *Elements of Chemical Philosophy*, pp. 152 to 154).

We, therefore, with permission, place the model in the Society's Room, and if it will in any way advance the cause in obtaining an improved class of steam vessels, in which the Society has taken so great an interest for the benefit of the public, we shall be gratified.—I am, &c.,

John White.

Medina Docks, Cowes, April 1st, 1873.

SEA SIGNALS.

Sir,—Besides recent letters upon this subject, in the *Times*, 27th January, suggesting the electric light of M. Gramme; 29th January, suggesting colours for distress-rockets, by Captain York, R.N.; 30th January, suggesting life-ships; 31st January, suggesting signals or the particular distress; 4th February, from Admiral Ommanney, suggesting government inspection of ships, &c., *Good Words* for this month contains a paper by Sir William Thomson, LL.D., F.R.S., pp. 217—24, in connection with danger signals, connected with this subject, although it applies chiefly to lighthouses. The writer alludes to the invention of Mr. Charles Babbage, one part of which, night telegraphic communication, "between ships at sea has been adopted, with marked success, in the system of signalling by flash lights, introduced practically by Capt. Colomb, ten years ago, and now in regular use in in our navy and in submarine cable expeditions."

A note from Mr. Babbage to the *Times*, 16th July, 1855, is printed in this paper, showing his plan for displaying small and large numbers; for instance, 2, 7, 4, in "little more than half a minute," useful, but "not the best in detail," nor equal to Capt. Colomb's plan in utility, which is worked in connection with the Morse telegraph alphabet, as is mentioned in *Good Words* for January, 1867.—I am, &c.,

Chr. Cooke.

March 28, 1873.

MANUFACTURE OF PRINTING TYPES.

Sir,—At the time when my paper on "Certain improvements in the manufacture of printing types" was read before the Society of Arts, on the 19th ult., I was suffering from bronchitis, and consequent deafness. I caught but a small portion of the points raised in the discussion, and hence my imperfect reply. Under these circumstances I trust to your sense of justice to insert the following remarks upon the attacks made upon me.

I should have pointed out that whereas the operations of the type-founders consist of six distinct manipulations —1, the casting; 2, the breaking-off; 3, the rubbing; 4, the setting up; 5, the cutting out the foot; and 6, the dressing—the 300 machines referred to only perform the first of these operations, and that subject to more or less big bodies, according to the skill and care of the attendant; whereas the machinery of myself and Mr. Atkinson performs the whole of these operations, and cannot produce either a big body or an extra thick sort. The three hundred machines, therefore, mentioned in the discussion, require to be supplemented by many hundred other persons in addition to the 150 employed in the casting; less than 200 of the self-acting machines, with 200 skilled attendants, will do the whole of the work, thus effecting an economy of the wages of many hundred persons, men and boys. Mr. Samuelson, the eminent engineer, has thoroughly examined the two relative systems, and proved the saving to be as follows:—

	Cost of labour		
	At ——'s Works.		At Patent Type Co.'s.
Nonpareil	7·24	....	2·61
Brevier	5·10	....	2·23
Bourgeois	4·77	....	1·40

The other matters referred to are of minor importance. Whether I invented and created the hard alloy, or whether I resuscitated former and abandoned experiments, is the same at law, and does not affect the service to the printing trade which I claim to have rendered. Five hundred printers can be brought to use the same words as Mr. Strangeways at the meeting—that they "never heard of hard type before I had introduced it."

With respect to electrotype matrices, I asserted that it was the custom for the founders generally to copy one another very extensively, and I pointed out in particular the copies made of the very important novelty in the form and dimension of the music note head introduced by my late partner, Mr. J. H. King, by which music type was rendered much more popular than it had hitherto been. This is distinctly admitted by Mr. Figgins, who said "when the founts cut by Mr. King were desired by the other founders, they set to work and had the punches cut, thereby incurring the same expense, and carrying out a rule of the trade which had never been objected to." Here is the whole pith of the system exposed. King had no legal property in the design, and the founders recognised none, but made a servile copy of it according to the "rule of the trade which had never been objected to."

With regard to the alleged inaccuracy of the history up to 1851, I merely quoted the jury reports on Class 17 of the Exhibition of 1851, which states the following facts:—

1. At least two combined foundries destroyed Pouchée's machine.
2. Machine-cast type could not be distinguished from other type except by a private mark.
3. No machinery was being used by the London founders, yet machinery was in their possession.
4. Machinery with steam power was in full use in America.

I have no doubt as to the combination of the founders to introduce machinery subsequently to 1851; I have never denied it, but I allege that all the 300 machines used by them contain the identical defect which, it is pretended, prevented their adoption previously. If they do not, let one of them be produced and its merits discussed by competent persons. The argument as to the relative numbers is easily disposed of. The 300 machines were made of the only models to which the founders had access; they had no opportunity of purchasing the automatic machinery before their own had been constructed.

One more point in dispute remains. Common report asserts that all the patents possessed by the founders were bought after the ruin or failure of the introducers, like that of Pouchée. If Mr. Figgins will show the amount of outlay for their acquisition, which was divided among the members of the union, he will set at rest this calumny, if indeed it be a calumny. If the inventors received even a moderate amount of compensation for their patents and machinery, to say nothing of the invention, I will willingly apologise.—I am, &c.,

J. R. Johnson.

EDIBLE STARCHES OF COMMERCE.

Sir,—In the report of Mr. Simmond's paper on the "Edible Starches of Commerce," given in last week's *Journal*, I read of African arrowroot that "the Canary Islands, Liberia, Lagos, Sierra Leone, and other districts produce it, but not in any quantity for shipment." This statement is not quite correct. In the last three years my firm has received from our houses in Liberia the following quantities:—in 1870, 33,213 lbs; in 1871, 34,032 lbs.; in 1872, 44,519 lbs.

From the figures adduced by Mr. Simmonds it appears that the consumption of arrowroot in this country has, within the last decade, considerably declined, the declared values of the imports of 1860 and 1870 being £42,404 and £33,063 respectively. I consider that this falling off is attributable to two causes—one being that the consumption is too generally confined to invalids, and the other the high price at which it is retailed. Its extendible uses in the culinary arts, such as in the making of blanc-manges, puddings, custards, sauces, thickening of soups, &c., are as numerous as those of corn flour. The price at which the Grain Coast, or Liberian arrowroot could be sold by the retailers need not exceed 5d. per pound.

It is probable that if the uses of arrowroot were more widely known, and if it were retailed at the moderate price I have named, public utility would be served, and the ground lost in quantity of the article imported soon recovered.—I am, &c., William Brooke.

April 1, 1873.

GENERAL NOTES.

Scholarships for Girls.—The Central Committee of the National Union for Improving the Education of Women has determined to offer seven scholarships of £25 each, tenable for one year, for competition throughout the United Kingdom :—The following learned bodies have been asked to award the scholarships, and have consented to do so:—The universities of Oxford, Cambridge, Edinburgh, and Dublin (at their local examinations, 1873) ; the Science and Art Department (in May); the Society of Arts (in April); and the College of Preceptors (in April). The girl over 16 years of age on January 1st, 1873, who stands highest at each of the above examinations (except that of the College of Preceptors and the Society of Arts), to be awarded a scholarship, provided that in the opinion of the examiners or delegates her work is not only relatively better than that of other candidates, but absolutely good enough to entitle her to the reward. The scholarships offered to the College of Preceptors and the Society of Arts to be awarded to the best female candidate in training as a teacher examined by them, under the same condition of real merit as above. The successful candidates are to pursue their studies for one year (for the College of Preceptors and the Society of Arts scholarships six months will be deemed sufficient), at some place of superior instruction in the United Kingdom or abroad approved by the National Union.

NOTICES.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

REPORTS ON THE LONDON INTERNATIONAL EXHIBITION OF 1872.

The reports which appeared in the last volume of the *Journal* on the various sections of the above Exhibition, are now published complete, in a pamphlet form (price 2s.), and can be obtained at the office of the Society.

THE LIBRARY.

The following works have been presented to the Library :—

Bulletin of the National Association of Wool Manufacturers (Boston, U.S.) for the years 1869-71. Vols. 1 and 2.

On Protoplasmic Life, and the Action of Heat and Antiseptics upon it. By Dr. F. Crace Calvert, F.R.S. Presented by the Author.

Experiments on the Oxidation of Iron. By Dr. F. Crace Calvert, F.R.S. Presented by the Author.

Handbook to the Collection of Minerals presented to the Colchester Museum by J. Yellowly Watson. Presented by J. Yellowly Watson.

The following work has been purchased for the Library :—

Gazetteer of India. By Edward Thornton.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. The following meetings have been arranged :—

April 9.—*No Meeting.*

April 16.—"On the British Settlements in West Africa." By His Excellency Governor Pope Hennessy, C.M.G.

April 23.—"On Silkworm Grain." By Mons. Alfred Roland (Orbe, Switzerland). On this evening Andrew Cassels, Esq., will preside.

April 30.—"On the Condensed Milk Manufacture." By L. P. Merriam, Esq.

CANTOR LECTURES.

The Third Course of Cantor Lectures for the present session will be "On Wines; their Production, Treatment, and Use," by J. L. W. Thudichum, Esq., M.D. The Course will consist of six lectures, the first of which will be given on Monday evening, the 21st of April, the remaining five on the Monday evenings succeeding.

INDIA COMMITTEE.

The report of the last meeting of the Committee is deferred till next week.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Society of Engineers, 7½. Mr. H. Gore, "Horse Railways, and Tramways."
Social Science Association, 8. Mr. Thomas Beggs, "On Provident Societies, Loan Societies, and Friendly Societies, as they Affect the Interests of the Working Classes."
London Institution, 4. Prof. Bentley, "Elementary Botany."
Stationers' Company, 7½. Technological Lectures. Mr. Ellis A. Davidson, "Printing, its History and Practice."
Farmers' Club, 5½. Mr. J. K. Fowler, "The Present Aspect of Steam Cultivation."
Royal United Service Institution, 8½. 1. Mr. W. Froude, "Apparatus for Automatically Recording the Rolling of a Ship in a Sea-way, and the Contemporaneous Wave-slopes." 2. Mr. Richard Bell, "Mode of Building Ships of War capable of Resisting the Heaviest Artillery."
Victoria Institute, 8. Prof. Kirk, "On Force."
Entomological, 7.
Medical, 8.

Tues. ...Medical and Chirurgical, 8½.
Civil Engineers, 8. Mr. John Head, "On the Rise and Progress of Steam Locomotion on Common Roads."
Photographic, 8.

Wed. ...Geological, 8. 1. Rev. T. G. Bonney, "Lakes of the North-Eastern Alps, and their bearing on the Glacier-erosion Theory." 2. Mr. J. R. Mortimer, "Notes on Structure in the Chalk of the Yorkshire Wolds." Communicated by Mr. William Whitaker.
Graphic, 8.
Royal Literary Fund, 3.
Royal Society of Literature, 4¼.
Archæological Association, 8.
Telegraph Engineers, 7½. 1. Mr. Wm. F. King, "On a Bell Alarm for Submarine Cables." 2. Mr. James Graves, "On the Measurement of Battery Resistance." 3. Mr. R. S. Culley, "On the Mechanical Tests of Iron Wire."

Thurs...Mathematical, 8.
Society for Encouragement of Fine Arts, 8. Madame Ronniger, "Macbeth."

Sat ......Royal Botanic, 3¾.

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FRIDAY, APRIL 11, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ENDOWMENT FUND.

With this week's number of the *Journal* is issued a small pamphlet, containing in a collected form a series of letters which were recently contributed to the *Journal*, advocating the formation of an Endowment Fund for the Society of Arts. The following donations and subscriptions in aid of this fund have been received:—

	£	s.	d.
Wm. Atkinson	50	0	0
W. R. Sandbach	50	0	0
Sir Walter C. Trevelyan, Bart.,	50	0	0
Col. A. Angus Croll	20	0	0
John Noble	20	0	0
G. T. Saul	5	0	0
W. R. Spicer	5	0	0
Chas. H. L. Woodd	5	0	0
Geo. W. Hart	2	2	0
John E. Evans	2	2	0
E. T. Blakely	1	1	0
Thomas Dixon	1	1	0

TECHNOLOGICAL EXAMINATIONS.

The Programme of Examinations in the Technology of some of the Arts and Manufactures of the country is now ready, and may be had on application to the Secretary.

The subjects selected for 1873 are Cotton, Paper, Silk, Steel, and Carriage-building. Those desiring to become Candidates, should apply for the programme without delay.

The following Prizes are offered by the Society of Arts in each of the five subjects mentioned above:—

To the best candidate in Honours, £10.

To the best candidate in the Advanced Grade, £7.

To the best candidate in the Elementary Grade, £5.

The following special additional Prizes are offered:—

By Wyndham S. Portal, Esq., to the Second and Third best Candidates in the Elementary Grade, Paper Manufacture:—

A Prize of	£3
A Prize of	2

By G. N. Hooper, Esq., to the Second and Third best Candidates in the Elementary Grade, Carriage Building:—

A Prize of	£3
A Prize of	2

By the Worshipful Company of Spectacle Makers, to the Second-best Candidate in Honours, in the Advanced Grade and in the Elementary Grade respectively, in the Manufacture of Steel:—

A Prize of	£5	5
A Prize of	3	3
A Prize of	2	2

The Council beg to announce the following contributions to the Prize Fund:—

The Worshipful Company of Fishmongers	£52	10	0
The Worshipful Company of Mercers	26	5	0
The Worshipful Company of Drapers	21	0	0
The Worshipful Company of Vintners	10	10	0
The Worshipful Company of Salters (annual)	10	10	0
The Worshipful Company of Cloth-workers	10	10	0
Dr. Crace Calvert, F.R.S. (annual)	5	5	0
Sir Daniel Cooper, Bart.	5	0	0
R. L. Chance, Esq.	5	5	0
Robert Nicol, Esq.	1	1	0

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal early in May next. This medal was instituted to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty the Emperor of the French, "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

The Council invite members of the Society to forward to the Secretary, on or before the 12th of April, the names of such men of high distinction as they may think worthy of this honour.

ECONOMIC USE OF COAL FOR DOMESTIC PURPOSES.

With reference to the sum of £500 placed at the disposal of the Council, through Sir William Bodkin, by a gentleman who does not wish his name to appear, for promoting, by means of prizes or otherwise, economy in the use of coal for domestic purposes, the Council have decided to offer the following prizes:—

1. For a new and improved system of grate, suitable to existing chimneys as generally constructed, which shall, with the least amount of coal, answer best for warming and ventilating a room.—*The Society's Gold Medal and Fifty Pounds.*
2. For a new and improved system of grate, suitable to existing chimneys as generally constructed, which shall, with the least amount of coal, best answer for cooking food, combined with warming and ventilating the room. —*The Society's Gold Medal and Fifty Pounds.*
3. For the best new and improved system of apparatus which shall, by means of gas, most efficiently and economically warm and ventilate a room.—*The Society's Gold Medal and Fifty Pounds.*
4. For the best new and improved system of apparatus which shall, by means of gas, be best adapted for cooking, combined with warming and ventilating the room. —*The Society's Gold Medal and Fifty Pounds.*
5. For any new and improved system or arrangement not included in the foregoing, which shall efficiently and economically meet domestic requirements.—*The Society's Gold Medal and Fifty Pounds.*

The Council reserve to themselves the right of withholding all or any of the above prizes, as the judges appointed by them may determine.

The competing articles must be delivered not later than the 1st of December, 1873, with a view to their being tested, and subsequently shown in the London International Exhibition of 1874.

Further particulars, as to place of delivery and other arrangements, will be published as soon as they are finally settled.

PROCEEDINGS OF THE SOCIETY.

INDIA COMMITTEE.

A Conference was held on Friday evening, March 28th, at 8 p.m., Sir LOUIS MALLET, C.B., Member of the Council of India, in the chair.

The Chairman, in introducing Mr. Blanford to the meeting, said the subject about to be presented, though not of such sensational interest as that recently brought forward with regard to Central Asia, was of the utmost importance to the future prospects and prosperity of India, and no one was more capable of introducing it. The geological survey had been conducted by the branch of the service to which Mr. Blanford belonged, under great difficulties—and in some cases dangers—and too much praise could hardly be given to those who risked their health and lives on the task. The mineral resources of India were limited in amount, and no very great development of wealth could be looked for from their working, but it was important to notice that the two principal articles were coal and iron, the possession of which exercised a most powerful influence on the industrial progress of a nation, and materially facilitated the carrying out of public works. He feared there was no prospect of India ever becoming a great manufacturing and exporting nation, but if its mineral resources were sufficient for its own internal requirements, it would be an immense advantage, and it was, in any case, important to know how far such sources of supply might be relied upon. Such knowledge was very important for the government, for he feared that for a long time to come, at any rate, there was little chance of private enterprise effecting much in the way of developing the coal and iron in India.

The paper read was on—

ON THE MINERAL RESOURCES OF INDIA.

By W. T. Blanford,

Assoc. Roy. Sch. Min.; F.G.S.; Deputy-Superintendent Geological Survey of India.

To give, within the limits of such a paper as the present, anything like a complete account of the useful minerals now employed by man, or which only await more favourable circumstances to render their extraction profitable, in a country so extensive as India, is of course out of the question. All that I can attempt this evening is to give you such a general summary of the present state of our knowledge with respect to the distribution and abundance of valuable minerals in India as will enable you to form some idea of the resources available for commercial purposes.

I shall probably state what is new to many when I record my conviction that the mineral resources of India are chiefly remarkable for their paucity, that, despite our imperfect acquaintance with the country, we know more of it than of many parts of Europe, and that we are fully justified in believing that, although isolated discoveries of much value may be made, and minerals now useless may be mined with profit at some future time, it is improbable that India can ever become a rich country through the development of its mineral wealth.

However, I would not be misunderstood. The idea, not yet extinct, that India is a country abounding with diamond and gold mines, and only awaiting the advent of the enterprising Anglo-Saxon digger and his cradle to pour forth its treasures, is one in which I certainly have no faith. The greater portion of the country is, I believe, either destitute of mineral resources, or those resources occur in a manner which throws serious obstacles in the way of their utilisation. The only really important minerals, so far as we know at present, are coal and iron ores, and to these I shall revert presently, first mentioning, as briefly as I can, the useful minerals which are found in India, and in the territories, out of India Proper, which belong to the Indian government. These minerals are the ores of copper, silver, lead, and tin; native gold, diamonds, and other precious stones, corundum, salt, and petroleum. Some other minerals, such as various kinds of brick clay, slate, or schistose-beds used as slate, and the several rocks used for building purposes, must be taken into consideration amongst the mineral substances used in the arts, and consequently of value, but it would be impossible to treat of these, even slightly, without exceeding the usual limits of a paper like the present.

Copper has been found in many parts of India, and mined in several places. At present there are mines in various parts of the Himalayas, especially in Kamaon, Gurhwal, Nepal, and Sikkim. These are all worked by natives on a very small scale, and the produce is so inconsiderable that even in Kamaon, where the number of mines is large, and many of them are said to be extensive, English copper is imported to supply part of the local demand. An attempt was made in 1839, at Pokri, in Gurhwal, to work one of the principal mines by European methods, but it was unsuccessful.

In the plains of India, the localities at which copper has been known to occur are very thinly scattered over the country. Neither this nor any other metal can be expected in the vast alluvial plains which form so large a portion of Northern India, nor in the immense tract of volcanic rocks occupying the greater portion of the Bombay Presidency and its vicinity; but even in the areas of metamorphic rock which cover so large a portion of the surface in the eastern and southern parts of the Indian Peninsula, metallic ores in general are remarkably scarce. Still copper has been worked at various times by natives in many places, the principal of which are in Rajputana, the countries south-west of Bengal, and Nellore, Karnul, and Kudapah, in Madras. At present I know of no mines which are still regularly carried on, except those near Jaipur, in Rajputana, of which an excellent description was given by Col. Brooke in the *Journal of the Asiatic Society of Bengal*, for 1864, p. 519, and the out-turn from these is far from large, but, doubtless, a little ore is from time to time extracted elsewhere.

Much copper ore appears to exist near Chaibassa, in Singhbhum, a country lying west of Midnapur, in Bengal. An extraordinary series of deposits, partly in irregular lodes and partly disseminated through schists, extends across the country for at least 80 miles. Throughout all this tract old workings abound, but there is much fine ore, chiefly carbonate and red oxide of copper, with occasionally copper glance, left in places. At least two attempts have been made by Europeans to work mines in these deposits, but, despite some success, the enterprise was not profitable. The workings were not carried to much depth, I believe never deeper than the old native mines had penetrated, but the impression left upon the managers of the mines was that the deposits decreased in richness below.

Lead is even less frequently met with in India than copper, and, where it occurs, is usually associated with that metal. Galena, the most common ore of lead, is found in Kulu, Gurhwal, and Sirmur in the North-West Himalayas, and in the former country there are said to be rich veins of the mineral, but they have hitherto been but little mined. I am not aware of any locality in the plains of India at which lead ores are now extracted, but some are found in Ajmir, Raipur, Manbhum, Karnul, Kudapah, &c.

Rich tin deposits are believed to exist in the Tenasserim provinces and Martaban, tinstone being found in the streams which run from the range of mountains dividing the British provinces from Siam. Farther south, on the flanks of the same range, are the well-known stream deposits of Malacca. Though these Tenasserim tin ores have long been known, the excessive wildness of the country which is covered with forest of the densest description, the extreme paucity of the population, and the total absence of roads or any means of carriage, have hitherto prevented all attempts at working.

In India itself tin has been reported from two or three places, but nothing accurate is known of its occurrence.

Silver is said to occur associated with lead in Kulu and Manbhum. In some galena from the latter country as much as 119 ounces of silver to the ton of lead was found, but only a small quantity of ore was assayed. Similarly in some copper ores from Deogurh in the Sonthal perganahs, Mr. Piddington found about 50 ounces of silver to the ton of ore, but other specimens from the same locality produced little or no silver. The locality in Deogurh I have myself visited, but could trace no vein or other regular deposit of ore; the minerals containing copper appeared to be irregularly disseminated in very small quantities through the rock.

Gold is found in many parts of India, but always in very small quantities, in stream gravels. It has been, and is still occasionally, extracted in several parts of the North-West Himalayas, also in Chota Nagpur, Manbhum, Singhbhum, and the tributary mehals of Orissa, in the Godavari valley, and in some places in Southern India. It is also found in Assam and in parts of Burmah. In all these instances it is obtained from the gravel and sand by rude processes of washing, and the returns are so small that only the poorest of the natives are occupied in the search, which is, as a rule, practised only at the time of year (the spring) when agricultural labour is suspended.

Before closing the list of metals I may mention that an ore of cobalt is found in small quantities near Jaipur in Rajputana, and is employed, it is said, chiefly for colouring enamels. It is probably the mineral known in European works as Syepoorite, Syepoor being evidently a mistaken spelling of Jyepoor or Jaipur. Antimony is found in Kulu and Lahaul, and zinc was formerly smelted, and may perhaps be so still, at Jawad in Mewar. Chromic iron occurs near Salem.

From the preceding details I think it is evident that the metallic ores of India are neither rich nor abundant. In most places where they are found there are remains of old workings, frequently of large extent, and I think that this circumstance tells strongly against the probability of richer deposits being discovered, because it shows that both mining and smelting have long been practised in India. My own belief is that the art of smelting has probably been longer known in India than in Europe, but to this I will refer again when speaking of iron. In speculating on the probable discovery of new mineral deposits, we must bear in mind that India is very unlike such countries as Australia or America, which, until recently, were inhabited by mere savages. For ages the population of India have been acquainted with many of the arts of civilised life, and the great command of labour which the rulers of the country possessed enabled them to carry on the processes which supplied them with such a desiderata as metals, in a manner which would be impossible to wild tribes, the greater part of whose existence is spent in a struggle to procure food and defend themselves from their enemies. It is to the same cause—the command of labour, given without pay as part of the service due from the people to their rulers—that I am inclined to attribute the quantities of precious stones, and especially of diamonds, formerly found in India. It is certain that of late years comparatively few have been obtained, and I suspect the reason to be that the deposits containing diamonds, like the ores of copper and the auriferous sands and gravels of the rivers, do not in many instances really pay the expenses of working them, and never did so; but all were worked, and to a great extent by the princes of the country, to supply the only wealth which they could accumulate, and to furnish the only form of magnificence, except large hosts of retainers, which they could appreciate.

Diamonds were formerly found chiefly in the country around Karnul, Kuddapah, and Ellore, in the Madras presidency, near Sambhalpur, on the Mahanadi, at Weiragad, south-west of Nagpur, and at Panna, in Bandelkhand. At the last-named place, at Banaganpilly, in Karnul, and a few other localities, mines still exist, and a few attempts have of late years been made to reopen those near Sambhalpur, but without success. Both at Banaganpilly and Panna the mines are in rock, the diamonds being found in a conglomerate—which, however, is clearly not their original matrix; but some of the diggings at Banaganpilly are in gravel, the materials of which are derived from the diamond-bearing strata, and at the other places enumerated all the workings appear to have been in loose deposits.

Although rubies, sapphires, and other precious stones are found in Ceylon, Independent Burma, and in the countries north-west of the Himalayas, I know of no locality in British India where they are now obtained; and the only stones procured for jewellery to any extent are the agates, carnelians, and other forms of quartz derived from the trap-rocks of Central and Western India, or from deposits resulting from the denudation of the traps. The largest number of agate pebbles are found in the neighbourhood of a small village called Ratanpur, not far from Broach, and in the Nerbudda valley; and the pebbles are worked by the lapidaries of Cambay and Jabalpur. The carnelians from the former locality were known in the time of the Romans.

Although the purest forms of sapphires are not found in India, the coarse varieties, or corundum, are met with in several places in Mysore and Salem, and in Rewah, where a bed occurs several yards in thickness, associated with jade.

I may pass over most of the miscellaneous substances which are mined in India, such as the sulphur and borax of the North-West Himalayas, the greater part of the latter, indeed, coming from beyond the British boundary; the mica of Behar, the shales from which alum is made in Rajputana, Sind, and the Himalayas, the graphite of Kamaon, Sikkim, and Travancore, &c. Petroleum has not hitherto been obtained in any quantity in British territory, although a considerable supply is procured in Upper Burma, and some is known to exist in Pegu and also in Assam. A small quantity also oozes from the ground at several places in the Punjab, and a few years since gas-works were erected at Rawul Pindi, and, I believe, pipes laid down, with the intention of utilising the mineral oil for the purpose of lighting this station. Whether this has been carried into effect or not I do not know; by the last accounts I have heard, it appeared probable that the supply of petroleum procurable was insufficient for the purpose. It is impossible not to express surprise that this point was not ascertained before any expenditure upon gas-works was allowed.

The salt of the Punjab salt range is one of the most valuable minerals of India. The supply has been pronounced by excellent authorities to be practically inexhaustible; indeed, Dr. Oldham declares that nowhere else in the world are deposits of such vast extent and purity known to occur. The government revenue from the salt exceeds £300,000 per annum.

Having thus briefly noticed the known metallic ores and other minerals of our Indian possessions, exclusive of the ores of iron and of coal, I shall proceed, before speaking of the iron ores, to describe the distribution of the various coal-fields, and the value, so far as it is known, of the fuel to be obtained from them, since the future prospects of the iron manufacture in India depend greatly upon the presence or absence of mineral fuel in the neighbourhood of the ore deposits. A report by Dr. Oldham, in 1867, on the coal resources and production of India, being a return called for by H.M. Secretary of State, gives a complete account of the Indian coal-fields known at that time, and of the progress which had been made in working them. Since 1867 much additional information has been obtained concerning the coal-fields in the central provinces, especially those in the basin of the Godavari and its affluents, and considerable progress in the task of mapping and examining the coal-bearing rocks in Western Bengal.

The known coal-fields of India are mostly comprised in a somewhat broad tract of country stretching from the neighbourhood of Calcutta, and from a line which may be roughly drawn parallel with the coast of the Bay of Bengal, but at a distance of between 100 and 150 miles from the shore, to about the 78th parallel of east longitude, or a little east of Nagpur. This tract is bordered by the plain of the Ganges valley on the north, and extends locally a little beyond the Godavari to the south. Outside of this limit the only coal-fields of any promise are some in Upper Assam; but deposits of small coal are found in the Khasi Hills, in the salt range in the Punjab, and in Tennaserim. Discoveries of coal have been announced in several other places, but all have, when inquired into, proved to be of no practical value.

It may confidently be stated that throughout the peninsula of India, south of the river Khrishna (and, in fact, south of the Godavari, with the exception of a tract not extending more than 300 miles from the coast of the Bay of Bengal), throughout the whole of Western India, comprising the Bombay presidency in its entirety, Rajputana, Gwalior, Indore, Guzerat, Kachh, and Sind; in the North-West Provinces, the whole Gangetic plain, and the Himalayas, not only is no workable coal known, but it is highly improbable—and, throughout the greater portion of the area, impossible—that any will ever be discovered. In the Punjab a few deposits, not of true coal, but of lignite, have been met with, but the quantity is very small and the quality inferior. It is thus evident that only a very small part of India can be considered as coal-producing; and even within the boundary I have pointed out, the coal-fields are in general but thinly scattered. Part of this country is still very imperfectly known, but a large portion has been carefully examined.

All the coals contained in the Indian fields, with two or three very trifling exceptions, come from one geological formation, known to Indian geologists as the *Damuda*, the name being taken from the river on which the Raniganj and several other coal-basins occur. The geological age of this formation has long been a matter of dispute, but is now clearly ascertained to be the same as that of the Australian coal, and to differ very little, if at all, from the carboniferous group of beds in Europe. The fossil plants associated with the coals of India, however, differ greatly from those of the European coal measures, and the Indian coal itself is very dissimilar, both in quality and appearance, its most characteristic distinction being its excessive lamination, due to its consisting of alternate layers of very bright and very dull minerals—the former a pure coal, containing a large proportion of volatile matter and but little ash, the latter earthy, and frequently shale rather than coal.

The coal basins may be roughly divided into four groups:—1st. Those of Bengal, including the coals of the Rajmahal hills, and valley of the Damuda. 2nd. Those of Rewah, Sirguja, Bilaspur, Chutia, Nagpur, and the tributary mehals of Orissa. 3rd. Those of the Nerbudda valley and the hills to the south of it. 4th. Those of Chanda and the Godavari valley. I will enumerate the different coal-bearing areas in each group.

1. *Rajmahal Hills.*—Along the western face of these hills, which run north and south from the neighbourhood of Rajmahal on the Ganges, there are several small fields, from which some coal was extracted during the construction of the East India Railway, in order to supply fuel for brick and lime burning. The extent of the fields it is difficult to define, because the coal-bearing rocks are covered at their edges in many cases by higher beds. In each small basin, one of which occurs in every large valley traversing the hills, are several seams of coal, varying in thickness from three to twelve feet, but the quality is not in most cases equal to that of the better coal seams in the Raniganj field.

2. *Raniganj.*—This is at present by far the most important of the Indian coal fields, nearly the whole of the coal mined in India being obtained from it. In 1868, the last year of which I have any trustworthy details, the coal extracted throughout the whole of India was about 497,000 tons, of which but 4.000 tons were obtained from all the other coal fields, the remainder being from the Raniganj field. There has been no very great increase in the produce of other coal fields since 1868, with perhaps the exception of the Kurhurbari field.

The Raniganj field commences at a distance of about 120 miles to the north-west of Calcutta, and is about fourteen miles in extreme breath from east to west, and eighteen from north to south. To the east the coal-bearing rocks are covered by alluvial deposits, and it is uncertain what are the limits of the field in that direction. The known area is between 500 and 600 square miles, a portion of which, about one-fifth, is covered so thickly with formations of later age that it must be left out of consideration in caculating the area available for the production of coal. The seams of coal are numerous, and many of them are of fair quality, sufficiently good at all events for railway purposes, for the East India Railway, and the other railways, which start from Calcutta have, ever since they were opened, been worked with coal supplied from Raniganj. The different seams which are mined vary in thickness from 4½ to 35 feet, and many of them vary in this respect within short distances. The seams near Raniganj itself, where the workings are more extensive than elsewhere, show but little variation, and are of more uniform quality than those in the north and west of the field, where, however, much good coal exists.

Although this coal-field is better known than any other, I do not think that mining operations are sufficiently advanced to enable any trustworthy estimate of the probable yield of coal to be formed. Unquestionably there is an enormous quantity available. Dr. Oldham estimates it roughly at 14,000 million tons, but in truth, many seams, perhaps all, vary in thickness, and we have not data for any accurate determinations. In 1860, there were altogether about 50 collieries at work, many of them, however, being nothing more than small open quarries; the number of the latter has since diminished, but the output of coal had doubled in ten years.

The Raniganj coal-field is traversed by the chord line of the East India Railway, and there is also a branch line to some of the collieries. To this, and to its being the nearest field to Calcutta, is due the much greater development of industry in mining this field than in any other part of India.

3. *Jherria.*—This field commences only ten miles to the west of the Raniganj coal-bearing tract. It is twenty-one miles from east to west, nine miles from north to south, and contains numerous seams of coal, some of them of great thickness. No collieries exist. The coal, so far as it has been examined, appears somewhat inferior in quality to the better seams near Raniganj, but this is a question which can never be fairly decided without mining.

4. *Bokaro.*—A long strip of coal-bearing rocks, commencing within a mile of the western end of the Jherria field, and extending forty miles from east to west, with a breadth from north to south never exceeding seven and a half miles. The coal is, so far as is known, inferior both in quantity and quality to that of Ranigunj, but it is not worked.

5. *Ramgarh.*—A small field, thirty square miles in extent, south of the last, and of the same character.

6. *Hoharo, or Karanpura Coal-fields.*—Two basins of coal-bearing rocks, respectively 472 and 72 square miles in extent, lying immediately west of the last-named fields, and due south of the civil station of Hazaribagh. They contain, apparently, a considerable quantity of coal of fair quality.

All the above-named coal-fields are in the valley of the Damuda, along which they form a slightly interrupted belt of coal-bearing rocks, extending for 150 miles, and occupying at least 1,500 square miles of country. As the extent of the Raniganj field to the eastward is unknown, this estimate is probably below the truth, and my colleague, Mr. Hughes, estimates the area of coal-bearing rocks in the Damuda valley at 2000 square miles. Over at least one half of this area, workable coal seams, of considerable thickness, occur within a distance not exceeding 1,000 feet from the surface. There is, however, a gradual diminution in the thickness of the coal-bearing formations to the westward, and the number of coal seams appears, also, to diminish.

7. *Kurhurbari.*—A small field, only comprising

18 square miles, of which 8½ contain productive seams of coal. This little tract is in the valley of the Barakar, a tributary of the Damuda, and it lies to the north of the fields previously mentioned. It is 25 miles distant from the chord line of the East India railway, and a branch has been made to connect the two. The quality of the coal is unusually good for India, equal or superior to the best found in the Raniganj field. Mr. Hughes, after a very careful survey of this field, which, from its small size, affords better means of calculation than the more extensive basins of the Damuda valley, considered that there was sufficient coal, after a liberal allowance for waste, to supply an out-turn of 250,000 tons per annum for 800 years. I place very small reliance upon all such estimates, but still they may give a rough approximation to the truth, and they are as likely to be too small as too large.

The collieries now worked in the Kurhurbari coal-field belong to the East India railway company, and I believe it has been found profitable to carry coals for the use of the railway throughout its whole length, and that they can compete successfully in the Panjab lines with the wood fuel which is almost the only local supply in the extreme north-west of India.

I omit from the list some small fields near Deogurh, in the Santhal Parganahs, east of the Kurburbari field, and of the Itkuri field to the west, as no coal of any value has been obtained from either, and the fields are of very small extent.

The second group of coal-fields consists of a number of basins scattered thinly over an immense tract of the wildest country in India. None of them are thoroughly explored, and it is highly probable that when the whole country is geologically surveyed, the number of coal-bearing localities will be largely increased. Great additions to our knowledge have been made during the topographical survey of these regions, coal being now marked on the maps in several places where it was before unknown. I shall merely mention the principal localities.

8. *Palamaan* (Palamow), or Daltonganj, in Chota Nagpur, a field about 30 square miles in extent Not much coal, but a colliery once existed.

9. *South Rewah Fields.*—Coal exists over a tract of country about 40 miles in length by 20 in breadth.

10. *Fields of Upper Son Valley.*—These are very extensive, but do not appear to be rich, the only seams known being thin and of poor quality.

11. *Fields of Sirguja, Bilaspur, in Eastern Chatisgarh, and country west of Chota Nagpur.*—I class these together, as all we know of them is that seams of coal, many of them of great thickness, occur in several places. At Korba, on the Hasdo river, a seam is exposed altogether 89 feet in thickness, of which 50 feet is coal, the rest shale. The coal, however, on assay, yielded a large quantity of ash. These fields will become important in the event of a direct line of railway being made from Calcutta to Nagpur.

12. *Talchir.*—This field is on the Brahmini river, about 50 miles north-west of Katak. No coal of any value has been found in it.

The third group of coal-fields comprises those in the Nerbudda valley, and the hills of the Satpura range to the south of the river. One locality is of great importance from its proximity to the line of the Great Indian Peninsula railway. Besides the fields noticed hereafter, small quantities of coal occur at Lameta Ghat, Sher river, Lokurtalai, and other places, and from the first-named a considerable quantity of inferior fuel has been at times extracted for local purposes, but no valuable deposits are known to exist. It is not impossible, however, that some may occur concealed by overlying formations.

13. *Mopani.*—This is the spot at which the collieries of the Nerbudda Coal and Iron Company are situated. The seam, so far as it is known, appears to average about 25 feet in thickness, but owing to the high dips, numerous faults and dykes, and to the small extent to which boring has hitherto been attempted, the prospects of this field are most obscure. I learn that Mr. Medlicott, deputy-superintendent of the geological survey, has been specially detached to examine the neighbourhood by boring in the course of the present season.

14. *Tawa Valley.*—Several seams of coal occur near Rawandyo, between Betul and Hoshungabad, about 35 miles south of the Great Indian Peninsula Railway. My own opinion of these seams was rather unfavourable.

15. *Umret, near Chindwara.*—Several seams of fair coal exist, and extend apparently over a considerable tract of country.

The last group consists of coal-fields on the edge of the great sandstone tract which occupies the valley of the Godavari and its tributaries, the Pranhita and Wardha, from the neighbourhood of Nagpur to near Ellore. Workable coal is known to exist in two localities.

16. *Wardha River, or Berar, and Chanda Field.*—Considering the very recent period at which attention was drawn to this important series of coal deposits, more has been ascertained concerning the beds than in any other coal-fields in India. This is due to the circumstance that all preliminary explorations have been carried out by the officers of government, and before any expensive works were commenced. The existence of a very thick seam of carboniferous shale and coal, altogther 50 to 70 feet in thickness, and containing a fair proportion of useful fuel, has been proved over a large area in the Central Provinces and Berar, and it recurs a few miles further south in the Nizam's territories. The quality of the coal hitherto mined, though inferior to the best seams of Raniganj and Kurhurbali, is sufficiently good for railway purposes, and it is rarely the case in a coal-field that the best coal is the first discovered.

17 *Kamarum.*—This is in the extreme eastern portion of the Hydrabad territory, and about 100 miles north-west of Ellore. Two seams of coal, nine and six feet in thickness respectively, have been found, and they are of good quality; but they have only been traced over a small tract of country, not exceeding a quarter of a square mile.

18 *Singareny.*—30 miles south-east of the last, and 30 miles north by east of Kamamet. The thickness of the coal is unknown, and further research is necessary, but the locality is interesting as being the most southern yet known in India.

It is probable that other coal seams remain to be discovered in the Godavari valley. Several have been observed near Dumagudem, the head-quarters of the navigation works at the first barrier on the

Godavari, but none as yet found is sufficiently good in quality to be of much value.

There is one point in connection with the distribution of coal throughout the different basins which is worthy of notice, and that is the much smaller thickness of the coal-bearing rocks to the westward, and the circumstances that the coal found in them is mostly concentrated in one bed of great thickness, consisting of alternations of coal and shale. In the Raniganj field, where the coal-bearing formations attain their maximum thickness, they consist of two groups, the upper 5,000 feet thick, the lower 2,000, each containing several seams of coal. The upper group entirely thins out, or is replaced by rocks containing no coal, to the westward, whilst the lower group diminishes greatly in thickness. It is but 600 feet thick at Mopani, in the Nerbudda valley, and even less near Chanda, whilst the coal is chiefly contained in each case in one large seam, 25 to 30 feet thick at the first named locality, 60 to 70 (coal and shale together) at the last.

Before leaving the subject of coal there are two localities in the extreme north-east of India which require mention, these are—

Khasi Hills.—Some coal of excellent quality occurs in these hills, but the quantity is limited, and the locality about 4,000 feet above the plains.

Assam.—One of the most promising coal-fields hitherto found in the Indian possessions occurs in Upper Assam, in the Dibrughar and Sibsagur districts. Scarcely anything is known of it as yet except the existence of several seams of excellent coal, containing only from two to five per cent. of ash. Unfortunately the localities, almost at the extreme east end of the Assam valley, and in a country thinly inhabited and covered with forest, are unfavourable for commercial enterprise.

The coal hitherto met with in Burmah is mere lignite, with the possible exception of a bed recently discovered at Maulmain, concerning which, however, I have no trustworthy information. As the excitement created by the discovery appears to have been succeeded by complete silence on the subject, I fear the seam is of the same small value as other Burmese coals.

From the above details it will be evident that in the portion of India to which coal-bearing rocks are restricted there is a practically inexhaustible supply of the mineral. All the coal-fields, however, are far from the coast, and the majority are in wild, unsettled districts, far from the great centres of commerce and lines of railway. When we proceed, moreover, to compare Indian coal with that of other countries, we shall find a startling difference in quality. Some of the Assam coals are said to cake in burning, but, with this exception, all Indian coals are freeburning, and they will not form true coke, although an inferior coke-like substance may be procured from some of them, and might be employed in manufactures with advantage. All ordinary Indian coals contain from 10 to 30 per cent. of ash, or even more, and the proportion of fixed carbon rarely exceeds 60 per cent. In many of the best known coal seams of the Raniganj field, which contain 10 to 15 per cent. of ash, the fixed carbon is but little over 50 per cent. The average composition obtained from assays of Indian coals from 74 different localities, as given in Dr. Oldham's report, is:—

Fixed carbon	52·2
Volatile by heat	31·9
Ash	15·5

Whilst the average of five specimens of English coal sold in the Calcutta market, assayed at the same time for the purpose of comparison, gave:—

Fixed carbon	68·1
Volatile	29·2
Ash	2·7

The result of various trials on Indian railways has been that it requires from half as much again to twice as much of Indian coal as it does of average English coal to do the same amount of work, or, in other words, that Indian coals are capable of doing only one-half to two-thirds the duty of English.

The use of Indian coal has hitherto been restricted to railways, river steam-boats, and stationary engines. For sea-going vessels it is very rarely used, owing to the larger bulk taken up by it, and the larger staff of firemen and coal trimmers required, in consequence of the increased quantity of coal burnt and of the resulting ash. Even should the price of English coal continue to advance, its place in sea-going vessels will probably be taken by Australian coal, of which a constantly-increasing quantity has of late years been imported into India.

For the development of the coal-producing industry of India we must, therefore, look to local demand, and, above all, to railways and manufactures. If the manufacture of iron in India by means of Indian coal could be successfully established, a greater impetus would be given to coal-mining than by any other means. I see no reason why, with careful selection, Indian coals should not be employed in manufacturing iron. Care will have to be taken in the selection, some coal containing too much sulphur, whilst in certain kinds an unusual proportion of phosphorus enters into the composition of the ash, and doubtless other difficulties will be met with at first, but, although the first attempts may be failures, I confidently look forward to ultimate success.

As its gold, copper, and precious stones formed the mineral wealth of India in the past, and its coal and salt are its richest productions at the present day, I cannot but think that its iron ores will prove its most valuable mines in the future. Unlike the ores of the rarer metals and the coal, the iron-producing minerals of India are widely scattered; and except in the alluvial plains and the trap area, there are few parts of the country in which none are found, whilst some of the deposits are unsurpassed in either quality or abundance.

The iron ores of India may mostly be comprised under three groups:—

1st. Magnetic and specular iron ores, and red hæmatite, in beds or veins, amongst metamorphic and subcrystalline rocks.

2nd. Clay iron ores from the coal-bearing strata, and beds of brown hæmatite in other stratified rocks.

3rd. Surface deposits originally derived from metamorphic and sedimentary strata, or from the rock known as laterite. These deposits usually contain either magnetic iron sand or nodules of brown hæmatite. Laterite itself often contains from 20 to 30 per cent. of iron, and some may be sufficiently rich for smelting.

The first group comprises the most valuable ores of India. It may be again subdivided into two sub-groups, the beds of magnetic or specular ore in the crystalline rocks, and the veins and irregular deposits, mostly of hæmatite, found in several of the older formations. To the former belong the great deposits of Chanda and Salem, and some of those in Kamaon; to the latter, the ores of Bandelkhand, the Nerbudda valley, and South-east Berar. The supply in many cases is practically inexhaustible. Perhaps the most remarkable deposits are those near Salem, in the Madras Presidency, consisting of immense beds from 50 to 100 feet thick, or even more, the outcrop of which may often be traced for miles. One of these commences about nine miles east of Salem. and forms the ridge of a hill 1,500 feet high, and four miles long. Again, on Kunjamullay hill, six miles west-south-west of Salem, there are five bands of magnetic iron from 20 to 50 feet thick, and they can be traced all round the hill, which is four miles in length. These are only two instances out of a large number. At Lohara, in the Chanda district, Central Provinces, there is a hill, nearly two miles long and half a mile broad, the surface of which is covered with masses of almost pure iron ore, a mixture of specular iron and magnetic, yielding to assay 70 per cent. of metallic iron. So far as I conld make out, the whole mass of the hill appeared to consist of this ore. Some thinner bands of magnetic iron ores occur in the gneissic rocks at the southern edge of the Raniganj coalfield.

The chief ores of Bandelkhand and the Nerbudda valley consists of hæmatite contained in veins and brecciated masses, or in local deposits, often of great extent and richness, derived from the denudation of the breccias. Although these deposits do not approach in abundance the wonderful masses last referred to, they are able to afford a large quantity of excellent ore.

The clay iron ores of the Raniganj and other fields of the Damuda valley are similar to those of the English coalfields, and the quantity is large. A large series of specimens from the Raniganj coalfield yielded on assay an average of nearly 39 per cent. of iron. In the other coalfields these beds are either sparingly distributed or wanting. In some places there are large deposits of hæmatite near the base of the coal measures.

The principal iron ore of Kamaon is obtained from an argillaceous band, containing large quantities of red hæmatite, with smaller proportions of brown hæmatite in the tertiary sub-Himalayan rocks. The ore bed is from 10 to 20 feet thick; it has been traced for a long distance, but it appears to be only locally rich.

The various surface deposits supply a great portion of the ores used by the native smelters, but much labour is necessary in collection, and the quantity procurable is often insufficient for large works. Still, these deposits would in places yield a very considerable supply, and might be usefully employed mixed with the richer ores.

I cannot better terminate this paper than by a very brief account of the native iron manufacture in India and a short notice of the efforts hitherto made by the government and private individuals to introduce smelting on a larger scale.

The iron manufacture in India dates from a period far beyond the range of history. In many parts of the country stone circles, cromlechs, kistvaens and similar relics occur, precisely similar to those found in Europe, but whereas, in the European localities, the only implements found beneath these ancient remains are of stone or bronze, in India, in numerous instances, weapons and other objects of iron have been met with. It is not, of course, certain that the stone circles of the two countries are contemporaneous. but still there appears every probability that those of India are of greater antiquity than the earliest use of iron in Europe.

The present method of making iron varies somewhat in different localities, but generally the process is carried on in a small clay furnace, three to five feet high, and about a foot in diameter inside. The blast is supplied in Bengal, Orissa, the Northern Circars, Bastar, the lower Godavari Valley, &c., by foot bellows of peculiar construction, elsewhere by the ordinary Indian goat-skin bellows, worked by the hand. The fuel employed is charcoal, and no flux is used. The smelting usually lasts eight to ten hours, after which a mass of impure malleable iron, weighing from ten to twenty pounds, is found in the bottom of the furnace. This is purified by reheating in an open hearth and hammering. The resulting iron is usually of excellent quality.

There are various modifications of this process. On the Godavari I found a wandering gipsy-like tribe of blacksmiths, who simply mix ore and charcoal in a hole in the ground, and by the means of foot-bellows extract a small mass of iron, which they proceed at once to hammer into any implement which may be required. In Bhirbhum, on the other hand, there are furnaces which produce upwards of a hundredweight per diem. The improvement in this case was first made by an Englishman, but has been adopted by the natives. But, however modified, the process is extremely rough and wasteful, the amount of labour and the proportion of fuel necessary being excessive, whilst the quantity of iron produced is very small. The natives engaged in the work are of the lowest caste, and are always miserably poor. The manufacture of iron throughout India is rapidly decreasing, in consequence of the forests being cleared.

The idea of introducing European methods of smelting dates from the commencement of the century, when, owing to the war, the introduction of charcoal iron into England had become difficult, and it is curious to note that the original intentions of the first association which ever attempted to manufacture iron on a large scale in India were to supply the wants of England. The original promoter, Mr. Heath, a Madras civilian, applied to the Government of Madras for aid in his endeavour to start iron works, and thus commences a very curious history, told, with great prolixity, in two Parliamentary blue books. The first transaction was, perhaps, the most remarkable of the whole. The Government of Madras did not like to advance money for the establishment of iron works, but they gave Mr. Heath a contract to supply the government with cotton, with the intention that he should apply the profits derived from the cotton contract to his iron manufacture. Unfortunately for the latter, the price of cotton rose, and instead of profiting, Mr. Heath lost by his contract. However, he still kept to his project, and about 1825 succeeded in obtaining an advance of money from government and in forming a company to establish iron works at Porto Novo, near Cuddalore, south of Madras, Polamputee, near Salem, Trincomalee, and at Beypoor, in Malabar. The former commenced to work about the year 1833.

It would be tedious to go through the long history of the Madras iron works. From beginning to end it is one unbroken tale of ill-success, despite much aid from the government, and all the shareholders, including Mr. Heath, lost largely. One company failed, and another was started to take its place. Several serious errors appear to have been committed, one of the principal of these being the distance of the works at Porto Novo from the supplies of ore and charcoal; another the faulty construction of the works in the first instance. The gradually-increasing cost of charcoal, in consequence of the destruction of forests near the works, and the distance from which it was necessary to bring fuel, also added to the expense, but after every allowance has been made, the utter collapse of the undertaking, and its unprofitable results from beginning to end, are difficult to understand. The works were, I believe, finally given up about 1860.

One attempt at least was made to establish iron works at Raniganj, and one at Jubalpur, but they came to nothing, and, in the former case at all events, no furnace was ever built.

Just before and after the mutinies, the commencement of railways in India, and the consequent demand for iron, seem to have greatly stimulated attempts at manufacture. One or two trifling attempts had already been made in Bengal, but in 1837 Mr. Sowerby, an engineer, was engaged by the government to report on the iron ores of Kamaon, and, subsequently, to construct iron-works. At the same time some blast-furnaces were built in the same country by private individuals; all proved failures. Another attempt was made by a Calcutta merchant, at Mahamadbazar, near Suri, in Bhirbhum, at a distance of about 100 miles from Calcutta, and close to the line of the East India Railway. I was ordered to report upon these works in 1860, and their prospect appeared to me fair, the only doubtful question being the supply of charcoal. However, they were abandoned shortly afterwards. Lastly, some works were erected by the government, at Burwai, on the Nerbudda, under the direction of Mr. Mitander, a very able Swedish metallurgist. I believe this was by far the most promising attempt ever made to construct iron-works in India. Mr. Mitander was admirably suited for the work; he had had much experience in making iron with charcoal, and was at the same time a good metallurgist, with sufficient scientific knowledge to enable him to overcome difficulties. After many assays all preliminary difficulties had been overcome, the works were ready for the production of iron, and nothing was required except the aid of some European workmen to superintend the natives; but, meantime, unfortunately, Colonel (then Captain) Keatinge, the present Chief Commissioner of the Central Provinces, to whom the establishment of the works was due, had been transferred to other duties at a distance, and, there being no one to urge the importance of completing the experiment, the government, in a fit of economy, after spending 7½ lakhs (£75,000), dismissed Mr. Mitander and closed the works, which they offered for sale, naturally without success. This was in 1864.

The Nerbudda iron works had, to the best of my belief, a fairer chance of success than any others which have ever been attempted in India. Ore and limestone abounded in the neighbourhood, and a large forest, extending for many miles to the East and North-east, furnished a sufficient supply of charcoal. Above all, a competent manager was in charge. It is greatly to be regretted that the experiment was never fully carried out, and that, after the large expenditure made, it was never ascertained by trial whether iron could be made with profit or not. Equally unfortunate is it that no record has been published of Mr. Mitander's various experiments of the plans adopted by him for burning and storing charcoal, &c. Should new works be started all will have to be done over again. The works have now been made over to Holkar, with the territory on which they stand.

All the iron works I have mentioned employed charcoal for fuel; the use of Indian coal for iron smelting has yet to be attempted. Several men of experience have been sent out at various times by the government of India to report on the prospects of iron manufacture, and last autumn Mr. Bauerman was despatched for the same purpose. It is to be hoped that his report will lead to some definite result. The increasing price of iron in England is most favourable to the chance of the manufacture proving profitable in India.

I will sum up in as few words as possible my views as to the mineral resources of India. The known ores of copper, lead, and silver, and the deposits containing gold and diamonds, are of small value. Valuable tin ores exist in the Tenasserim provinces, and still more valuable beds of salt in the Punjab. Coal abounds, but is limited to a comparatively small portion of the country, and the quality is inferior; iron ores occur plentifully, but hitherto they have been very little worked. I think I am justified in my opinion that India, taken as a whole, cannot be considered rich in minerals.

DISCUSSION.

Mr. Hyde Clarke inquired what were the mining laws of India, and if any new ones had been lately passed?

Mr. Blanford said he could give no information on that point.

Mr. Dantry said he believed there were no special laws, but that the government regulations were favourable to mining enterprise.

Mr. Blanford understood that the minerals were the property of the government, except in Bengal, where the permanent settlement prevailed, where they had been allowed to become the property of the landowner.

Mr. Drew thought it had always been the rule that minerals should belong to the Crown, though there were cases in which, when the revenue was settled, even for a short period, they were allowed to go with the land. He had known such cases in the Punjab. He was acquainted with some of the copper mines in the north-west corner of the Himalayas, but the deposits were not rich, and, as a general rule, it was found impossible to work minerals with advantage in the mountain districts. With regard to coal and iron, however, he was more hopeful.

Mr. Wilde, who was acquainted with Singhbhum, said an apparently rich deposit of copper had been found there, but it was soon worked out, and the mines had to be abandoned. He was also interested in the Nerbudda Coal and Iron Company, and might mention that a new shaft was now being sunk there, which was expected to be 700 feet deep before reaching the coal. The character of the strata was yet far from accurately determined, there was a good deal of trap rock, and disappointment was often experienced. It was still believed, however, that there was a large quantity of coal yet to be discovered. The great advantage of these coalfields lay in the fact of their being the nearest to a line of railway, so that the coal can be readily disposed of. He had always understood that a comparison of native with ordinary English coal showed the former to be about one-third inferior, but he had lately taken the quantities consumed respectively on the East Indian Railway and the Eastern Bengal, both of which burnt native coal; the Great Indian Peninsular, burning English coal exclusively; and the Bombay and Baroda, burning it chiefly; and the result, dividing the total quantity of coal consumed by the train mileage, seemed to show an inferiority on the part of the native coal of only one-tenth. This of course was but an approximate mode of estimating it, and there might be a difference in the construction of the locomotives, which would affect the result.

Gen. Vaughan said he had had experience only of the salt mines in the Punjab, which were very interesting. There were two kinds of salt, one which was dug out of the bowels of the earth, in the Punjab, the working forming the most beautiful crystalline grottoes, the prevailing colour being white, though it sometimes assumed a pink or reddish hue—the other being found in the beds of ravines and nullahs in the Trans-Indus country of Afghanistan. This kind of salt was found in large masses, two being often a good load for a bullock. There was an immense trade in salt, which was carried almost to Central Asia—certainly beyond the outlying districts of the Punjab and the Afghan tribes; and formerly there had been an immense deal of smuggling, but this was now almost entirely prevented by improved regulations. This salt from the nullahs of the Trans-Indus country differed from that of the Punjab, in being a grey colour, but it was considered to be even more savoury or to possess more saline properties than the white. The salt mines of the Punjab were quite one of the curiosities of the neighbourhood, and were visited by Lord Dalhousie, who was much interested in them.

Mr. Hyde Clarke said, from the account given of the early iron workings there could hardly be any doubt that they must have existed for thousands of years, and the probability was that similar processes were carried on in Europe by the same races who developed those monuments to which reference had been made, and which were perfectly conformable in the east and west. Thus identically the same process which Mr. Blanford had described as pursued by a gipsy-like tribe in India, he had seen followed by people who had migrated from India in the more western portions of Asia; and the same thing might be seen in Hungary and elsewhere. He could not agree in the conclusion as to the exhaustion of the deposits at the present day on the ground that they had been worked at former periods. No doubt the ancient miners displayed great industry; the Romans, for instance, were good engineers and indefatigable workers, and yet it was well known that in nearly every quarter of the globe where they had carried on their operations they might still be pursued with successful results. In this country there were remains of Roman mining operations both in Cornwall and in Cumberland, and in both places their abandonment was no proof of the exhaustion of the ores. The fact was that the appliances of the Romans, ingenious as they were, as described in the classic authors, were not sufficient to exhaust the resources of the mines. The same thing applied in Spain and other countries, and, therefore, he drew the conclusion that the existence of old abandoned workings in any part of the world was rather an encouragement to the modern miner than the reverse. One of the most interesting portions of the paper was that which contained the history of the failures of the iron manufacture in Madras, and it must be remembered that nothing was more valuable in science or the arts than the history of failures whenever their cause could be discovered. Allusion had been made to the name of a gentleman who had rendered inestimable services both to India and to his native country. Mr. Heath was a civilian in India, who laboured hard to establish those iron works which had proved so disastrous to his own fortunes; and he was, moreover, one of the few pioneers of railways in India—in fact, no one hardly took a more active part in the introduction of railways into the Madras presidency. He was also known in England as the inventor of a process which was the means of renovating and vastly extending our steel manufactures, and had led to the creation of numerous branches of industry, by the great reduction which it effected in the cost of steel. In that matter, however, as in others, he was pecuniarily unfortunate. All that he asked of the steel manufacturers was a royalty of £1 per ton on the £20 per ton which they were enabled to save by means of his process. A combination was formed, however, to contest his rights—and, as was generally the case in patents, as soon as anything was successful it was found out that some one had made the same discovery before. In Mr. Heath's case it unfortunately happened that a previous improvement of his own, which was not included in his patent, gave his opponents a weapon with which to fight him, and he died crushed by the consequences of his own success, still leaving to his successors some small heritage in the limited compensation which was ultimately given by the steel manufacturers to his representatives. His name ought never to be forgotten in any discussion affecting India, and certainly not in that hall where he had received the thanks of the Society and such reward as they were able to offer him. His career was one which should be carefully studied if any useful lesson was to be drawn from it, and he considered it gave no ground for discouragement. No doubt his life had been a series of failures, but what was their history as he had heard from his own lips? He was a civilian collector, who knew nothing whatever about the iron manufacture, and all his knowledge had to be acquired from books and from occasional visits to Europe. He was a promoter of the culture of cotton, and of the progress of his collectorate in every respect; and in the time when the company was a trading company he was allowed, as had been mentioned, his own profits on cotton, as a fund by means of which to carry out his experiments in the manufacture of iron. Thus, the old government of India afforded him a great deal of encouragement, but the result was what might naturally be expected. Mr. Heath was a man of great power of mind and of an inventive genius, but his whole career was one of experiment; and, however able he became as a man of science to the last day of his life, he never was a man of business; and when such matters were carried out by an amateur, as he and many other servants of the Indian government were, what could be expected but failure? But, so far from that being cause for discouragement, it ought to be a lesson not to commit the same errors in the future. The whole history of Mr. Heath illustrated one of the evils which seemed inherent to the government of India; when a man had made great exertions, and perhaps spent large sums from the public revenue in promoting an important manufacture, he was removed to another district before his plans were matured, and someone took his place who probably upset the whole of his arrangements. Turkey was often pointed to as an example of foolish government, but what could be more absurd than sacrificing an expenditure of £75,000 and foregoing all beneficial results? The whole career of India bore marks of the same want of administrative foresight. Thousands and tens of thousands of pounds were expended on experiments, which were often entrusted to men totally incapable of properly conducting them, while a few hundreds or thousands which might have been employed annually in a careful, persistent course of improvement were denied. Coming now to the point with which he started, if there were to be any successful development of mining enterprise in India, there must be such security of tenure for the miner as would enable him to carry out, with some prospects of success, what was always a most speculative business. They had been informed that there were no general mining regulations in India, and that in large districts they were entirely dependent on the casual arrangements which occurred at the time of the Bengal settlement. Whereas the law of the country generally, as of all the rest of the world, was that the minerals belonged to the state, without the least regard to public interests these mineral rights were passed over to the zemindars of Bengal — the most extraordinary arrangement it was possible to conceive. When in Turkey he found mining affairs in much the same state as in India—a few rich mines were worked which were State monopolies, while large districts of country, abounding in mineral wealth, were absolutely unworked, and there was not one company in successful operation in Turkey. The government were very anxious to develope these mineral resources, and set up a code of mining laws, which they obtained from Paris; but the French not being remarkable for mining enterprise, it was not very well adapted for the purpose, the pains, and penalties, and dues, and tolls, being so heavy that it was impossible to work a mine at all. He having pointed the reason of this to the minister, a large reduction was made, but still not enough to encourage mining operations. Having sent to the government information of the discovery of a coal basin, the minister telegraphed back, thanking him for that and other favours, and begging him to accept a concession of the coal-field under the ordinary mining laws. His answer was that the discoverer of the coal-field ought to have the benefit of it, and that, as for himself, he begged to decline the offer, because it would be simply ruinous to work the mines under the government conditions. The tolls had since been still farther reduced, and a few companies were now at work. To take another example, for a government not remarkably liberal, Philip II. of Spain followed in America the same encouraging system which had been adopted in the old world, giving the property in any mine to the discoverer. The same law existed in South America as in Cornwall, though there was in the former country more scope for its operations. Any man who discovered a mine had only to go to a local office and register it, paying a fee of two rupees, and he thereupon became the proprietor in perpetuity, subject only to his carrying on the works to a certain limited extent. He had at once, therefore, a property which he could sell or raise money upon for conducting the works, and thus mining was encouraged and developed. The same system might be adopted in many parts of India with great advantage. He had no doubt that when Mr. Blanford's valuable paper was published in India, so far from creating discouragement, it would cause greater attention to be paid to the subject, and to the ascertaining on the spot the causes of failure. The circumstance that many of the most valuable mineral deposits existed in those districts which were least explored, and still occupied by wild aboriginal tribes, showed the necessity for paying more attention to those districts, and the fact, which had been stated, that the most valuable coal and iron deposits lay far from the main lines of railway, was simply a reason for further and early railway extension.

Mr. Prichard said he had been much interested in Mr. Blanford's paper, but at the same time somewhat dismayed at the account given of the mineral resources of India. He could not help the feeling that, as in ancient times, India was known to be the source from whence flowed the principal supply of wealth to the whole of the civilised world, it was strange if the supplies had altogether become exhausted. The remark of Mr. Hyde Clarke, that the abandonment of ancient workings did not prove the exhaustion of the mine, struck him as having considerable weight, for it was well known that the fires which had recently been extinguished in South Wales owing to the strike, had, until that unfortunate occurrence, been burning almost without interruption from the days of the Romans. It seemed on the face of it strange, therefore, that the country formerly celebrated as the richest in mineral wealth, should now be really one of the poorest. As far as his own experience went, he must, however, corroborate Mr. Blanford as to the unproductive character of the gold washings, which he had witnessed in Northern India, in the valley of the Punjab, and on the Indus. But it had always seemed to him reasonable to suppose that where small quantities of gold were found in the bed of a river, larger quantities might be looked for by tracing that river to its source, and he should like to know if search had been made for gold on this principle. In the Aravelli range, and also in Rajpootanah, he had seen quartz rock similar to what he had seen described as the auriferous quartz of California and Australia, and it occurred to him that gold might be found if properly searched for. His own experience of minerals was confined to the observation of some ores sent to him from the Kheytree Rajah to be examined, which he believed consisted of antimony, copper, and cobalt. He had not seen the mines from which they were taken, but understood they were worked in the ordinary native manner; and probably, if taken up by Europeans with energy and capital, much better results might be obtained. He had made inquiries if there was any trace of platinum in Rajpootana, but never found any trace of any. He should also like to know if any reason could be assigned for the failure of the Kamaon iron works, which suddenly collapsed some time ago, though very sanguine hopes were entertained with regard to them.

A Gentleman inquired whether Indian coal was bituminous or anthracite, and how it compared with English coal of the same description.

Mr. Blanford, in reply, remarked, first of all, with regard to the enormous wealth brought from India in ancient times, that pearls were not minerals, and, in the next place, that the economic and industrial conditions of those days were totally different to anything which would be tolerated now, certainly by Englishmen. The ancient ruler had an almost unlimited command of labour at no expense, and very probably they employed it in the accumulation of wealth in that shape in which alone, in those times, it could be secured from the violence of enemies, and which, at the same time, ministered to their ideas of princely grandeur and magnificence. It was quite possible, therefore, that gold and precious stones might have been procured at the period referred to, by an expenditure of labour which now-a-days would be wholly disproportionate to the result. It must also be remembered that the whole of the wealth of the East did not come from India, but also from Burmah, Central Asia, Turkistan, and possibly even from China and Japan, though India, being the centre of eastern wealth and civilisation, got the credit of the whole. What he had already said bore somewhat on the question of the ancient and abandoned workings. Several mines existed now, especially in the Himalayas, which had been declared again and again, by practical European miners to be not worth working by any system known to them which would involve European superintendence. The native plan was to work at any little bit of ore which they came across, until the whole place became like a rabbit-warren, and they were satisfied with returns which a European would not take notice of. He had no wish to depreciate the resources of India, neither, on the other hand, did he desire to exaggerate them, and he had simply stated the results of his own observations. No doubt there was gold in India, but not in large quantities, because it had been inhabited for time immemorial by a race which knew gold as well as any European, and was quite as keen in its acquisition. They were not savages, like the natives of Australia or America, but were quite sufficiently civilised to know the value of gold, and to spare no effort in seeking it. One difficulty, he believed, was the absence of a regular supply of water, there being too much at one time and not enough at another, a constant supply being requisite in washing either for gold or gems. He rather thought he had heard of gold being found in the Arivelli range, but was not quite certain. He had never visited the country himself. Nor had he ever had authentic information of platinum being found in India; there were one or two small fragments in Calcutta, but he could not say where they had come from. He was not acquainted with the cause of the failure of the Kamaon iron works. India coal was free-burning, not anthracite, but slightly bituminous; it left a considerable quantity of ash, and had no tendency to cake. With regard to the copper mines of Chibassa, there was no doubt that workings abounded there, and that much fine ore was left in them. It was much to be regretted that the enterprise had not been more successful, for it certainly started with better chances than many others. But if the quantity of ore diminished with the depth, which was the impression of Mr. Sturr, the manager, that would account for the small quantity now found. To the best of his belief, the mines sunk by Messrs. Duschuet and Company never penetrated deeper than the old workings. There were not yet sufficient data to give any definite opinion as to the extent and value of the Indian coal-fields; in some cases it was found at a much greater depth than had been expected, and in others the quality deteriorated; but in any case there must be a considerable quantity of serviceable fuel in India. Whether or not it would be wise to give discoverers a right to the minerals he could not say, but he knew for a fact that there were large deposits of coal well known to exist which no one thought it worth while to work, though, no doubt, the owners would readily do so if they saw their way to make a profit by it. Unfortunately there was no demand for it, and he could not quite see the wisdom of making railways to the coal-fields in order that the engines might consume the produce.

The Chairman, in proposing a vote of thanks to Mr. Blanford, said that gentleman had well utilised the results of his twenty years' experience in connection with the geological survey in Bengal, the Central Provinces, Madras, Burmah, and Bombay, and his valuable paper had given rise to a most useful discussion. Mr. Hyde Clarke's remarks were very suggestive, though he could not quite agree with them all. The difficulty arising from the system of constant changes in government officials, was, no doubt, great, but it seemed, under present circumstances, impossible to avoid; and, with regard to the tenure of land and mines, the system adopted in Bengal was the same as that of England, where the minerals belonged to the owner of the soil. The opposite plan, of reserving the mineral rights to the State, did not appear to work very well in Turkey, according to Mr. Clarke's own account. The subject of private enterprise in India was too wide a one for discussion then, but the importance of cultivating it as far as possible could not be over estimated, though the difficulties connected with it under such a form of government as must necessarily exist there, were very great. Mr. Blanford's observations on the causes of the great wealth of India in ancient times were well worthy of attention, history fully bearing out the statement that despotism and slave labour, both happily things of the past, were the two main instruments in the production of the vast hoards of wealth formerly possessed by eastern potentates; and it was never likely such a state of things would occur again.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

Engineering gives the following account of the steel exhibits in the Exhibition. It says they will form, in many instances, complete histories of the processes of manufacture of both light and heavy steel goods—from a needle to a locomotive boiler. The lion's share of the credit due for forming a very extensive display of heavy steel goods—as interesting as it will be instructive—must unquestionably be awarded to Mr. F. W. Webb, the locomotive engineer of the London and North-Western Railway. This gentleman has sent a collection of steel articles representing various portions of a locomotive, each being shown in various stages of manufacture. He has also sent a number of specimens of steel wrought into various forms for other purposes. Some idea of the extent of this collection may be gathered from the circumstance that it will occupy nearly the whole of Room No. 26, leading from the west gallery of the Exhibition building, which was used for the purpose of exhibiting the scientific inventions last year. Here the visitor to the Exhibition will find specimens of the crude materials for the manufacture of steel by the Bessemer and the Siemens-Martin processes; pig iron and spiegeleisen will be illustrated in a similar manner. Then there will be seen a number of Bessemer steel ingots, bars, boilers tubes, boiler plates, and various other exhibits of the same nature, each of which will have its own special history to tell, its own practical lesson to teach. Then will come the heavy parts of locomotives, such as steel connecting rods, springs, axles, wheel tyres, fireboxes, and finally a locomotive boiler itself. In fact the collection will be the most complete and extensive in the Exhibition. The return portion of Room No. 26—a length of about 20 ft.—will be occupied by springs from the Railway Spring Company, and some heavy specimens from Messrs. Howell and Co.'s works. The light steel goods are being arranged in the east and west crush-rooms on the balcony in the Albert Hall. In these rooms will be found samples of Messrs. Howell's homogeneous metal, cast steel, and special steel, as well as various kinds of goods manufactured therefrom. Here will be aggregated steel ornaments, toys, tools, pens, needles, and fish-hooks, knives and scissors, swords and spurs, and in fact specimens of all the known applications of one of the most useful and important metals. In order to complete the collection, machinery processes and apparatus for the testing of steel rails, steel wire ropes, &c., will find places in the building.

In the account of the meetings of the Statistical Society in last week's *Journal*, it was stated that the paper on "Purchase of Railways by the State," was by Mr. R. Biddulph; it should have been Mr. R. Biddulph Martin.

Advices recently received from New York state that the production of coal in the United States last year was 41,491,135 tons. This total presents an increase of upwards of 3,000,000 tons as compared with 1871. The production of anthracite coal last year was 22,039,313 tons.

Experiments are now being made upon the Great Western Railway to test the merits of two railway carriage lamps, Silber's and Griffiths'. Both lamps burn paraffin oil, the flashing point of which is 20 deg. The trial train starts from Paddington at 4.50 p.m. each day, and runs to New Milford. The Griffiths lamp is used on Tuesday, Thursday, and Saturday, and the Silber lamp on Monday, Wednesday, and Friday.

EXHIBITIONS.

VIENNA EXHIBITION, 1873.

Her Majesty's Commissioners for the Vienna Universal Exhibition have received from His Excellency Baron von Schwarz-Senborn, the Director-General of the Exhibition, the following communication :—"The Board of Managers of the 'Rudolphinum,' a philanthropic institution for the assistance of students, who are supplied in common household with board and lodging, have, in accordance with the wishes of the founder, Chevalier A. M. Pollack de Rudin, offered, in a most obliging manner, to place at the disposal of 300 professors, schoolmasters, and teachers of all nations who intend to visit the Vienna Universal Exhibition during the school vacations this year, the second floor of the institution building, comprising thirty rooms, so that a lodging, free of expense, will be secured for each of the guests. The Board intend to distribute the said thirty lodgings in such a manner as to accommodate at the same time, as far as possible, gentlemen of different countries, in order to render the intercourse between them the more pleasant and of lasting advantage to science. Considering that only thirty of the gentlemen invited can be lodged simultaneously during a fortnight, at which time another group of thirty gentlemen will have to occupy the rooms for a similar number of days, the Board of Managers request to be informed of the applications to be expected from foreign commissions, in order that each turn of lodging may be fixed in advance. The Board of Managers will inform the applicants by letter in due time of their reception being secured, as well as of the date on which it can take place, and these letters of advice will serve at the same time as an introduction for the applicants on their arrival at the Rudolphinum." In addition, Her Majesty's Commissioners have been informed that the Midsummer vacations at the Rudolphinum will commence this year as early as the 15th June—at all events, not later than the 1st July, and they will terminate at the end of September. The professional gentlemen who intend to avail themselves of the advantages offered to them are therefore requested to forward their application to Her Majesty's Commissioners not later than within a week from the present date, in order that the same may be duly transmitted to the Board of the Rudolphinum. Those applicants who notify the time of their intended visit to Vienna will be lodged, so far as is possible, in accordance with their wishes, unless there should be prior claims for the same period, to which preference must be given. If within three days after the date fixed for the occupation of an assigned lodging its expected tenant should not have arrived at the institution, such absence will be considered equivalent to a renunciation of the lodging assigned, which will then be given to another guest. All applications are to he made to the London officers of the Commissioners, in order that the same may be forwarded in time to His Excellency Baron von Schwarz-Senborn for transmission to the Board.

From particular inquiries we have made in Vienna, says the *Engineer*, we understand that, though the International Exhibition will be "opened" on the 1st of May, yet it will be more of a fictitious than a real opening. The official opening will be as much of a real and virtual opening as that of the Paris Exhibition in 1867, wherein, although opened on the 1st of May, hardly anything was finished at that date. Then the exhibitors will not be any better, and probably not worse, represented than they were on the 1st of May, 1867, at the Paris Exhibition. It is positively certain that all the interior decorations of the building will not be finished by the end of this month. But these are matters of detail, and there is no doubt that by about the month of June everything will be as complete as can be expected.

According to the official accounts, which reach up to the third week in February, the railways forwarded on the whole 2,760,199 cwt. of material for the construction of the Exhibition building. Up to the time mentioned, 21,563,700 bricks had been used; 160,860 cwt. of iron, 145,932 cwt. of lime, 170,380 cwt. of timber, and 279,950 cwt. of sand for mortar have gone to make up the imposing edifice and outbuildings. The bricks took up 9,256 cars, and weighed 1,890,310 cwt. The amount of gravel brought to the spot may be estimated from the fact that from March, 1872, to February, 1873, no less than 2,229 trains, with a total of 56,720 trucks, averaging 25 trucks to a train, constituted the traffic for this article alone.

Among the American exhibits are sewing machines of great variety, knitting machines, scroll saws, wood working machines, windmills, pumps, steam engines, water wheels, safes, pianos, school furniture, &c., besides ores, bales of cotton, hemp and other products from various parts of the country, representing the growth and industries of the sections from which they come. On the main floor of the American department will be shown, in actual operation, shoemaking, brush, bucket, and nail-making machines, stone breaking tools, flax cleaning machinery, rock drills, circular looms, machines for making pipe elbows, boot heeling machines, and numerous kinds of wool-working machines. General Newton has sent a perfect model of the engineering works carried on under his direction at Hallett's Point. The United States Lighthouse Board have forwarded their best specimens of lighthouse lanterns, and the Navy Department have sent their new and improved apparatus for hoisting and lowering boats. About seven hundred exhibitors have space assigned to them. We understand that the President of the United States has appointed Mr. Edwin Sherman as special commissioner during the forthcoming International Exhibition at Vienna, to report upon the metallurgical industries of Europe.

According to the *Architect*, the "model houses" which are about to be exhibited in connection with the Vienna Exhibition ought to be alone worth a journey to see. The last example which is mentioned as being on its way, is a model of one of the better-class country villas, belonging to the wealthy class of the Moors, which are built in the suburbs of Tetuan, Fez, and Morocco. It was prepared, under great difficulties, by Mr. Schmidl, the Austro-Hungarian Consul at Tangier, part of the work being executed at Fez and Tetuan. The model is of wood, 27 feet square and 20 feet high, and contains in addition to the entrance and the "Patio" or court, six rooms. The minute and delicate tracery in colour is the handiwork of a painter from Tetuan, Mimon Benshelrad, who ought to be exported along with the house, for Mr. Schmidl says that his ingenuity and prolific invention are only equalled by his steady application and unexceptional conduct, and a model workman like this is not every day met with. It appears that the workmen gave great trouble, and, not content with higher pay than was ever given in the town of Tangier, actually resorted to a strike at a time when the loss of even a day was of vital importance.

Mr. Nicholas Chevalier has, we understand, been requested by the Prince of Wales to accompany him to Vienna, in order to prepare sketches of the Exhibition.

Exhibition of Victoria.—One hundred and fifty thousand persons visited the Exhibition during the period it remained open. The receipts amounted to £5,000, placing £1,600 to the credit of the commissioners.

The Dublin Industrial Exhibition.—Active preparations are proceeding to render this year's Exhibition worthy of public support. Meetings have been held of the Committee for Ornamental Art, and it is reported that numerous communications have been received offering loans of china, porcelain, &c. Collectors and owners of plate, jewellery, metal work, miniatures, bronze, enamels, china, porcelain, and other objects of art are solicited by the Committee of the Loan Museum to communicate as soon as possible their intentions respecting their exhibits.—*Irish Builder.*

THE INSTITUTION OF NAVAL ARCHITECTS.

The institution (as mentioned in last week's *Journal*) held their annual session in the hall of the Society, by permission of the council, on Thursday, Friday, and Saturday last, April 3rd, 4th, and 5th. On Thursday the Right Hon. Sir J. S. Pakington, Bart., M.P., G.C.B., D.C.L., President, was in the chair, and after the annual report of the council and the address by the President, the following papers were read and discussed:—(1) "The Unmasted Sea-going Ships, Devastation, Thunderer, Fury, and Peter the Great," by Mr. Nathaniel Barnaby, Chief Naval Architect of the Royal Navy, Member of Council; (2) "The Load-draught of Steamers," by Mr. W. W. Rundell, Secretary to the Liverpool Underwriters' Association, and to the Underwriters' Registry for Iron Vessels, Associate; (3) "On the Overloading of Steamers," by Mr. J. Wigham Richardson, Associate; (4) "An Investigation of various Proposals for fixing the Load-line of Vessels," by Mr. Edward Withy, Member; (5) "On a Case not provided for in the Admiralty Regulations for Preventing Collisions at Sea," by Mr. James R. Napier, F.R.S., Member of Council. At the evening meeting the papers were: (1) "On Auxiliary Power for Ocean Navigation," by Mr. Henry Claughton, Member; (2) "The Causes of the Racing of the Engines of Screw Steamers, investigated theoretically and by experiment," by Mr. Osborne Reynolds, M.A., Professor of Civil Engineering in Owen's College, Manchester; (3) "A new form of Safety Valve," by Mr. W. Babington. On Friday morning Admiral Sir Spencer Robinson was in the chair. The first paper read was a "Description of an Instrument for automatically recording the Rolling of Ships," by W. Froude, F.R.S., Vice-President. Admiral Stewart, the Earl of Lauderdale, Mr. Rundell, Captain Selwyn, Mr. Merrifield and others spoke. The next paper read was "On Vessels for the Channel Service," by J. Grantham, a Member of Council. Mr. A. J. Dudgeon read a short paper on the same subject, and produced a model of a vessel which he proposed should be used in running across the Channel. Mr. J. White, of Cowes, naval architect, referred to a model of his, the novelty of which consisted in giving a concave form to the bottom of a vessel instead of a convex one, thereby making a single channel for the water amidship, by which the principal elements of displacement were transferred to the bilges. The other papers were "Considerations respecting the effective Wave-slope in the Rolling of Ships at Sea," by Mr. Froude; (4) "On Water-tight Bulkheads," by Mr. L. Hill; and (5) "On Water and Fire-tight Compartments," by Mr. T. Moy. On Friday evening, with Sir J. Packington, M.P., in the chair, the proceedings were commenced by the reading of "Remarks on the Theory of the Rudder," by Herr Ludwig Lutsch Aunig, professor of theoretical and practical shipbuilding in the Imperial and Royal Naval Academy of Trieste. Mr. Reed (late Chief Constructor of the Navy), Mr. Byrne, and J. Henwood spoke in the discussion. The next paper was "On the Relation of Frame Space and Shift of Butts to the Butt Fastenings of the Skin-plating of Iron Ships," by W. H. White, Fellow of the Royal School of Naval Architecture and Marine Engineering. The other papers dealt with were (3) M. Emil Bertin's "Memoir on the Experimental Study of Waves," (4) Mr. J. S. Gisborne's "On a New Hydraulic Steering Gear," and (5) a paper by the late Professor Rankine "On Waves in Liquids."

At the Saturday meeting the principal subject of discussion was the means of lowering boats at Sea, on which papers were read by Mr. F. J. Sweeting, Mr. J. C. Dixon, Mr. C. G. Grumpel, Lieut. Stephanhoff, and Mr. Hills, whose invention is adopted on board the *Challenger*. In the discussion which followed Mr. Stirling Lacon, the Earl of Lauderdale, Sir E. Belcher, Sir J. Hay, Mr. Bramwell, and others, took part. The other subjects on which papers were read were "On An Instrument for Extinguishing Fire in Ships," by Mr. J. Paton, and "On a Proposed Torpedo Catcher," by Mr. W. E. Sercombe.

ON THE ELECTRIC LIGHT.

By W. H. Walenn, F.C.S.

II.

Between the electric light, as now capable of being utilised, and the light produced by Sir Humphrey Davy in 1813, there is a great gap. Davy's light was produced by enormous battery power, at a very great consumption of zinc and acid; the light was fitful, from the want of adjustment of the electrodes as they burned away, and the apparatus for trying the light as a philosophical experiment was not adapted to give it as a lamp. The galvanic battery, it is true, was the analogue of the chemical forces in the sun, but the chemical power of the atmosphere in contact with the carbon electrodes established a second and most undesirable chemical action which tended to destroy the electrodes; the constancy of the light was further interfered with (as mentioned above) by the carrying over of particles of ignited carbon from the positive to the negative electrode. This was the condition of affairs about thirty years ago, when De Moleyns, Staite, and others endeavoured to devise electric lamps of a practical character. In Staite's, Deleuil's, and, latterly, in Duboscq's lamps, the distance between the electrodes is regulated by self-acting means, an electro-magnet being included in the galvanic circuit for that purpose, and certainly a good steady light is obtained at a much cheaper rate and in a more manageable manner than Davy's, especially in the case of Duboscq's light. Duboscq's lamp, in common with all the more recent lamps, may be satisfactorily worked by a Bunsen's battery of 50 cells; it is that generally used in the Royal Institution and other lecture-rooms for throwing luminous images on to a screen in the manner of a magic lantern. This lamp is well suited for optical purposes, as it has the luminous point in a fixed position under all circumstances.

The power of the electric light is so great and its light is so pure, that it is not surprising to find that renewed efforts are being made to extend the sphere of its usefulness, and, instead of its being used in lecture-rooms and on exceptional occasions only, to bring it into more general use for illuminating purposes. The light from between 40 and 50 Bunsen's cells has been variously estimated as equal to that from 500 to 1,000 sperm candles; and Fizeau and Foucault computed the intensity of the voltaic arc of a 46-cell Bunsen's battery to be thirty-four times greater than that of the lime-light.

The cheapness of electricity from a magneto-electric machine, and the readiness with which it is obtained from a well-made arrangement, have tempted several electricians to try what can be done with magneto-electricity applied to lighting. The experiments have been so far successful that the South Foreland has been protected by a lighthouse with a magneto-electric light, for some time, by a machine or machines adapted to that purpose by Mr. Frederick Hale Holmes. In September, 1869, Mr. T. Stevenson, C.E., was engaged in testing the practicability of illuminating beacons and buoys by the electric light; and it has been proposed to light the tunnels and dangerous places of railways by its means. In 1869 a French shipping company are said to have decided to adopt the electric light on board its vessels, but no definite results have yet been published. The substitution of the magneto-electric machine, an apparatus of coils and magnets driven by steam power, for the destruction of zinc in a galvanic battery, is a step that promises well, both for practicability and economy. It substitutes the moving of an apparatus already made, and but seldom requiring attention, for the constant expense, trouble, and mess that the working of the ordinary galvanic batteries entails, and the price of coal is thereby placed in favourable juxtaposition with that of zinc. Some trials will shortly be made with new developments or modifications of magneto-electric power, and they will have the good-will of all who desire to see so useful an agent made still more serviceable, and further removed from the cabinet of the curious to the workshop of the artisan and to other walks of daily life.

That electric light which would bear out the above analogy of sunlight in the most perfect manner, would have two points which none of the lights hitherto mentioned possess. First, there should be no break or convective discharge, for the mechanical carrying over of particles which accompanies this kind of electric light is a direct loss of electric power, since it is motion across a given space which ought to be stopped and not allowed to absorb that electric power which it is desired to transmute into light. Second, the light should be generated in vacuo, or in a non-active atmosphere, so as to cut off the access of air, and thus prevent any chemical change from taking place at the light itself. The application of continuous metallic and carbon conductors, intensely heated by the passage of a current of electricity, to the purposes of illumination is first put forward in the patent specification, No. 10,919, dated November 4th, 1845, filed by Edward Augustin King, as a communication from a foreigner residing abroad, and this plan has been tried by some subsequent workers in practical electricity. In 1848, Mr. Staite tried the light from incandescent iridium enveloped in glass. In 1850, Nollet described an apparatus for producing electric light from incandescent carbon in an exhausted globe; it appears that magneto-electricity was used in this invention. Finally, in 1852, Martin John Roberts experimented upon the transmission of the electric current through a continuous thin piece of graphite enclosed in an exhausted glass globe. These attempts to prevent the wearing away of the electrodes, and to substitute a continuous current for the convective discharge, were not, in the main, successful. This was partly owing to the use of impure carbon and the deposition of an opaque film thence derived on the glass globe containing the incandescent material, and partly in consequence of the vacuum not being able to be well maintained, in the presence of the heat developed when the light was working, considering that the putting out of the light also annulled the heat; the alternations of temperature thus induced on the apparatus prevented a true vacuum from being maintained. Under these circumstances, the points to be borne in mind in order to attain success in this development of the electric light, are:—First, the use of pure carbon and the proper adjustment of the electric current to its capacity. Second, the attainment of an atmosphere of some kind that does not act upon the carbon at the high heat to which it is raised, in the glass vessel containing the light. Such conditions as these are very difficult to fulfil practically, but the author is given to understand that a powerful attempt is now being made to produce an electric light without the convective discharge and enveloped in a non-active gas. All that money and talent can do to utilise this agent is now to be devoted to the task, and a few weeks will enable the inhabitants of London to judge for themselves of the efficacy of the light which will be shown. If the hopes of the inventor are realised, the gas companies will do well to make arrangements with him in time, and their pipes will serve to protect the insulated conductors from external harm. If the conduction of electric force across a partially conducting medium, such as carbon, can be made to do the work of illumination properly, it will afford a means of employing electricity, which is denied to the ordinary electric light apparatus, for, when the convective discharge is used to produce the electric light, it is practically impossible to have two electric lights in the same electric circuit. It is most probable that the adoption of the continuous conductor principle will admit of two or more electric lights being included in the same electric circuit. Most certainly, if this invention becomes in very deed and in practical working an accomplished fact, our analogy will be carried out, and we shall have our streets and our houses illuminated with light which, in a philosophical as well as a practical sense, is truly described as artificial sunlight.

CORRESPONDENCE.

SAVING LIFE AT SEA.

Sir,—I was much surprised at not finding Captain Dansey's kite for shipwrecks in the list of life-saving apparatus at sea, an expedient that can be rigged up in a few minutes by any sailor with the materials to be found in every ship.

A kite from a stranded vessel must inevitably fly over a lee-shore, and thus afford immediate communication between the wreck and the land, in defiance of wind and waves. A full description of the kite and appliances is found in a former volume of the Transactions of our Society.

A trial was recommended to be made by the Committee with an experimental kite in Hyde-park. The main spar of the kite was a pole nine or ten feet long, and though it was not a very windy day, it dragged five or six of us down on the grass, and I was obliged to send up the messenger to bring it down, or we should have been dragged over the fences. The main kite line was what sailors call $1\frac{1}{2}$-inch rope.—I remain, Sir, yours, &c.,

Henry W. Reveley.

Reading.

GENERAL NOTES.

Lectures on Geology.—Six elementary lectures on geology in the Easter holidays, adapted to a juvenile audience, will be given by J. Tennant, F.G.S., &c., at 149, Strand, London, on April 14, 15, 16, 17, 18, and 19, at 3 p.m. Terms—Half-a-guinea for the course; 5s. for children of fellows of the following societies—Geological, Zoological, Chemical, Royal Microscopical, Royal Geographical, Royal Horticultural, Geologists' Association, and Society of Arts. Descriptive Geology—Classification of rocks into aqueous, volcanic, plutonic, and metamorphic. Mineral Composition of Strata—Arenaceous, Argillaceous, Calcareeus—Chronological classification of sedimentary rocks, with description of the principal fossils belonging to each great deposit. Tertiary, or Cainozoic Series—Cave-deposits, crag, Isle of Wight, and Bagshot series, London clay, Woolwich beds. Secondary, or Mesozoic Series—Cretaceous, wealden, oolitic (upper, middle, and lower), triassic groups. Primary, or Palæozoic Series—Permian, carboniferous, Devonian, silurian, and Cambrian groups. The mode of collecting, cleaning, and arranging fossils, minerals, and rock-specimens will be described.

New Aniline Red.—This colour is produced by the action of the chloride of sulphur upon aniline in the cold. To 25 to 30 drops of aniline, chloride of sulphur is gradually added, with constant stirring. In five to ten minutes a red solid mass is formed. It dissolves in acetic acid, forming a red liquid. The colouring matter dissolves also in ether and alcohol. These solutions are not miscible with water, on the addition of which they are decomposed, with precipitation of a grey colouring matter.—*Iron.*

Our Patent Laws.—It appears that at last there is a prospect of the present state of our patent laws receiving the careful attention of Parliament. An Act dealing with the subject is, we understand, to be introduced during the present session by the Lord Chancellor, and with the matter in such hands some definite result is certain to be arrived at.—*Engineering.*

NOTICES.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

REPORTS ON THE LONDON INTERNATIONAL EXHIBITION OF 1872.

The reports which appeared in the last volume of the *Journal* on the various sections of the above Exhibition, are now published complete, in a pamphlet form (price 2s.), and can be obtained at the office of the Society.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. The following meetings have been arranged:—

April 16.—"On the Practical Use of Lenses and Reflectors in Artificial Illumination, with especial reference to Street Lighting." By T. A. Skelton, Esq.

April 23.—"On Silkworm Grain." By Mons. Alfred Roland (Orbe, Switzerland). On this evening Andrew Cassels, Esq., will preside.

April 29 (Tuesday Evening*).—"On the British Settlements in West Africa." By His Excellency Governor Pope Hennessy, C.M.G.

April 30.—"On the Condensed Milk Manufacture." By L. P. Merriam, Esq.

CANTOR LECTURES.

The Third Course of Cantor Lectures for the present session will be "On Wines; their Production, Treatment, and Use," by J. L. W. Thudichum, Esq., M.D. The Course will consist of six lectures, the first of which will be given on Monday evening, the 21st of April, the remaining five on the Monday evenings succeeding.

Lecture I.

Description of the vineyards of Jerez de la Frontera, from personal observation of the lecturer. Geographical and geological position. Climate. Flora and fauna. Varieties of vines cultivated, particularly those used for wine-making. Wild or indigenous varieties, as studied by the lecturer in the primæval forest, the Algaida, near San Lucar de Barrameda. The vintage at Jerez. Implements and processes. Fermentation. Vinification.

Lecture II.

The varieties of wines produced at Jerez—mostos, añadas, finos, palos-cortados, amontillados, rayas, bastos, &c. Physical and chemical observations on the causes of these different results. Brandying, plastering, sulphuring, mixing, and counterfeiting of Jerez wines. Neglect of scientific guidance in vinification diminishes the certainty and success of otherwise highly-developed viticultural and commercial operations. Other Spanish vineyards and wines.

Lecture III.

Description of the vineyards of the Alto Douro, from personal observation of the lecturer. Contrast of geological position of these vineyards to those of Jerez. Varieties of vines cultivated; all medium-sized grapes; whereas the Jerez grapes are all large-sized. Indigenous vines, as studied by the lecturer in the province Entre Douro e Minho. Viticulture in the Alto Douro. The vintage and wine-making.

Lecture IV.

The varieties of wines produced in the Alto Douro; how treated at Oporto. Lodges. Brandy. Legend of elderberry. Unbrandied and dry natural Alto Douro wines. Neglect of scientific guidance here also, but processes more simple, and varieties of results not so great as at Jerez. Description of other Portuguese vineyards—the Beiras, Valley of the Tagus, Bucellas. Fable of the transplanted Rhenish grapes. Collares. Torres Vedras. General remarks on the nature and difficulties of Portuguese viticulture and vinification, all based upon personal observation of the lecturer.

Lecture V.

The wines of France compared to those of Spain and Portugal. The Gironde, its vineyards, wines, and varieties of wines. The Bourgogne and its productions. Belgian appreciation, and sweetness of Burgundy wine. The wine requires the procédé. The Champagne; peculiarities of viticulture. Chemical treatment of effervescent wine to ensure its soundness. Absurd notion of some writers on champagne; of the same on second wines and sugar-water wines; exposure of the sycophancy.

Lecture VI.

The wines of Germany; Riessling a type of bouquetted wines. Classification of the wines of the world, as determined by quality, quantity, value in the market of highest and lowest qualities. Active ingredients of wine. Use of chemical analysis. Use of wine to the healthy, whether old or young; wine, under which condition preferable to all other alcoholic liquids. Wine should be a beverage, not a dram. Use of wine to the delicate and sick. Selection and prices of wine. Proposed modification of the import duties, to adjust them to the climatic difficulties of Spain and Portugal.

INDIA COMMITTEE.

A Conference will be held on Friday, 25th inst., at 8 p.m., when a paper will be read by William Tayler, Esq., on "The Rosary in India."

Members are entitled to attend these Conferences free, and to admit two friends to each of them.

MEETINGS FOR THE ENSUING WEEK.

Tues....Civil Engineers, 8.
Statistical, 7½.
Pathological, 8.

Wed....**SOCIETY OF ARTS, 8.** Mr. T. A. Skelton, "On the Practical Use of Lenses and Reflectors in Artificial Illumination, with especial reference to Street Lighting."
Architectural Association, 7½. Mr. Wynfield, "On Taste in Colour."
Meteorological, 8.
London Institution, 7. Professor Ella, "On Music."

Thurs...Linnæan, 8. Prof. Reichenbach, "Burmese Orchideæ" from the Rev. C. P. Parish. Prof. McNab, "Perigynium of Carex."
Chemical, 8. Dr. Heinrich Debus, "On the Heat produced by Chemical Action."
Numismatic, 7.
Zoological, 4.

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* A meeting specially appointed, as His Excellency is leaving England.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,065. Vol. XXI.

FRIDAY, APRIL 18, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ENDOWMENT FUND.

With the last number of the *Journal* was issued a small pamphlet, containing in a collected form a series of letters which were recently contributed to the *Journal*, advocating the formation of an Endowment Fund for the Society of Arts. The following donations and subscriptions in aid of this fund have been received:—

	£	s.	d.
Wm. Atkinson	50	0	0
W. R. Sandbach	50	0	0
Sir Walter C. Trevelyan, Bart.,	50	0	0
James Bentley	20	0	0
Col. A. Angus Croll	20	0	0
John Noble	20	0	0
G. T. Saul	5	0	0
W. R. Spicer	5	0	0
Chas. H. L. Woodd	5	0	0
Geo. W. Hart	2	2	0
John E. Evans	2	2	0
E. T. Blakely	1	1	0
Thomas Dixon	1	1	0

TECHNOLOGICAL EXAMINATIONS.

The Programme of Examinations in the Technology of some of the Arts and Manufactures of the country is now ready, and may be had on application to the Secretary.

The subjects selected for 1873 are Cotton, Paper, Silk, Steel, and Carriage-building. Those desiring to become Candidates, should apply for the programme without delay.

The following Prizes are offered by the Society of Arts in each of the five subjects mentioned above:—

To the best candidate in Honours, £10.

To the best candidate in the Advanced Grade, £7.

To the best candidate in the Elementary Grade, £5.

The following special additional Prizes are offered:—

By Wyndham S. Portal, Esq., to the Second and Third best Candidates in the Elementary Grade, Paper Manufacture:—

A Prize of	£3
A Prize of	2

By G. N. Hooper, Esq., to the Second and Third best Candidates in the Elementary Grade, Carriage Building:—

A Prize of	£3
A Prize of	2

By the Worshipful Company of Spectacle Makers, to the Second-best Candidate in Honours, in the Advanced Grade and in the Elementary Grade respectively, in the Manufacture of Steel:—

A Prize of	£5	5
A Prize of	3	3
A Prize of	2	2

The Council beg to announce the following contributions to the Prize Fund:—

The Worshipful Company of Fishmongers	£52	10	0
The Worshipful Company of Mercers	26	5	0
The Worshipful Company of Drapers	21	0	0
The Worshipful Company of Vintners	10	10	0
The Worshipful Company of Salters (annual)	10	10	0
The Worshipful Company of Clothworkers	10	10	0
Dr. Crace Calvert, F.R.S. (annual)	5	5	0
Sir Daniel Cooper, Bart.	5	0	0
R. L. Chance, Esq.	5	5	0
Robert Nicol, Esq.	1	1	0

PROCEEDINGS OF THE SOCIETY.

EIGHTEENTH ORDINARY MEETING.

Wednesday, April 16th, 1873, P. Le Neve Foster, Esq., M.A., Secretary of the Society, in the chair.

The following Candidates were proposed for election as Members of the Society:—

Bleckly, H., Latchford-grange, Warrington.
Bodmer, J. J., 23, The Grove, Hammersmith, W.
Brockelbank, George, Tower-house, St. Katherine's-wharf, E.
Cochrane, Henry, the Longlands, Middlesboro'-on-Tees.
Coles, Edward (Alderman), High-street, Rochester, Kent.
Hampton, Thomas, Phœnix Bessemer Steel Works, the Ickles, near Sheffield.
Harvey, John, 13, Upper Thames-street, E.C.
Henfrey, Charles, jun., 75, Victoria-street, S.W.
Hennessy, His Excellency J. Pope, C.M.G., Governor of Barbadoes.
Jenkins, John J., The Grange, Swansea.
Lemare, William, Mus. Doc., 382, Brixton-road, S.W.
Nichol, Rev. John George Scrymsour, King James's Grammar-school, Knaresborough.
Rew, Charles H., 5 Victoria-street, Westminster, S.W.
Sullivan, Sir Edward R., Bart., 13, Grosvenor-place, S.W.
Tattersall, Charles, Burbage-house, Buxton.
Walker, Frederick James, Claxton-hall, York.
Williams, James, 223, High-street, Shadwell, E.

The following Candidates were balloted for and duly elected Members of the Society:—

Backhouse, Thomas, Cleveland Iron Ship Yard, Middlesborough-on-Tees.
Cobb, Benjamin Francis, 9, Old Broad-street, E.C.
Eames, Alfred, Royal Naval School, New-cross, S.E.
Galloway, Charles J., Knott Mill Iron Works, Manchester.
Gjers, John, Ayresome Iron Works, Middlesborough-on-Tees.
McEwen, Lawrence, Lombard House, George-yard, Lombard-street, E.C.
Routledge, Edmund, 294, Camden-road, N.

The Paper read was—

ON THE PRACTICAL USE OF LENSES AND REFLECTORS IN ARTIFICIAL ILLUMINATION, WITH ESPECIAL REFERENCE TO STREET LIGHTING.

By T. A. Skelton.

The subject of artificial illumination has for many years engaged a large share of scientific attention, but perhaps public notice has never been more forcibly drawn to its consideration than at the present time.

The increase in the price of coal, and in the cost of labour, has resulted in a general advance in the price of gas. This circumstance has favoured or necessitated the introduction of improvements in the manufacture of ordinary gas, and has encouraged the promotion of inventions for the production of illuminating gas from other materials than coal, and it has also brought into prominent notice other means of obtaining artificial light.

These questions will probably attract even yet more attention during the present year; and as "Artificial Illumination by all Methods, Gas and its Manufacture," is to form one of the chief subjects of the London International Exhibition in 1874, it may be anticipated that the public, as well as those more immediately concerned in the details of these questions, will look to that Exhibition, not only for a full and complete representation of the subject, and for a comparison of the rival methods for the production of artificial light, but also for an illustration of the means of using it with the greatest economy and effect.

It is with the utilisation of artificial light that I have the honour to engage your attention this evening, and I shall first beg leave to impress upon your minds the fact that however successful the attempts to improve the methods of the production of such light may be, either in increasing its intensity or in diminishing its cost, the scientific application of lenses and reflectors will still be for some purposes absolutely necessary, and for many others will give valuable aid to artificial light by yet further increasing its lighting power, by controlling its direction or by reducing the quantity of light necessary to produce a required effect of illumination.

The optical principles upon which the action of lenses and reflectors depend are so generally well known, and were, in the first series of "Cantor" lectures in the present session of this Society's proceedings, so minutely explained, that I need only very briefly refer to them on this occasion.

Firstly, you are aware that light, meeting with a reflecting surface, is deflected from it at an angle equal to the angle of incidence.

Secondly, that a prism of glass may be employed as a reflector by using the internal and total reflection from what we may term the interior of one of its sides.

And, Thirdly, that light passing through a transparent body, such as a lens, will be refracted from its original course into a new direction, dependant upon the refractive power of the material, and the angles of its surfaces in relation to the course of the light.

We have thus two practical means by which to control the direction or course of light: reflection, by the use of catoptric reflectors or prisms; and refraction, by the use of a dioptric lens; the use of either or both in combination will depend upon the use to which the light is intended to be applied—or rather, in fact, upon the amount of deflection of the light necessary to be produced.

Artificial illumination for useful purposes may be broadly classed under two heads. First, Signal lights; second, Artificial light as a substitute for sunlight. Now, although it is my intention to treat more particularly of the second of these two divisions, yet as the application of lenses and reflectors has hitherto been more scientifically and successfully studied in relation to signal lights, and such application, after passing through years of practical experiment and use, having at last, in the modern "Catadioptric" lighthouse light, reached a completeness that may be deemed almost if not absolute perfection, it may be advantageous to sketch out briefly the progress of science and invention in that form of artificial illumination, as a help to our consideration afterwards of the question as to how far the principles and means so successful in regard to signals may be practically applied with advantageous results in other uses of artificial illumination.

In its simplest form a signal light would be represented by a flame radiating its light into space in every direction, and consequently diminishing in intensity as the square of the distance increases; such indeed was the feeble characteristic of our lighthouses or beacons up to the beginning of the present century.

The first improvement made was the use of a parabolic reflector; this form of reflector, as you are aware, throws forward in parallel lines the reflection of a light placed in its focus, thus concentrating about one-half of the light into a single direction, but entirely obscuring the light in the opposite direction, so that if a fixed light was required to be visible over the entire radius of the horizon, or any large portion of it, a number of lights and reflectors would be required.

At the North Foreland Lighthouse, a lens was placed in front of each flame, in addition to the parabolic reflector; but these lenses, which had cost £50 each, were found to be useless in such a combination, and were removed in 1835; in fact it is impossible to obtain any advantage by the use of a dioptric lens in conjunction with a parabolic reflector, as the direct rays of light impinge upon the lens at a different angle to that of the reflected rays, and hence one or the other must be dispersed beyond the required direction.

To return to our lighthouse illustration, we find that about the year 1822, Fresnel introduced in France the method of concentrating light for lighthouses by the method of refraction, using a dioptric lens of a novel but scientific form. The great advantage of this system was that, by dispensing with reflectors behind the flame or light, the light was visible round the whole horizon, so that one light only was now necessary, and far more of the light was utilised than by any previous method. Fresnel's admirable system has however been improved upon by the addition of prisms, acting by reflection placed above and below Fresnel's dioptric lens, intercepting and utilising rays of light far beyond the power of a dioptric lens. Thus nearly the whole of the light produced is usefully employed by being compelled to travel in a plane parallel to the horizon. This is the form of lighthouse light known as the "catadioptric," from its combination of the powers of both reflection and refraction. It is now used in our best modern lighthouses. The diagram I have here represents the North Foreland Lighthouse, erected in 1858, and it is a system that may fairly be considered as the perfection of the application of reflectors and of refracting lenses to signal illumination.

Having thus merely brought the leading principles and illustrations of this part of my subject before you, I have now to ask your attention to its second division—the use of artificial light as a substitute for sunlight; and in tracing the course of invention in relation to the use of lenses and reflectors as aids to this form of artificial illumination, I shall have to refer to many unsuccessful schemes, giving them, however, only sufficient attention to explain the cause of their inutility, and we shall meet with but few inventions or proposals which have achieved or even deserved success.

Allow me first to divide this branch of our subject into two distinct subdivisions — light used within an enclosed space, having reflecting surfaces, such as an ordinary room, and light used in an unenclosed space, in fact, open-air illumination.

The essential difference of these conditions must be familiar to you; you cannot fail to have noticed how a lamp or candle, which in a room or hall with light walls and white ceiling had appeared cheerful and brilliant, suddenly seemed to be deprived of its energy, and looked dismal and feeble when removed into the open air at night. The intensity of the light was the same—the circumstances under which it was burning alone had changed.

For ordinary indoor lighting the reflection of light by the walls and ceilings is usually sufficient, and ensures a fair and even diffusion of light throughout the space illuminated; shades are usually placed on lamps more to protect the eye from the direct rays emanating from the light than from any reflective power they possess; and where in the passages of public buildings or in other places, silvered reflectors are placed behind the flames of wall-lamps the effect is nearly always more dazzling than advantageous. It is, therefore, in the use of artificial light in the open air that the aid of lenses and reflectors is in fact required; and we may take for an illustration an ordinary street-lamp; any improvements in such lamps will probably be useful in many other situations.

As in the case of the early form of signal light or beacon in the last century, so an ordinary street-lamp of this day radiates its light into space in every direction; some few of the rays may faintly illuminate the walls of adjacent houses, but in any case a very large proportion of the light produced is absolutely wasted. Long ago this fact appears to have attracted attention, and early in the history of street-lighting, attempts were made to utilise the wasted rays of light. We find records of these efforts among the specifications at the Patent Office dating as early as 1791, when the first use of lenses in connection with street-lamps appears to have been proposed. In 1793 two other inventions for the purpose are recorded, and all these seem to have been various and ineffective forms of the dioptric lens applied to the globular oil lantern.

Passing over the various improvements in the lanterns used for oil lighting, we come to the earliest form of street-lamp used in gas lighting in this metropolis. I have here a sketch of one of these from Lincoln's-inn-fields; these had solid metal roofs, probably once polished or whitened in the interior, but now rusted and blackened. Even at their best they could have reflected to the ground only a very small amount of light, while they effectually prevented the adjacent buildings from being illuminated above the level of the lamp when the flame was placed at the usual height in the lantern. The first improvement in these gas lanterns was simply to roof them with glass, as is the common practice at this day. These lamps certainly had a lighter appearance, and were at least not worse than their predecessors except in their greater liability to breakage. Still, anything like a scientific application of lenses or reflectors to control the direction of the light was not—at least as far as I can ascertain —attempted, until Sir Goldsworthy Gurney obtained patents, in the years 1841 and 1842, for his improvements in regulating and dispersing light and heat. These, however, required the use of an argand burner and glass chimney, and were not of a character suitable for the rough usage or careless cleaning usually given to a street-lamp, nor were they indeed specifically proposed for this purpose.

In 1854 we find a proposal, by Messrs. Boggett and Pettit, for the use of what they termed "dioptric refractors." These were annular reflecting prisms, and their application, among many other purposes, was proposed as an improvement in street lighting. This was to be effected by dividing the ring into semicircles and placing them on either side of the gas flame, at an angle of about 45 degrees. Either the cost of making these prismatic lenses, the danger of breakage from the heat of the flame, the practical difficulty of cleaning, or the very slight benefit to be obtained by their use in this form, must have proved a sufficient reason for their not being adopted for use in street-lamps.

Reflectors, of parabolic and other shapes, have often been placed behind the flame in street lamps; commonly two flames were used with two reflectors back to back between them, while, even recently, another form of this attempt at improvement has been the subject of experiment in Paris, when silvered glass globes, about thre inches in diameter, some flattened on opposite sides, with two gas flames, and others flattened on three faces, with three gas flames, were fixed in the lanterns in the Place Vendôme. These experiments resulted in absolute failure; no increase of light was obtained, and the glass globes were fractured by the heat of the adjacent flames. Indeed, a successful result was impossible; and any form of solid reflectors intercepting the rays of light visible in the street in any direction, is simply absurd and wasteful in application to street lamps.

We may now dismiss, with these few examples, any further consideration of arrangements of lenses or reflectors requiring to be placed inside the lantern; they would necessarily be in danger of damage or destruction by the flame used, and interfere seriously with the cleaning of the interior of the glass lantern, besides themselves requiring great care in cleaning and polishing, without which they would be useless.

Here then is the broad distinction between the application of lenses and reflectors upon the large scale of a lighthouse, where each single part can be separately cleaned, and a similar application of lenses and reflectors to so small an object as a street lamp.

I must now invite your notice to some arrangements of reflectors which, forming part of the lantern or its glazing, appear to be free from some of the difficulties I have noticed, and which have for different purposes been successful in various degrees.

The simplest of these arrangements is the use of solid reflecting plates in the roof of the lantern. This, under various forms, has been the subject of many patents; it is, however, of use only when an increase of light is desired close under the lamp, and where, cutting off from adjacent buildings all the light above the level of the lamp is of no importance; but as a consequence of this concentration of light close under the lamp, this arrangement is entirely unsuited for ordinary street-lighting, as, unless the lamps were placed much closer together than at present, the intervals of darkness between the lamps would, by comparison, be rendered darker. Examples of this principle may be seen at Primrose-hill, in the globular lamps there, but the result is anything but satisfactory.

Another form of solid reflecting roof may be illustrated by a diagram representing the large lanterns now in use in the London and South-Western Railway yards at Nine Elms; it is evident at a glance how small a part of the waste light is intercepted, and how little concentration even of that is effected; the inverted cones were, I believe, originally polished, but now are simple white surfaces, from which the light radiates freely in all visible directions; in this apparatus a glass tube or chimney is required to protect the reflecting cone. Some street lamps of this character may also be seen in the Strand, opposite Exeter Hall, and it will readily be seen there how little aid is obtained from reflectors in this form and position.

Leaving the use of solid reflectors as valueless for general application, we turn to the next series of proposals—that in which the sheets of glass used in glazing the lantern are used also to divert the rays of light.

The first of these is the use of opal glass in the roof of the lantern; this, while acting chiefly as a solid reflector, and subject to its disadvantages, yet permits a small portion of the light to pass through its substance; but even this small quantity is radiated in all directions visible from the surface of the opal glass, so that little or no control is obtained of the intercepted rays. A few specimens of this system may be seen in Oxford-street, but it will require careful searching to discover them, or to see the difference between them and the other street-lamps at a slight distance, especially if the other lamps not having been recently cleaned, present a very dull appearance.

We next have a suggestion for cutting the upper part of the side panes into lines and facets, something after the manner of a cut-glass decanter; the small advantage gained by this method was certainly not worth the cost.

A more scientific application of dioptrics was proposed in 1857 by Degrand, who obtained a patent for what he described as "Lenticular Glasses." These appear to be a modification or variety of the dioptric lenses introduced by Fresnel, and for calculating the forms to be given to the striæ or waves of the improved glasses. The formulæ of Fresnel are especially referred to because of their accuracy. These glasses, among various other uses, were designed for street-lamps. I am not aware that the invention ever took a practical shape in this direction in England, and the great cost of manufacturing such delicate optical glasses in thin sheets with sufficient accuracy and polish—and without either they must have been worthless—probably prevented their application to street-lamps.

Recently, another form of this application of the dioptric lens was experimented upon in Paris; in this case the lantern was a cylinder formed of thick glass panes, cast in the form of a dioptric lens, such as may be seen in some ship-lamps; the light was entirely obscured from direct view, and the plan was found upon trial quite unsuited for street purposes.

We have how traced the course of invention in street-lamps, beginning with the simple flame, as we did with the simple beacon light in the case of signal lights; and, passing through the stage of parabolic and other reflectors behind the flame, into the use of various forms of the dioptric lens, we arrive at the year 1871, without further progress in the application of lenses and reflectors to street lighting than the state of advance in signal illuminanation in 1822, when Fresnel introduced his dioptric improvements, and practically without any really useful application of the principles of reflection or refraction to this important public use of artificial light.

We have seen in the case of lighthouse lights how perfection in principle has been reached by the addition of the catadioptric or reflecting prisms to Fresnel's dioptric or refracting lenses; we have also seen how powerless the dioptric lens is to assist us in street-lighting. Let us then consider these catadioptric prisms—these additions which have secured such good results in signal lights, and see how far their use may serve our purpose in street illumination.

We readily perceive their power to control the direction of light reflected by them, and how far beyond the range of a dioptric lens that power extends. We see also that they can be applied above the level of the flame, so as not to intercept in any direction the direct action of the light usefully employed, but the difficulties we find in their use are the cost of accurately-shaped, polished glass prisms, their weight, and the great trouble of cleaning them. How then shall we obtain the evident advantages their use might confer, and avoid these difficulties? The course is easy enough, as the action of a reflecting surface and a reflecting prism is identical; use thin reflecting plates instead of prisms, and so obtain at once economy and lightness, and avoid the necessity of cleaning each separate reflecting plate, by enclosing each group of reflectors between plates of glass set in a metal frame.

I have here a specimen of the street-lamp now known as the catoptric lamp; this will serve to illustrate the manner in which these reflecting plates can be applied. The angles at which the reflecting plates are placed in this specimen are such that, while they intercept light radiating upwards through 53 degrees of arc, they concentrate it within an arc of 15 degrees; this gives sufficient dispersion of the reflected light over the dark intervals between the lamps in a street; by varying the angles of these reflectors we can perfectly control the direction of the reflected light. In appearance you perceive three points of light, first the flame itself; then, through the group of reflectors at the side of the lamps, an inverted image of the flame; and in the group of reflectors in the roof, a second inverted image of the flame; this, from reflecting the edge of the flame, or rather the flame in a more concentrated shape, as viewed from the position of this group of reflectors, gives an image of the flame even more brilliant than the appearance of the flame itself.

The concentration of the light radiating through 53 degrees of arc into a much smaller area gives this reflected light its brilliancy and penetrative power, as in the example of the modern lighthouse light. There, however, the rays of light are concentrated into parallel planes, and here we have them extended over such degrees of arc as the amount of concentration or diffusion we desire may necessitate.

This system of street lighting was introduced upon one side of Waterloo-bridge in November, 1871, and so satisfactory was the result, that soon after both sides of the bridge were fitted with lamps of this description, and the daily press described its effect in terms of the highest praise.

Lamps exactly similar to the pattern before you are in operation in Moorgate-street and many other parts of this metropolis; and in the town of Southampton the High-street, one-and-a-quarter miles in length, is entirely lit with them, and the brilliant appearance, the increased lighting power, and the even diffusion of light in that street has given the greatest satisfaction. Numerous other towns have these lamps on trial previous to a general adoption of the system.

It is obvious at a glance how different this application of reflectors for street-lighting is to all which have preceded it, and how great is the variety of form and detail of which it is capable. Here we have a specimen with reflecting plates fluted vertically; no advantage in power is, however obtained by it, and although the effect may be pleasing, its extra cost would perhaps prevent its use in ordinary street lamps.

This question of cost brings me to the commercial question, whether the use of reflectors and lenses in street-lamps, admitting its practicability, is of sufficient advantage to warrant the increased cost of the lamps and apparatus and the possibly increased cost of maintenance, or whether we can balance the extra cost, or entirely save its annual equivalent, by a saving in the amount of lighting material consumed, and yet give at the same time double the useful effect of the present lighting. Let us see. Here we have lamps of various patterns all burning gas from the same main, each at the rate of five feet of gas per hour. These street-lamp regulators are by Mr. Sugg, of Westminster, all carefully adjusted, and giving, as you see, even results. Now in this specimen of a catoptric lamp I have a regulator, allowing a flame to burn at the rate of four feet of gas per hour only. The great increase in lighting power is still apparent to you; and at least double the lighting power is given by this lamp, as compared with the others burning five feet of gas per hour. Here then is a saving of 20 per cent. in gas, or about 13 shillings per annum. This would actually pay the entire extra first cost of the lamp and reflectors in two years, and practically the cost of repairs has not been found to be much more than the cost of repairing an ordinary lamp.

The question of cost cannot, however, be considered, as if our present street-lighting was so satisfactory that no improvement was desirable or necessary. The want of efficient street-lighting in our cities and towns is an acknowledged grievance of long standing. London has been declared to be the worst lit city in Europe, and everyone must admit the dangerous darkness which prevails in streets without shops, or after the shops are closed in others, and we depend only upon the public lamps for illumination.

How, then, is this defective lighting to be remedied? How are we to obtain at least double the present lighting?—and less than double will not be satisfactory. Will the authorities be induced to double the number of lamps we have at present? It seems hardly probable, when such an outcry is raised against a few shillings per lamp increase in the cost of gas, or when we remember that in 1866, according to a Parliamentary report, there were about 40,000 public lamps in the London district alone, costing, at the present average of £4 per lamp, £160,000 per annum, while we cannot fairly estimate the total number of open-air lamps in this country at less than 300,000.

It is therefore, I think, obvious that it is to the use of reflectors, properly constructed and applied, which will in reality utilise to our advantage the hitherto wasted light, and which are of such a practical nature as to be fit for the rough work of public use, that we must look for immediate relief from the prevailing street darkness.

The use of such means, if not only doubling the present lighting power of our street-lamps, but also ensuring a more equal diffusion of light over the whole course of our streets, would be a boon worth paying even an extra amount for; but when these advantages can be actually obtained without extra cost, as I have shown they may be, then, slow as the introduction of any improvement ever seems to be, strong as may be the power of prejudice or of interest, or powerful for resistance as mere apathy or indifference may prove, it seems difficult to believe that the increased street lighting demanded by the public can long be refused to them by their representatives when the power of obtaining that increase on such terms—an increase that means better protection to life and property—is absolutely and practically at hand.

DISCUSSION.

In reply to several questions, Mr. Skelton stated that the catoptric lamps were no more trouble to clean than the ordinary street lamps, as the outside was simply a piece of plain glass, and that the extra cost would be £1 5s. per lamp.

Mr. Smartt said there seemed a considerable amount of metal in the new lamp frame, which might be reduced with great advantage. One great difficulty which occurred to him with regard to street lighting, especially in the country, was, that as you approached the lamp, there was a powerful light, which tended to dazzle the eyes, and directly you passed the lamp you appeared to be in darkness; he should like to know whether it would not be possible, by the use of ground glass, to reduce that dazzling effect. As it had recently been proposed that lamps should be lighted by electricity, there appeared to him no reason why the number should not be increased, the lights being smaller, and if this were the case, they could be arranged against the walls of the houses, instead of being in the path and the roadway, and reflectors might be placed at the back of the light By that means the obstruction of the posts in the streets would be avoided. It would also admit of more powerful reflectors being used, because tin or some other metal could be employed, which, he thought, would have greater effect than the strips of silvered glass used in Mr. Skelton's lamps. One difficulty which occurred to him was, if these reflecting strips were enclosed in an air-tight case, the alteration of temperature would tend to break them; and, on the other hand, if they were not hermetically closed, the dust would get in and obscure them. His own opinion was, that a lamp similar to the one shown, with the opal glass top, and with a metal reflector, would be very advantageous.

Mr. Defries thought Mr. Skelton's lamp a most ingenious contrivance. At the same time the ordinary street lamp might be very considerably improved in various ways. For instance, the frames were much too large, and if they were reduced, and the lamps placed at a proper distance, the illuminating power would be increased. The glass also was frequently obscured with paint and putty. He understood that Mr. Skelton's lamp complete cost £2 19s., while a common ordinary street lamp only cost 8s. 6d., but even with that great difference in price he believed it would be to the advantage of the ratepayers to introduce the new invention.

Mr. Arntz, whilst allowing that Mr. Skelton had introduced a vast improvement, did not think he had yet reached perfection. He had tried a lamp of his own design close to his own house, with a top reflector throwing the light back again into the lantern, but the glass of the lantern was ground, and the innumerable faces of the ground glass brought the light out in all directions, and diffused it as a quiet light in such a way that there was a total absence of shadow. Thus, although at some distance the part of the street where the lamp was did not look as well lighted as the other parts, still as soon as you came close up to it you found you could see all round quite as well as where there were clear glass lamps. There was also a total absence of the flickering shadow close to the road, which often caused horses to shy. He believed, therefore, that until some plan could be hit upon—not only for economising the rays and directing them horizontally, but for masking the light itself—the right thing would not be obtained. He quite repudiated the idea that cost was any material element; for he believed the authorities of London, at all events, would be perfectly willing to pay whatever was required for the right lamp when once it was found. He hoped Mr. Skelton would persist in his endeavours, for he had already done good service, and he had no doubt would soon perfect a very useful invention.

Mr. Macomber asked whether the rays of light were much diminished by passing through ground glass?

Mr. Arntz said the light he had spoken of near his own house had answered admirably until in course of time the ground glass got dirty, when it was past the power of cleaning, and the lamp was a failure.

Mr. Smartt said he thought he had seen lamps without divisions in the frame, and suggested that it would be possible to make the lanterns in one circular piece for the lower part, and another portion for the top, so as to avoid the shadow of the iron framework.

Mr. Hale gathered from the paper that there had not been any improvements in street lamps worth notice from 1822 to 1871. It seemed as if there were some inherent difficulties in the way, which perhaps accounted for the apparent apathy on the matter. As far as he could judge, Mr. Skelton's seemed a vast improvement on the ordinary lamps; but he felt somewhat doubtful whether the reflectors would not get dirty, in which case he feared the cleaning would be a somewhat difficult and complicated process. It was one thing to exhibit a lamp for half an hour in a lecture room, and another thing altogether to submit it to the rough usage of every-day wear in the streets. It also appeared to him that the time in which the extra cost would be saved had been rather under-estimated, for, putting the saving of gas at 20 per cent, that would represent about 3,000 hours, at 4s. per thousand hours, or 12s. per lamp per annum, and, according to the figures given by Mr. Defries, this would require four or five years to recoup the extra outlay in the first instance. There was no doubt that this question of cost was a very important one. He must also say that, although he should rejoice to see the streets better illuminated, he could not agree that London was the worst-lit capital in Europe.

Mr. Skelton, in reply, said the effect of using ground glass was to destroy the penetrative power of the rays of light; the glass became, as it were, self-luminous, and the light radiated from it all around. It was quite true that the metallic frame of the lamp might be reduced in size, and that in proportion as it was so would the shadow be diminished. The dazzling effect of the light at a distance had been alluded to, and no doubt it existed to some extent; but if the space between the observer and the lamp were as well lit, or nearly so, as that around the lamp, the dazzling effect would be greatly diminished. This even illumination is produced by the catoptric lantern. Mr. Smartt had also suggested that, by calling in the aid of electricity, a greater number of smaller lights might be used, but it had been found practically that gas could not be burned to advantage for street-illuminating purposes in less quantities than from 4 to 5 feet per hour. As to putting the lamps against the walls, that plan was adopted in several continental towns, and with very bad results, nearly one half of the light being wasted. If reflectors were placed behind such lamps, they would only have the effect of throwing the light across the street, where it was not so much required, and, by increasing the light near the lamp, would make the intervening spaces appear darker. Reflectors of such a character, therefore, were worse than useless. With regard to the catoptric reflectors getting soiled or dusty, he could only say that practically the difficulty had not occurred. Theoretically, no doubt, the framework ought to break with the expansion of the air, but it was not found that such was the effect in practice, and in the High-street of Southampton some lamps had been in use for fifteen months, and many more than six months, and they were reflecting now as brilliantly as when first erected. With regard to solid reflectors, he had shown a specimen. It was the fault of all lamps of that kind that they concentrated the light in and under the lamp, instead of diffusing it, so that really the illumination of the street was injured. It was impossible to fix a street-lamp, formed of one piece of glass, without a framework on which to rest it, and that would cast a shadow the same as an ordinary lamp. Mr. Defries was in error in stating the cost of one of his lamps for ordinary street purposes at £2 19s., that being the price of one with reflectors for throwing the light in four directions; for ordinary purposes, however, a lamp such as those used in Southampton would be sufficient, reflecting the light in two directions only, up and down the street, the cost of those being £1 15s. 6d. He quite agreed that the ordinary lamps might be much improved, but, while doing so, it was much better to make them really efficient instruments for lighting the street, instead of mere cases for holding a light which would permit more than half to be wasted. This lamp was, in one sense, a clear glass lamp, but not in another. A clear glass lamp allowed the light to escape in all directions, but this catoptric lamp caught that which would be lost and threw it into the street. The idea of masking the light by the use of the ground glass could not be practically carried out, if it were required to illuminate the dark spaces between the lamps. The use of ground glass, to prevent the dazzling of the eyes, would also have the effect of destroying the penetrative power of the rays of light. Although no real improvement had been made in street lamps until 1871, the records of the Patent-office were full of attempts and suggestions, only a few of which he had mentioned. Mr. Hale's question as to the cleaning had been already answered, but he might add that in Southampton the cleaning of these lamps was performed by the same men, and in exactly the same manner as the other lamps in the town. He estimated the amount of saving at 13 shillings per lamp in the gas consumed, with a much better light, and this, in two years, would pay for the extra first cost of the lamp. With regard to breakage, it would he quite possible to throw a stone at one of the reflectors and break the outside glass, doing exactly the same amount of damage as in an ordinary street-lamp. The reflectors made of strips of silvered glass, coated with metal, being placed edgeways, were strong enough to resist a blow, but even if one or two were broken they were very easily replaced, and the reflectors would be as good as new.

Mr. Defries said that he had alluded to a lamp with four reflectors.

COMMITTEE ON THE MEANS OF PROTECTING THE METROPOLIS AGAINST CONFLAGRATION.

The following evidence was given by Mr. Rawlinson before the Committee :—

Q.—The Committee are of course aware that you are a civil engineer of great experience in water supply, and I believe you are now in office at the Local Government Board.

A.—I am chief inspector and consulting engineer.

Q—About how many towns are now supplied with water where the works have been carried out under your superintendence as engineer?

A.—Nearly twenty; that is, actual works, not only the public supply, but the house services also.

Q.—Is there any one of those which is not on the constant system?

A.—No.

Q.—Have you received information as to the relative consumption under the system of constant supply in these towns, as compared with consumption under the system of intermittent supply in London, where the consumption is stated to be thirty-three gallons per head?

A.—In those towns where there has been proper supervision. the rate of supply has been reduced to below twenty gallons per head; but where they have neglected the services, the water has been wasted. It was found to be through neglect of the fittings, sometimes from leakage in the supply mains. New works are very liable to this; some of the parts may be found defective after working a time, and occasionally joints will draw. The pipes never cease contracting and expanding, and there is generally a little difficulty for twelve or eighteen months from this cause.

Q.—Are you aware of the statement that in a great majority of cases the supply on the constant system has been under twenty gallons per head?

A.—Considerably under. In places where they have been very careful, and managed properly, it has been as low as twelve gallons. At Alnwick there are 1,200 services all under strict supervision, but no external stand-pipes. Every tenement has a service pipe taken inside. That was one of the greatest possible sources of protection against waste, because persons could not afford to have waste in the room. If a tap leaked in any degree, they must have it stopped.

Q.—You have had no occasion in any of these towns under the system of constant supply, to apply waste-preventors or other expensive apparatus that have lately been stated to be indispensable?

A.—No; and I may state that I had one of the patent waste-preventors—which were so strongly recommended for use in the metropolis—put up at my stables, which acted for about a fortnight, and then ceased to act, becoming an ordinary tap. The descending valve stuck fast, as I anticipated it would, and ceased altogether to act as a waste-preventor.

Q—Are you conversant with instances where a change has been made from the old intermittent system to a constant supply?

A.—Only where old works have been taken over by a new company. At Wigan and other places the old supply was an intermittent supply; but when the Corporation acquired the property, they carried out new works and put on a constant supply.

Q.—Was that constant supply put on by the Corporation as a body, or upon requisition by the householders?

A.—The Local Boards that I had to deal with introduced it. Some were companies, but my recommendation always was that either the board or the company should tap the mains and lay the services—if it were to a court, into the court; if to houses in a street, to the front wall—and carry that cost to their capital account, not charging the cost to the consumers. Then the consumer or owner of the property merely had to pay for the service-pipe from the front wall to the inside.

Q.—Can you form any estimate of what, under such circumstances, might be the average cost of change of system?

A.—The cost in fitting ordinary houses in a town would be from 5s. to 10s. for cottages, from 10s. up to 20s. for houses from £10 to £20 a-year, and so on with larger property. The metropolitan estimates of £10, £15, or £20 per cottage house, I have never found justified in my experience.

Q.—How long have wrought iron pipes been in use in the houses where you have had them applied?

A.—They are in use now in Berwick-upon-Tweed, Alnwick, Olmskirk, and other places, going on for 20 years. Even the basement of the House of Commons is supplied with water through wrought-iron pipes. The whole of the gas services throughout London are all supplied with wrought-iron. The life of an ordinary wrought-iron pipe in the streets of London, unprotected, is from 15 to 20 years. If it were laid in a rough V box, and run in with asphalte, there is no limit, that I know of, to its endurance.

Q.—Have you any data from these towns as to the cost of repairs under the system of iron services?

A.—I have one return from Alnwick, where there were upwards of 1,200 house services. The taps were all of the best kind (screw down), and the return I had was that the whole of these services were maintained for 12 months at a cost within £5.

Q.—Mr. Marten, (who had first served as an engineer at the East London Waterworks), in his evidence to the Board of Health, speaking of his experiences of making the change at Wolverhampton, from the intermittent to the constant supply, stated that the actual cost was sixpence per head of the population; that on the whole, even including reservoirs and other matters, he thought it a fit and fair estimate to put it at two shillings per head to the population in the metropolis, which would probably be an average of six shillings or twelve shillings per house. Might that be a fair estimate of the cost of making the change in London?

A.—I have no practical experience as to London or the East-end, but if you wish to convert an intermittent to a constant service, with houses up to £20 rental value, I think it should not in any case cost more than 20s., and in some cases below, if the companies acted as I say they ought to be expected to act, that is to say, not putting the tenant or the owner to the cost of tapping the main and running the service up to the property. A great portion of the cost at present goes in tapping the mains and taking the service from the main up to the property, and in taking up and replacing pavements.

Q.—But on the whole do you think that that estimate of Mr. Marten's of two shillings per head of the population was an under estimate or a fair one?

A.—I think it was a very fair one.

Q.—Suppose it to be two shillings per head, or twelve shillings per house, from your experience under the Public Health Act of introducing new works by distributing the charges over thirty years, do you not consider it would be preferable to do this in the same way, so as, instead of calling upon the owners to spend 12s., to pay only a small sum, some one or two shillings, by way of equal annual instalment of principal and interest?

A.—I do.

Q.—Is not even a small charge, imposed upon owners of property having only a short term of some four or six years, for a thirty years' benefit, to that extent an injustice?

A.—There is some little difficulty in laying down a hard and fast rule in these cases. There is always a difficulty about ownership. If you capitalise the money, and give from five to ten or fifteen years to make the payment and do the work, as I suggest, it would be a very easy matter.

Q.—Under the Public Health Act the loan may be distributed over thirty years?

A.—That was the time allowed, and also in the Lancashire public works, but I always preferred to recommend shorter terms. I do not think it is desirable to have private improvement loans hanging over for a long period.

Q.—Mr. Quick has stated that the difference between the work done by a private plumber at the expense of the individual occupier or owner, and having it done, as I presume it was, by private improvement rates, and by common contracts under the Public Health Act, would be from one-third to one-half?

A.—More, I dare say.

Q.—Taking your own house as a specimen, how much do you think would be the cost to put your cisterns, and taps, and other fittings in a state to receive a constant supply, as prescribed by some of the Companies' engineers?

A.—I can hardly say. I have not considered the question. I am not very far from the main, and it would not cost much if I were not compelled to put in cisterns. But I should be compelled to put in service boxes for each closet, and they are supplied at from 30s. to 50s.. Iron tubing has recently doubled in price, but it is not very expensive, even now, compared with lead.

Q.—If the new regulations were fully enforced, then it would cost you some pounds, would it not?

A.—According to an estimate that I have here, it must cost me at least £30 or £40.

Q.—May not the present measure be pronounced to be an expensive failure?

A.—No; because Major Bolton, the official water examiner, informs me that all the companies are, in new works, preparing for constant service, and new houses are also being fitted up for constant service. The only company that has really attempted to face the difficulty on a large scale is the East London, and the engineer reports that there are 36,000 houses on the constant service. I have before me a table which may be useful to the committee. There are a series of questions that were drawn up and put to the different companies. Question 12, in the first column, asks the number of houses supplied on the constant service. The New River says about 11,000; the East London, 35,000; the West Middlesex, very few, about 60; the Grand Junction says none; the Chelsea says about 100 special supplies direct from the main to large consumers; the Southwark and Vauxhall says 375 have a supply from the main, which is practically a constant service; the Lambeth says 200; the Kent, about 600; and the constant supply is provided for the government establishments at Deptford and Woolwich. Then the volume of water supplied for trade purposes is given. Also the number of water-metres, stand-pipes, and length of time the water is on. With regard to the last point, the New River says it is on for thirty minutes; the East London, from fifteen to thirty minutes; the West Middlesex three-quarters of an hour to three hours, and so on. Then with regard to the quantity of water supplied (at question 11), the New River says it is about 28 gallons per head on an average; the East London about 20, after making due allowance for large consumers, and that is with 35,000 constant services. The West Middlesex says about $30\frac{1}{2}$ gallons, the Grand Junction 41 gallons, including trades; the Chelsea from 36 to 37; the Southwark and Vauxhall, 35; the Lambeth, 44, the maximum for all purposes; the Kent, 28. Then question 26 is as to the amount of waste, and the New River says it is supposed to be one-third of the whole supply; the East London, whose supply is only 20 gallons per head, says it is unknown, but probably one-third of the whole domestic supply; the West Middlesex have no means of estimating, but believe it to be about one-third of the total quantity. The Grand Junction says probably not less than one-third of the total supply. The Chelsea says it is impossible to state the amount of waste, but it is very great; the Southwark and Vauxhall, probably not less than a third; Lambeth, probably four to five million gallons per day; Kent, unknown. Now, as in London all these companies are pumping companies, that means waste of capital, waste of coal, waste of labour, and, in fact, in every way, far more than the mere waste of the water. It means one-third added to the expense of the entire supply.

Q.—The loss accruing from divided management is, by the eight companies, as estimated by Mr. Quick, and was estimated by the Board of Health in 1854, at upwards of £100,000 per year. Do you think that an excessive estimate or an under-estimate?

A.—I am perfectly satisfied that at least £100,000 a-year would be saved by consolidation and by proper management. I have a return of the number of turncocks employed by all these companies, showing that there is a perfect army of them. Now, under a constant service, all those turncocks might be dispensed with in that shape, and might act as inspectors and repairers of fittings, with some few exceptions, because it would be utter madness to introduce a constant service in London and then leave it to take its chance. The same thing occurred at Croydon some years ago. That is a pumping supply. They had so much waste that their consumption went up to 60 and 70 gallons per head, and they wanted more capital. I said to the engineers, "It is no use to come and ask the Board to give you more money to extend your works and get more water; the Board will do nothing of the kind. Put on some inspectors and some fitters, and make good use of what water you have, and do not get more money to pump more water to run to waste as this has." They did so, and it reduced the supply one-half in less than a month.

Q.—Do you suggest that each house should have a meter?

A.—No; I do not think you can sell water by meter for domestic purposes. I have heard it argued, and a very intelligent man came to me and almost shook me in my opinion, showing me a meter that was very economical, but I did not quite see it, and I think it would be a useless incumbrance. You cannot deal with water as you deal with sugar and milk. However socialistic it may appear, the rich must pay for the poor. For instance, in London we pay upon the rateable value, not upon the number of persons in the house, or upon the quantity of water used. Take my own case. There are ordinarily four persons in the house, myself and wife, and two servants. My fittings are always kept in order for my own convenience, and I pay upon my rental, including the stable; but I do not use as much as one of those poor cottagers at the East-end of London, who only have an intermittent supply.

Q.—Is your supply constant?

A.—The service is not constant, but my cisterns make it practically constant, except that during the last month my wife has complained. They are either pinching us in the supply or there is something amiss. I pay £10 a year for what another person (a poor man) does not pay 10s., but still I think it is quite right and fair.

Q.—All the reductions of waste by the constant supply have been made with simply the ordinary apparatus of the service pipes in communication with the tap, without waste preventors or meters, or anything of that kind?

A.—I have never myself seen a waste preventor that I would give a pin for; they are either an inconvenience which you ought not to be subjected to, or they get out of order, and cease to be waste preventors. They are always inconvenient. For instance, why should you be denied the use of an extra gallon of water if you want it? Why should you be prevented discharging more than two gallons at a time down the closet? You are not going to stop there all day for the purpose of wasting the water, but you may, on certain occasions, want to hold the handle up for a second or two longer and discharge more water. But with one of these service boxes you cannot do it. You must give one discharge, which gives an unpleasant rattle through the house, and then you must wait until the box is filled again.

Q.—We have been considering the constant supply with special reference to the prevention of fire. Can you tell us anything with reference to the different hydrants you used in towns for this purpose? In the metropolis, assuming that there must be hydrants for fire-preventing and street washing, what sort of expense do you think need be incurred?

A.—It would be a very considerable item, but it is part of the capital which the companies ought to be made to supply without one single moment's hesitation. I have had considerable experience in fire-hydrants, and I put up one or two of those patented ball valves, but I made a vow I would never use another. I always use a hydrant with an ordinary sluice cock, so that I am master of the position, and the thing is not master of me. With a ball hydrant, if it goes wrong, you are no longer master, and you must turn the supply off before you can get at the ball to alter it. With a sluice-cock, which should be made of gun metal, for 50s. each, you have all you require. The hydrants altogether will cost about £4 each. That includes everything, up to the nozzle-pipe in the street for the stand-pipe to be screwed on.

Q.—You agree, it is to be presumed, with the representation that has been made of the necessity of tying all the districts together for the purpose of fire prevention, so as to bring the whole force of the supply to bear upon any case of conflagration?

A.—Yes. I think if the mains were properly looped up, and a proper record kept of them, and if you had intelligent turncocks, you could always have an abundant volume of water in any district affected by a fire; but I do not think that, in the present arrangement of mains in London, you could get direct service from mains, but you could get a much better delivery out of the mains. The friction is, however, very great in the long lengths of mains in London.

Q.—Are not a great many of the vestries, which have resisted the application of the constant supply, composed very largely of small owners, and people who would have to pay these immediate charges?

A.—It is so; there are many owners of cottages who dread any sort of expense coming upon them.

Q.—Have they not a reasonable dread of immense unreasonable outlay?

A.—I think they have.

Q.—Is not putting upon people, who may only have a five years' interest, the expense of a thirty years' benefit, of which they may have only short one, two or four years' purchase, an injustice?

A.—I think it is.

Q.—And supervision and economy would be efficient in proportion to the scale upon which it was carried out?

A.—Yes.

Q.—The policy of the Public Health Act under which you first served, was that supplies of water should be provided as a public service, and only at the expense of the service, and not for a trading profit on the necessities of the population. Can you state the extent to which that policy has been acted upon, and, where it has been acted upon, how as a rule it has worked?

A.—Water supplies are now in the hands of local authorities in many places, and should be so in all places, as good water should be at command without stint, both for public and private uses—as for street-watering, sewer and drain flushing, fire service, public fountains, and water-troughs for cattle. I have known a company charge 2s. 6d. per 1 000 gallons when the charge ought not to have been more than three pence. It is not proper to sell water as milk or beer are sold, by the gallon.

Q.—It was proposed by the General Board of Health as terms of compulsory purchase of the trading companies' supplies, that besides compensation for the officers, the shareholders should receive public security for their existing dividends. What, within your experience and observation, has been the rule of compensation to the shareholders of water companies for a compulsory purchase of their works?

A.—Officers whose services were not retained may have a retiring allowance. Shareholders may be secured the maximum dividend, and as a local authority can borrow money at a low rate of interest, and can use compulsory powers, as also levy a rate in aid, water may be used at the least cost for all purely sanitary purposes.

ANNUAL INTERNATIONAL EXHIBITIONS.

The Exhibition was opened to the public on Monday, without any ceremony. At ten o'clock in the morning the visitors did not number more than two or three hundred, but as the day wore on the arrivals became much more numerous. The official return gives the visitors as follows:—By season tickets, 495; on payment of 1s., 9,658; total, 10,153. After 6 p.m.—Season tickets, 12; on payment of 6d., 443; total, 455. On Tuesday the number of visitors was as follows:—Season tickets, 249; on payment of 1s., 3,020; total, 3,269.

The water supplied to the city of Munich contains nitrate of potash. Professor A. Wagner states that the amount of water used by the city in one year, by the ordinary water pipes, contains saltpetre sufficient to make 18,106 cwt. of gunpowder.

Peat is being used in Fond du Lac, Wisconsin, more extensively this winter than ever before, both in offices, residences, and for making steam. The results are said to be generally satisfactory.

EXHIBITIONS.

VIENNA EXHIBITION.

The following resolution has been adopted, on the subject of the "Trial of Agricultural Machinery in the Field, by British Manufacturers," and submitted to his Royal Highness the Prince of Wales and her Majesty's Commissioners for the Vienna Exhibition, 1873:—

"At a meeting of manufacturers of agricultural machinery who are exhibitors at the Vienna Exhibition, held in London, on Friday, March 14, the question of the proposed trial of agricultural machinery at Siebenbrunn was fully considered, and after a lengthened discussion it was unanimously agreed not to take part in the competition at those trials; and, as chairman of the meeting, I have the honour to request that her Majesty's Commissioners will inform the Imperial Austrian Commission of this decision. I am also instructed to express the obligation which the English exhibitors feel that they are under for the efforts which her Majesty's Commission has made to procure information respecting these trials, and a satisfactory space for the exhibition of their manufactures; and also to acknowledge the courtesy extended to them by the Imperial Austrian Commission. I am further instructed to state that the decision of the English agricultural machinery exhibitors has been taken in consequence of their conviction of the extreme improbability of the time allotted being sufficient for such trials as will determine the relative merits of the different articles exhibited; the great disadvantage under which, with the most perfect arrangements, they must stand on account of the great distance from England; and finally, on account of the enormous cost and difficulty of maintaining an adequate staff to properly exhibit their manufactures in competitive trial so far from home. I may also call attention to the fact that the Royal Agricultural Society of England, after 30 years' experience, and with excellent organisation, has found it impossible to make a satisfactory trial annually of the whole body of English agricultural machinery, and has this year come to the decision to divide such machinery into nine classes, only one of which will be submitted for trial each year. — J. Shuttleworth, Chairman of the Meeting."

The trials of the agricultural implements are appointed to commence on June 23rd, on the estate known as the Leopoldsdorf, about twenty miles from the city. A piece of ground, called Gutenhof, ten miles from the city, will also be used if necessary.

A shed is provided for the protection of machinery and tackle, but the commission is in no way responsible for any loss or damage. Watchmen will, however, be provided for the protection of articles from wilful damage or thieves. All damaged machines are to be restored to perfectly good condition, in workshops provided for that purpose, before being permitted to resume their place in the Exhibition.

Steam engines are to be tried in the Unter Prater, with two of Anderson's dynameters, and Ostravian (Ostrauer) coals are to be used for firing (7·10 per cent. ash). For the trials with reaping and mowing machines upwards of 300 acres have been reserved. Several hours' work will be provided for each thrashing and corn-dressing machine, and nearly 400 acres are set apart for steam and other ploughs.

The trials are to be divided in four periods, as follows:—

Period A (June 23rd to 26th).—Implements for the cultivation and preparing of roots, turnip-cutters, oil-cake breakers, &c.

Period B (June 27th to July 2nd).—Reapers, mowers, haymakers, harvesting machinery, &c.

Period C (July 14th to 16th).—Commencement of steam-plough trials, corn-elevators, threshing and corn-dressing machines, &c.

Period D (July 21st to 25th).—Steam and other ploughs, seed-distributors, drills, clod-crushers, &c.

Empty cases will be warehoused by the commission. A fee of about 2s. per cubic metre will be charged for warehousing, and broken cases repaired in workshops provided for the purpose, at a moderate charge, by the workmen of the commission.

In the course of the week the English boilers will probably be all fixed, but the machinery hall is still behindhand, especially at the English end; the flooring not being prepared, no unpacking can be proceeded with.

A statue of Buddha, 50 feet high, copied from a bronze statue made 600 years ago, has just arrived at Vienna, for the Exhibition, from Japan. The old Japanese State religion will be represented by the model of a Sinto temple.

Twenty cases of articles from the Imperial Treasury, Constantinople, destined for the Vienna Exhibition, were sent off on Saturday last.

King Victor Emmanuel has been invited by the Emperor of Austria to visit the Vienna Exhibition, and has undertaken to do so if the political condition of Italy will permit him.

Exhibition of Life-Saving Apparatus.—Last Tuesday the Lord Mayor opened an exhibition of models of life-saving apparatus at the London Tavern. The exhibition comprised life-boats, boat-lowering apparatus, mortar and line rocket apparatus, a group of miscellaneous objects, and distress signals, the entire collection including nearly two hundred models and plans.

Dublin Exhibition.—The Committee of the Loan Museum of the Dublin Exhibition of 1873 have resolved to open it to the public on May 14. It is under the patronage of the Prince of Wales and a number of gentlemen, who are exerting themselves with considerable activity to make it successful.

Victoria Exhibition.—A very full notion of the rapid material progress of Victoria in almost every direction may be obtained from the Official Catalogue of Exhibits of the Victoria Exhibition, opened at Melbourne in Nov. 1872. The entries number 1,682, and though there are very few directly connected with science, it would be unjust to form from this fact a low estimate of the progress made in scientific discovery by the colony; an investigation of the entries in the various departments shows that the principles of science have been abundantly taken advantage of in them all. It is gratifying to find, from the patent statistics, that every year shows an increase in the number of inventions connected with agriculture and manufactures, while the mining resources of the country continue to occupy a large share of the attention of inventors. The compiler of the catalogue claims with justice that Victoria has contributed a considerable amount of valuable data to various departments of science. Appended to the catalogue is an interesting essay on "Mining and Mineral Statistics, with Notes on the Rock Formations of Victoria," by Mr. R. Brough Smyth, F.G.S., Secretary for Mines for Victoria. A preliminary note gives some satisfactory statistics as to the progress of the Industrial and Technological Museum of Melbourne, which was opened in September 1870.—*Nature.*

The Japanese coast is to be lighted with mineral oil.

STEAM LOCOMOTION ON COMMON ROADS.

At the meeting of the Institution of Civil Engineers on Tuesday, the 8th inst., an interesting communication was read by Mr. John Head, of Ipswich, on "The Rise and Progress of Steam Locomotion on Common Roads." Although Mr. Head deemed the carriage of passengers on common roads a hopeless task, he was of opinion that in a very short time we should use steam power on our tramways, where engineers would not have to encounter the same difficulties as they had hitherto experienced, and he illustrated his views by a description of a tramway locomotive, designed by Mr. Leonard J. Todd, of Leith. A description followed of the Aveling and Gellerat systems of steam road rolling, the former usually employed in England, and the latter in France, and statistics were given which demonstrated the advantages which steam has over animal power in making and repairing macadamised roads. The various agricultural locomotives now in use were described in detail, as well as Messrs. John Fowler and Co.'s ploughing and traction engine, and some information was given respecting the great increase in the use of steam power for the requirements of agriculture. The paper concluded with a dissertation upon the employment of road locomotives for military purposes. The author showed that the engine could be used for hauling wagons or guns, either by coupling direct when the roads were good, or by means of a wire rope when the inclines were very steep, or the guns were required to be taken over soft places; also that it could be made into a stationary machine, and adapted for sawing wood for siege purposes or pumping water; and, lastly, the ordinary wheels could be taken off and flanged wheels substituted, by which means the engine could be employed on the ordinary railways in case the enemy had secured all his rolling stock. Mr. Aveling had designed an admirable engine for military purposes, and several of them were in constant use by the engineer department at Chatham and elsewhere. Some of Messrs. Fowler's traction engines were also used in the late Franco-German war by the Prussians. The paper was illustrated by a number of excellent drawings and models.

GENERAL NOTES.

The Sub-Wealden Exploration.—Quite unexpectedly, at a depth of 131 feet, a stratified mass of pure white crystalline gypsum (statuary alabaster) has been reached. No such accumulation of gypsum was ever met with in Sussex before. Gypsum being a material which is commercially valuable, the landowners are seriously considering the question of working it.—*Builder*.

Technical Education.—In the matter of instruction in technical matters, the Stationers' Company may (says the *City Press*) lay claim to being the first in the field. Their lectures being an experiment, letters were sent to the principal printing establishments for the firms' names of such as were likely to attend, and applications were made for 2,400 tickets, 2,100 being by City workmen. The Company, being thus taken by surprise, for the hall will only hold 600, reduced the issues to one quarter for the first Monday night, and to another quarter for a repetition of the lecture on the following Wednesday, when the hall was crowded with as orderly audiences as ever came together, all seemingly bent upon being instructed.

Price of Coal in 1830.—As this is not the first year in which we have suffered from the dearness of coal, so it is not the first in which that dearness was attributed to artificial causes. In 1830, we learn from the "British Almanac and Companion" for the following year, a deputation from the City of London waited on the Duke of Wellington and the Chancellor of the Exchequer, to confer with them "on the subject of the high price of coals, the combination among the coal-owners of the Tyne and Wear, and on the best means of reducing the high charges in the port of London." The price of coal, as quoted in the *Times* for that date, was 36s. a-ton. Great complaints came from Ireland in the same year on account of the coal-tax, by which the import of coals into Ireland from England was prohibited.

The Patent Laws. — The *Scientific American*, commenting on the proposed new "Patent Bill," is rather more complimentary than usual about our present law. It says:—"Nearly all of the changes proposed in this Bill are steps in a backward direction, not an advance in keeping with the spirit of the age. The present British law is immeasurably superior to this one now proposed. Indeed, the existing law is admirable in nearly every respect, and works admirably. Almost the only change it needs is a reduction of the enormous patent fees it now requires, and the limitation of the issue of patents to inventors only."

Cask-Making by Machinery.—Patents have been taken out by Mons. Thuillier, of Desvres, near Boulogne, and Mons. Emile Gerard, engineer, of Boulogne, for a series of machines, jointly invented by them, for the manufacture of every description of cask and barrel by machinery. On the 12th inst. the small factory they have installed at Desvres was visited by the President of the Chamber of Commerce of Boulogne, and the principal exporters of salt fish connected with the herring trade of Boulogne, who employ nearly 200,000 barrels every year in packing salt herrings. After these gentlemen had carefully inspected the machinery adapted to each several process, the various machines were set in motion, and a quantity of casks made from beginning to end in their presence in a comparatively short space of time. The inventors aver that their machinery permits a very large saving in time and expense, can be adapted for casks of any size or form, and that it turns out much more perfect articles than can be made by hand labour. It is understood that Messrs. Thuillier and Gerard intend organising a factory at Boulogne on a much larger scale than their present small experimental one at Desvres.

Phormium Tenax. — At a recent meeting of the Abroath Literary Club, Mr. A. K. Forbes delivered an essay on "New Zealand and its Productions," in which he gave an account of this plant. He stated that his experience of the fibre leads him to the opinion that, although the fibre of the *Phormium tenax* was capable of being made into the finest cloth, it could not be compared practically with the ordinary flax used in our trade, and he feared all attempts to produce an article to compete with European flax would only result in disappointment, although for a mixture it was highly qualified, imparting strength to the fabric. The most profitable and desirable object appeared to be the production of fibre sufficiently clean for the common branches of manufactures, such as coal-bags, sacking, woolpacks, &c., and which could be accomplished at a minimum expenditure of labour, and he believed eventually that in New Zealand this manufacture would spring up.

NOTICES.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

THE LIBRARY.

The following works have been presented to the Library:—

Turning for Amateurs; being Descriptions of the Lathe and its Attachments and tools. Presented by the Manager of the "Bazaar."

Histoire Technique du Percement du Mont Cenis. Presented by Professor Colladon.

Cause and Effect; or, the Globe we Inhabit. By R. M. Browne. Presented by the Author.

Astronomical Geology; a Treatise respecting the Causes to which the Structural and Superficial Configuration of the Earth's Crust is attributable. By R. G. M. Browne. Presented by the Author.

A Paper read by W. E. Teale on Patent Protector Colliery Lamp. Presented by the Author.

New Arctic Expedition; Correspondence between the Royal Geograpical Society and the Government. Presented by Professor Tennant.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. The following meetings have been arranged:—

April 23.—"On Silkworm Grain." By Mons. Alfred Roland (Orbe, Switzerland). On this evening Andrew Cassels, Esq., will preside.

April 29 (Tuesday Evening*).—"On the British Settlements in West Africa." By His Excellency Governor Pope Hennessy, C.M.G.

April 30.—"On the Condensed Milk Manufacture." By L. P. Merriam, Esq.

May 7.—"On Improvemements in the Manufacture of Gun-cotton." By S. J. Mackie, Esq., C.E.

May 14.—

May 21.—"On Recent Processes for the Production of Gas for Illuminating Purposes." By Thomas Wills, Esq.

CANTOR LECTURES.

The Third Course of Cantor Lectures for the present session will be "On Wines; their Production, Treatment, and Use," by J. L. W. Thudichum, Esq., M.D. The Course will consist of six lectures, the first of which will be given on Monday evening, the 21st of April, the remaining five on the Monday evenings succeeding.

Lecture I.

Description of the vineyards of Jerez de la Frontera, from personal observation of the lecturer. Geographical and geological position. Climate. Flora and fauna. Varieties of vines cultivated, particularly those used for wine-making. Wild or indigenous varieties, as studied by the lecturer in the primæval forest, the Algaida, near San Lucar de Barrameda. The vintage at Jerez. Implements and processes. Fermentation. Vinification.

Lecture II.

The varieties of wines produced at Jerez—mostos, añadas, firos, palos-cortados, amontillados, rayas, bastos, &c. Physical and chemical observations on the causes of these different results. Brandying, plastering, sulphuring, mixing, and counterfeiting of Jerez wines. Neglect of scientific guidance in vinification diminishes the certainty and success of otherwise highly-developed viticultural and commercial operations. Other Spanish vineyards and wines.

Lecture III.

Description of the vineyards of the Alto Douro, from personal observation of the lecturer. Contrast of geological position of these vineyards to those of Jerez. Varieties of vines cultivated; all medium-sized grapes; whereas the Jerez grapes are all large-sized. Indigenous vines, as studied by the lecturer in the province Entre Douro e Minho. Viticulture in the Alto Douro. The vintage and wine-making.

Lecture IV.

The varieties of wines produced in the Alto Douro; how treated at Oporto. Lodges. Brandy. Legend of elderberry. Unbrandied and dry natural Alto Douro wines. Neglect of scientific guidance here also, but processes more simple, and varieties of results not so great as at Jerez. Description of other Portuguese vineyards—the Beiras, Valley of the Tagus, Bucellas. Fable of the transplanted Rhenish grapes. Cullares. Torres Vedras. General remarks on the nature and difficulties of Portuguese viticulture and vinification, all based upon personal observation of the lecturer.

Lecture V.

The wines of France compared to those of Spain and Portugal. The Gironde, its vineyards, wines, and varieties of wines. The Bourgogne and its productions. Belgian appreciation, and sweetness of Burgundy wine. The wine requires the procédé. The Champagne; peculiarities of viticulture. Chemical treatment of effervescent wine to ensure its soundness. Absurd notion of some writers on champagne; of the same on second wines and sugar-water wines; exposure of the sycophancy.

Lecture VI.

The wines of Germany; Riessling a type of bouquetted wines. Classification of the wines of the world, as determined by quality, quantity, value in the market of highest and lowest qualities. Active ingredients of wine. Use of chemical analysis. Use of wine to the healthy, whether old or young; wine, under which condition preferable to all other alcoholic liquids. Wine should be a beverage, not a dram. Use of wine to the delicate and sick. Selection and prices of wine. Proposed modification of the import duties, to adjust them to the climatic difficulties of Spain and Portugal.

INDIA COMMITTEE.

A Conference will be held on Friday, 25th inst., at 8 p.m., when a paper will be read by William Tayler, Esq., late Commissioner of Patna, on "The Rosary in India." Sir M. Digby Wyatt, F.S.A., will preside.

Members are entitled to attend these Conferences free, and to admit two friends to each of them.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...SOCIETY OF ARTS, 8. Cantor Lectures Dr. Thudichum, "On Wines; their Production, Treatment, and Use."
Social Science Association, 8. Mr. F. S. Reilly, on "A Code or a Digest."
Stationers' Company, 7½. Technological Lectures. Mr. E. A. Davidson, "Printing, its History and Practice."
Victoria Institute, 8. Rev. G. Henslow, Paper on "The Argument of Design as bearing upon Atheism."
London Institution, 2. Professor Bentley, "Elementary Botany."
British Architects, 8.
Medical, 8.
Institution of Surveyors, 8. Mr. W. Menzies, "Arterial Drainage Works, Water Supply, and Sewage Drainage Works, executed at Windsor, between the years 1867 and 1873."

Tues....Civil Engineers, 8. 1. Discussion, "Steam Locomotion on Common Roads." 2. Sir Charles A. Hartley (time permitting), "On the Delta of the Danube, and the Provisional Works executed at the Sulina Mouth."
Medical and Chirurgical, 8½.
Anthropological Institute, 8.
Royal Institute, 3. Mr. Dannreuther, "Music of the Drama."

Wed. ...SOCIETY OF ARTS, 8. Mr. Roland, "On Silkworm Grain."
Royal Society of Literature, 8½.
Archæological Association, 8.
Antiquaries, 2. Annual Meeting.
London Institution, 7. Mr. Barrett, "On some Phenomena connected with Magnetism."

Thurs...Royal, 8½.
Royal Society Club, 6.
Royal Institution, 3. Professor Tyndall, "On Light."
Society for the Encouragement of Fine Arts, 8. Mr. W. Cave Thomas, "Sculpture."

Fri ......Royal Institution, 9. Professor Flower, "Palæontological Evidence of Modification of Animal Forms."
Quekett Club, 8.

Sat......Royal Botanic, 3¾.
Royal Institution, 3. Professor J. Odling, "On Ozone."

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* A meeting specially appointed, as His Excellency is leaving England.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,066. Vol. XXI.

FRIDAY, APRIL 25, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ROAD-TRACTION.

The Committee in charge of this subject met on Tuesday, the 22nd instant. Present:—Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman of the Council, in the chair; Mr. E. Chadwick, C.B.; and Captain Douglas Galton, C.B., F.R.S. Mr. C. E. Amos, C.E., attended, and reported that the dynamometer specially constructed for the purpose was now complete, and that he had made the necessary arrangements for carrying on these experiments. Instructions were given by the Committee as to the nature of the experiments they desired to be made. Mr. Amos kindly undertook to conduct them. They will take place very shortly.

INDIA COMMITTEE.

The Secretary of State for India has appointed this day (Friday, 25th instant), at one o'clock, to receive a Deputation of the Society for the purpose of presenting a memorial on the facilitating our communications through India with Central Asia. Major-General Eardley Wilmot, R.A., F.R.S., Chairman of the Council, will head the Deputation.

TECHNOLOGICAL EXAMINATIONS.

The Programme of Examinations in the Technology of some of the Arts and Manufactures of the country is now ready, and may be had on application to the Secretary.

The subjects selected for 1873 are Cotton, Paper, Silk, Steel, and Carriage-building. Those desiring to become Candidates, should apply for the programme without delay.

The following Prizes are offered by the Society of Arts in each of the five subjects mentioned above:—

To the best candidate in Honours, £10.

To the best candidate in the Advanced Grade, £7.

To the best candidate in the Elementary Grade, £5.

The following special additional Prizes are offered:—

By Wyndham S. Portal, Esq., to the Second and Third best Candidates in the Elementary Grade, Paper Manufacture:—

A Prize of	£3
A Prize of	2

By G. N. Hooper, Esq., to the Second and Third best Candidates in the Elementary Grade, Carriage Building:—

A Prize of	£3
A Prize of	2

By the Worshipful Company of Spectacle Makers, to the Second-best Candidate in Honours, in the Advanced Grade and in the Elementary Grade respectively, in the Manufacture of Steel:—

A Prize of	£5	5
A Prize of	3	3
A Prize of	2	2

The Council beg to announce the following contributions to the Prize Fund:—

The Worshipful Company of Fishmongers	£52	10	0
The Worshipful Company of Mercers..	26	5	0
The Worshipful Company of Drapers..	21	0	0
The Worshipful Company of Vintners..	10	10	0
The Worshipful Company of Salters (annual)........................	10	10	0
The Worshipful Company of Clothworkers........................	10	10	0
The Worshipful Company of Coach and Coach Harness Makers	10	10	0
Dr. Crace Calvert, F.R.S. (annual)	5	5	0
Sir Daniel Cooper, Bart................	5	0	0
R. L. Chance, Esq.	5	5	0
Robert Nicol, Esq....................	1	1	0

PROCEEDINGS OF THE SOCIETY.

NINETEENTH ORDINARY MEETING.

Wednesday, April 23rd, 1873, Andrew Cassels, Esq., Member of Council, in the chair.

The following Candidates were proposed for election as Members of the Society:—

Bleckly, John J., Daresbury-lodge, Warrington.
Crossley, William, Greenscot-house, Dalton-in-Furness.
Dunlop, Alexander Milne, 28, Clanricarde-gardens, Kensington, W.
Forbes, David, F.R.S., 11, York-place, Portman-square, W.
Henman, Edward Thomas, 12, Blomfield-street, London-wall, E.C.
Ramsden, William, Cliffe Mills, Great Horton, Yorks.

The following Candidates were balloted for and duly elected Members of the Society:—

Fox, Theodore, Newport Rolling-mills, Middlesborough.
Glover, Samuel, 3, Harrington-square, N.W.
Head, Jeremiah, Newport Rolling-mills, Middlesborough.
I'Anson, J. Coventry, Darlington.
Maples, Jarvis, the Crown Tavern, Clerkenwell-green, E.C.
Mayhew, Rev. Samuel Martin, New Kent-road, S.E.
Richardson, Charles Fletcher, 8, Great Winchester-street-buildings, E.C.
Scott, Dugald, the Moorland, Kersal-edge, Higher Broughton, Manchester.

Shaw, John, South Eastern Railway Company, London-bridge, S.E.
Thorn, William Thomas, 19, Great Portland-street, Oxford-street, W.
Tucker, Edwin, Derrystone, Abergavenny.
Winterbourne, Sydney, 13, Forbes-road, Penge, Surrey.

The Paper read was—

ON THE PRODUCTION OF SILKWORM GRAIN.

By Mons. A. Roland.

An unexpected opportunity has induced the writer of this paper to bring before public notice the following information, which he had intended to publish in the course of a few years.

Preface.

Having occupied myself for ten years past with the education, in the open air, of silkworm "grain,"—having made, and still making every year, numerous experiments, I had thought, previous to writing this paper, of distributing, in countries fit for sericulture, several thousand ounces of good grain; thus enabling myself, at the time of publication, to bring forward a convincing proof of the excellence of the system which it explains, by adding thereto a great number of certificates from silk reelers and educators.

I do unquestionably possess a certain number of these certificates; but having, within a few years only, given a greater degree of extension to my magnanerie, I should have wished the number of ounces of grain, acknowledged to be good, by the result of education, to be more considerable, and consequently better known.

Mrs. Neill, widow of Colonel Bladen Neill, now residing in Australia, who came to Europe last spring to procure some good silkworm grain, and who followed up an entire course of education in my establishment, has put me in communication with the Committee of the Sericulture Department of the International Exhibition of 1873, by the intervention of Sir Daniel Cooper, chairman of that committee, and they have very obligingly proposed to me to exhibit my entire system of education in the open air in the grounds of the Exhibition.

I have considered it to be my duty, in the interest of sericulture, to profit by this unexpected opportunity, and thus anticipate, by some years, the date which I had fixed for making known what I was doing; for if the system be exhibited, it must, of necessity, in order to be well understood and made public, be accompanied by a complete explanatory treatise.

Introduction.

"Do not attempt to cure the disease in so minute an animal as the silk worm; it would be lost labour; prevent it by rational education, and you will succeed, for prevention is better than cure."

When I began to devote my attention to sericulture, and had, after a first season of rearing, familiarised myself with the larva and all its transformations, I read many books on the subject, in French, Italian, and German.

Among the number there are some which deserve all praise, both for the learning displayed as well as for the numerous experiments detailed by their authors, the minute attention bestowed on their search for the causes, and the actual nature of the diseases which for a long time past have proved so destructive to the magnaneries. Among others, I will mention the excellent works of Dandolo, Dr. Cornalia, Robinet, and the splendid volume of M. Duseigneur-Kleber, "La Monographie du Cocon."

Dr. Chavannes.

But of all these works, the one which seemed to me especially worthy of the greatest attention is, as I have already stated, in a pamphlet formerly published in France, the distinguished production of one of my fellow-countrymen, Dr. Chavannes, ex-Professor of Zoology at the Academy of Lausanne. His work on "The principal disease of silkworms and their cure" was "crowned" by the Lombard Royal Institution of Arts and Sciences. I take this opportunity of offering my highest commendations to Dr. Chavannes; for to this day no work treating of the diseases of silkworms, and of a sure and easy mode of cure, has ever been so successful, and I strongly urge every one who wishes seriously to take up the subject of "sericulture" to study this book attentively.

Dr. Chavannes, altogether casting aside old traditions, and wishing, not only, in the interest of science, to determine and to study the nature of the different diseases of silkworms, which others had done already, but also with the philanthropic purpose of relieving the sufferings of the silkworm-rearing districts, wishing to discover the most efficacious means of obtaining healthy grain, Dr. Chavannes, I say, disregarding the old erroneous ways, inaugurated the plan of education in the open air, and, leaving the over-heated and almost always unhealthy magnanerie, approximated to nature, reared the larva on the mulberry tree itself, and gained results beyond his expectations.

As he himself says in his work, Dr. Chavannes was not the first to rear upon the tree. From the beginning of the eighteenth century some experiments of open-air education were made in France; subsequently many more trials were made in the same country, in Italy, and in Austria; but the practical means were insufficient, and to Dr. Chavannes belongs the honour of having made this mode of education possible, and on my system even easy.

With rearing on the tree the diseases disappeared; there was no more "passis," "gattine," or "pebrine." If any worm is attacked by one or other of these forms of disease, of very rare occurrence, and which may happen to wild caterpillars, as my experiments have proved to me, it does not thereby infect the others, and, what is more, it nearly always cures itself. As for the "muscardine," the most terrible of all these diseases, it is quite unknown. Therefore, without paying attention to any other system of education, I set myself zealously to follow up the data of Dr. Chavannes, and, after some years' experience, I have succeeded beyond all expectation.

In practice I have gone farther than Dr. Chavannes, as I shall explain below. As a physician and professor absorbed in numerous occupations, he has not had leisure to complete his work, but it is from him that the first idea has its point of departure. With education on the mulberry tree for the basis, and the magnanerie in the open air for the complement of the system, I am firmly convinced that we can restore this beautiful branch of industry to the highest state of prosperity. This I ardently desire, and have great hopes that the London Exhibition will successfully help to bring this system into general use.

By education on the tree, and especially by hybernation of the grain exposed on the branches, the worm necessarily becomes more robust, and, after some years, returns to a state of nature. Ultimately the larva has nothing to fear from violent wind, heavy rain, or burning sun, and remains firmly fixed on the branches or on the leaves.

The pattern on the wings of the moth becomes more strongly marked, its movements are much more lively, and it makes use of its wings as much as its naturally sluggish nature will allow it to do.

The open-air magnanerie, which is the natural sequence, and the necessary mode of general application of the education on the tree, also affords results as satisfactory as may be desired.

We shall begin by succinctly studying the education on the mulberry tree, then proceed to describe minutely the open-air magnanerie and its education, and conclude with the method I have adopted for tending the cocoons, the coupling of the moths, the laying of eggs, and the grain.

Education on the tree. Pruning.

The mulberry tree from which the leaves are to be gathered has the head lopped and the branches spreading out. The case is different for one that is to be covered with a manchon (muff-shaped hood). It is then cut in a similar manner to the willow, which it resembles in respect to its top; the pruning takes place every spring, as the shoots of the current year are sufficiently strong, and the manchon is not to assume exaggerated dimensions. Each branch of the preceding year is cut down to the head of the tree, retaining only one or two eyes; in this manner the head becomes covered with a great quantity of young shoots, which the young larvæ can easily reach.

The height of the mulberry tree, from the ground to the top, should not exceed two feet six inches. I have proved, by experience, that this size is most convenient for covering with, and removing the manchon.

"Manchons."

The whole apparatus consists of a few feet of wire gauze and canvas, some cotton, and string. In order to enable the reader to comprehend accurately this procedure, of elementary simplicity, I will indicate the exact dimensions of the manchons which I make use of. I take some wire gauze of eight threads to the centimetre (*i.e.*, twenty threads to an inch) on which a coat of oil paint is laid, to preserve it from rust. The breadth must be 3 feet 6 inches. If the gauze cannot be had of this size, two breadths may be fastened together with wire, or tarred silk. The length must be 8 feet 10 inches, and the two ends brought together will form the circumference of the manchon, with an interior diameter of 35 inches, sufficient for an ordinary sized tree.

All round the circumference of the top and bottom of this wire gauze tube I sew on some fine canvas, previously steeped in oil, and this must be two feet broad. As a matter of course the paint must be thoroughly dry before the manchon is used, and all green colour must be avoided, on account of its arsenical exhalations.

When the manchon has been made open at the top and bottom, it is slipped over the tree, so that the lower canvas may be tied round the stem of the tree, just below the branches, taking care to wrap some wadding round it, lest the string should injure the bark; and, in like manner, to put some at the point of junction of the bark and canvas; for the purpose of preventing the passage of any noxious insect into the manchons. The silkworms are then placed on the top of the tree, by the upper opening of the canvas, which is then tied up with a string, care being taken to cover with wadding all the interstices which are left by the folds of the canvas where it is tied up. This operation being completed, two stakes must be firmly stuck in the ground, right and left of the manchon, and a strong string tied across, from the top of one to the other. To this string the top of the manchon must be fastened, so that it may not press upon the top of the tree; this contrivance will also prevent its displacement by the wind.

Method of Rearing.

Dr. Chavannes, in his work, advises the placing of the silkworms in the manchons at the second age only, and their removal when they are at the fifth age, to make them cocoon in the magnanerie.

As I have stated above, I have carried my practical experiments much farther than Dr. Chavannes, and, after the convincing proof of several years' experience, I can maintain that in our climate the silkworm may be born, live, and cocoon, the moth be formed, couple, and lay its eggs upon the tree. I will also mention that every year I let a certain number of moths lay their eggs on the branches of the mulberry. This grain remains there during the winter, exposed to all external changes of weather, and simply protected by the manchon from noxious insects. In the spring this grain is hatched perfectly, and very vigorous silkworms are produced from it.

To this hybernation on the tree, which I have practised for several years past, I attribute the exceptionally robust health of the race which I rear.

Every spring the silkworms are hatched naturally with the appearance of the first shoots of the mulberry. When they have eaten nearly all the foliage of the tree on which they are hatched, I place them on another tree in full leaf. For this operation we must not wait until all the leaves have been eaten, for the worm needs some leaves to shelter it from the rain and the rays of the burning sun.

In order to change the silkworms from one mulberry tree to another, the leaves on which they rest must be delicately taken up one by one, and placed in a paper box, without crowding them together too much, to avoid injuring the worms; they are then to be carried to the tree on which they are to remain, and, as soon as the manchon has been fixed in the manner described above, they are distributed over the top of the tree. The manchons must be visited daily, and this is very easy, since the silkworms can be seen distinctly through the wire gauze. As soon as it is perceived that the leaves are nearly all eaten, the worms must be immediately placed on another tree.

I do not count the worms before they come out of their second moulting, that is to say, the beginning of the third age. Then, in order to obtain one ounce of grain, thirty-one grammes, I keep about 300 worms, taking care to select only the most equal in size, and during the fourth and fifth ages, put fifty in each manchon, to avoid the necessity of changing them too often. At the fifth age I leave only twenty-five in each manchon, so that they more easily form their cocoons. There is often great inequality among the worms reared on the tree, and after each moulting they should be selected according to their size, in order to obtain a supply of moths of equal strength. It is for this reason that I advise the setting apart in the third age of 300, although 170 cocoons reared in this manner generally produce an ounce of grain.

Every year fifty cocoons must be left, twenty-five in each of the two manchons, from which will be hatched the moths that are to lay the grain on the mulberry tree. If the tree is too bushy, it is better to cut off some branches, so as to facilitate the coupling of the moths.

This grain will pass the winter on the tree, and will be hatched naturally in the spring; this is the store from which the worms are produced to be reared on the tree the following year. I propose two manchons, as a double provision to guard against accidents during the long lapse of time through the winter. It must be well understood that I speak here of the education needed to obtain one ounce only of grain; whoever wishes to obtain more will naturally have to make a greater proportional provision.

By the education on the mulberry tree every race of silkworm may be regenerated in a short time. At the end of three years of successive education and hybernation on the tree, the blood of the larva, under microscopic examination, becomes exactly like that of the wild bombyx. With a little practice this work is easily accomplished; the necessary materials are, as we have seen, very simple, and may last many years.

Thirty mulberry trees, cut as explained above, and ten manchons, suffice to rear the silkworms which ought to produce an ounce of grain.

The period of education, from the time of hatching to that of forming the cocoon, necessarily varies, according to the season; the average duration is forty days, often less. By these data for raising one ounce, every educator will be enabled to raise the grain which he requires, according to the importance of his magnanerie, provided always that he bear in mind that the magnanerie which suffices to raise one ounce (if he is prudent and really wishes to maintain great uniformity on his *claies** by rejecting, at the time of moulting and *dédoublement*, all the worms which are of slow and imperfect growth) ought, for his own best interests, to contain at least one-half more grain than he can rear at the fifth age. With respect to the grain which is to serve for rearing the following year in the magnanerie, this is my mode of procedure.

Having left on the tree those cocoons the grain of which is to pass the winter in the open air, I remove the rest to a dry and well-aired place. After having cleaned them of the external flue adhering to them, I weigh them separately; the female cocoon is generally heavier than the male. I perform this operation in order to separate, as much as possible, the sexes, and thus prevent the coupling of moths of the quality of which I am not entirely satisfied.

Every moth which is not perfectly formed must be thrown away without hesitation. I then string the cocoons in chaplets of a hundred together, without crowding them, and hang them up so that they may be well aired on all sides.

Dark brown cloths, stretched on frames and in a sloping position, receive the moths. I allow the coupling to continue for twenty-four hours. The very few moths which, at the end of this time, remain still coupled, are gently separated, and the males thrown away. The females still remain on the frames for forty-eight hours. It is, therefore, necessary to have sufficient cloths ready to receive, every day, one or more new swarms, according to the importance of the issue of the moths from the pupæ.

The first year of education in the open air the silkworm has much difficulty in holding on to the tree in very windy weather, and often lets itself drop to the bottom of the manchon, for it often attacks the leaf at the leaf-stalk which holds it to the branch; the male moth has also a difficulty in finding the female among the branches, and therefore many of them die.

The case is very different after a few years; the caterpillar becomes stronger and more lively, the moth more alert, and the pattern on its wings more clearly marked. In a word, by returning to a state of nature, the *Bombyx serigena* becomes completely regenerated, and, its grain, exempt from disease, promises an unfailing return for the following year.

Education in the magnanerie principles.

Education on the tree is the true criterion of the regeneration of the races of silkworms, but, although very simple, it cannot be carried on on a large scale, considering the minute attention required for it. Firmly convinced that in the actual crisis of affairs it was a matter of great importance to supply the educator for silk with an abundance of really good grain, and having, by a series of educations on the mulberry tree, completely regenerated the race which I rear, I devoted my attention, during several years, to carry out more fully what was on too restricted a scale in the manchons.

Before all things, it was indispensable not to depart from the laws of nature, lest, through principles tending to a rapid degeneration, I should lose the reward of all my labours. After a long series of minute and costly experiments, I have succeeded, as far as possible, in making education on the tree, with the help of the open-air magnanerie as its natural sequence, a matter of course; and in thus rearing a great quantity of silkworms by not depriving them of their essential element—pure air—the air being continually renewed; in a word, rearing them in the external circumambient air.

The splendid results obtained in the South from grain produced in my magnanerie have proved, to my own satisfaction, the excellence of my own system. And what is more clearly evidence of this lies in the fact that every year intelligent educators rear my grain without artificial heat, and obtain from it a supply of grain of the first quality. But nothing can last for ever, and it would be requiring too much of this open-air education to expect that it will, once for all, regenerate the race of silk worms from the moment that the system of education is changed, and this belief would only lead to great disappointment. It is absolutely necessary to have a firm conviction of the following principle:—The grain which has been regenerated on the mulberry tree and subsequently reared in the open-air magnanerie, and afterwards in the magnanerie not heated, cannot be reared for grain the following year. It will yield an excellent crop of silk; but the imprudent director of a magnanerie, whose education for the produce of silk has been conducted with the aid of artificial heat, and who would wish to make a selection of cocoons for grain amongst his productions intended for silk spinning, ought to be prepared to find the following year not only that his hopes of a fine crop are not realised, but perhaps have ended in total disappointment. Education under heat, however necessary for obtaining a crop of silk in a short time, is an unnatural process, which infallibly engenders the principles of disease in the silkworm. Besides, the merest elementary data of a rational selection will easily lead anyone to believe the fact.

Description of the magnanerie.

The magnanerie is a large shed, of good height, open on all sides, having the two sloping surfaces of the roof pierced with ventilating chimneys. The enclosing panels are entirely made of wire gauze. Folding frames are used, with blinds stretched over them, that they may be let down when the sun's rays fall directly on the silkworms, or when the wind is too strong. These blinds are to be lowered only when absolutely necessary; in ordinary weather they remain open day and night, fixed by an iron hook to the ceiling. The roof must be lined with planking, to prevent the possibility of rain coming through, or the insects which may lodge in the interstices of the slates. It is of such a slope as will favour the free circulation of air, and pierced at intervals of two metres (six feet), with ventilating air holes, each capped with a tin tube, the orifice of which is covered with wire gauze. The floor, raised about six inches above the level of the ground, is to be covered with tiles or cement. The wire gauze, having twenty threads to the inch, nailed on the wooden cross-pieces and uprights which support the roof, is to extend from the ground to the eaves, which project beyond the walls about twelve inches, and are fitted with spouts to keep the rain or snow from spoiling the wire gauze. A gangway four feet six inches wide is left all round the three rows of trays (*claies*), one above the other, which space is not more than sufficient for feeding and cleaning the silkworms. It will be necessary, at frequent intervals, to cover the external basement with a coat of gas tar, mixed with grease, to keep ants from making their way in. The magnanerie must be built in a locality where nothing hinders the free circulation of air.

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* *Claie*—the frame on which the silkworms are reared in feeding them. It is made of square deal laths.

Appliances

The trays on which the worms rest are double, that is to say, in the middle, in the direction of their length, they are divided by the cocooning frames (*échelettes coconniers*). The worms are therefore to be tended right and left of the trays.

Three rows of trays placed one above the other, in sufficient number, 18 inches (45 centimetres) distant from each other, the lowest row being also the same distance from the ground, make up just the height which a middle-sized person can reach to feed and clean the topmost tray; it must be understood that a cocooning frame is to be placed above this latter.

A double flooring, by which means a great number of trays may be arranged, must not be thought of, as it would intercept the free circulation of air. The division lengthwise of the trays being made by the cocooning frames (*échelettes*), their length is to be subdivided by other *échelettes*, so as to give compartments of 24 square inches (60 centimetres), with 18 inches in height from one tray to another, enclosed on three sides, and surmounted by cocooning *échelettes*. These dimensions I have found to be most practically useful. The silkworm, at the time of the mounting (*montée*), easily reaches the laths between which it is to make its cocoon. I use exclusively Davril's system of *claies* which have been in general use in France for a long time past, and have the double advantage of allowing a free circulation of air and sufficient space for the silkworm to make its cocoon conveniently, and likewise of avoiding the annoyance attendant on the use of bunches of heather, which cause much damp, by interfering with the cleansing process (*délitements*), so important during the last days, prevent the circulation of air, and are exposed to the risk of fire.

There would be no difficulty in arranging two parallel rows of double *claies*, provided they are separated by a gangway 4 feet 6 inches wide; but I would not advise a greater number to be used. With two rows of tables the external air comes in freely over the silkworms, which cannot be the case if there are more.

By the open-air education the worms become more vigorous naturally, but they are also more disposed to crawl away; therefore a piece of muslin, or tulle, must be fixed on each *claie*, under the lower one, and at the two ends against the *échelettes* which divide the spaces, which, in no way intercepting the current of air, prevents the worms from decamping at the time of recovery from moulting, before the first meal, and especially at the mounting period. The worms in each compartment rest on a moveable frame, having a piece of fine calico stretched over it; at each cleansing (*délitement*) this cloth is to be shaken clear of all litter, the process being thus facilitated These frames are to be two feet square; there will then be sufficient space between the *échelettes* and the frame to enable one to take it up conveniently.

Three kinds of nets are required for the *délitements*. Tulle for taking up (*la levée*) the young worms when first hatched, and during the first age; of coarser tulle, or fine net, for the second and third ages; of net with larger meshes for the fourth and fifth ages. The meshes of these nets must be square, and of sufficiently strong thread not to break under the weight of the worms, which is by no means slight in the fifth age.

To prevent the worms from rolling into the middle of the net during the cleansing process, it must be stretched on four small laths, of the breadth of the mesh, so that they may be slipped into the outer meshes of the net, and then nailed at the four extremities.

These frames have the advantage of keeping the worms always on a level surface, of preventing all overcrowding, and of leaving a space at the time of cleansing between the net on which the worms rest and the one which receives the leaves, a space formed by laying one frame on the other. The nets of the two latter dimensions are to be two feet square.

I always cut up the leaf, having frequently observed that the worm, being less free in its movements in the magnanerie than on the tree, attacks the leaf more readily when cut up; besides, it can thus be more equally distributed over the *claies*. The leaf must naturally be cut finer for the first ages than for the latter ones. It must be cleanly cut, not chopped, which would spoil it, and the knife kept perfectly free from dirt.

The objection may be raised, it is true, that nature does not cut the leaf for the worm. Evidently not; but from the moment that the larvæ become domesticated, that is to say, reared in the magnanerie, and, instead of being able to circulate freely on the branches, inevitably somewhat crowded together, it becomes a matter of necessity to facilitate the means of feeding. For the same reason the silkworm, which, on the tree, sustains with impunity the effects of pelting rain or burning sun, being able to take shelter under the leaves if it feels disposed, which, by-the-bye, it does not always do, cannot endure with impunity the rain or sun in the magnanerie.

The magnanerie, established in the manner described above, gives free access on all sides to the surrounding air; the silkworms can be protected from the direct rays of the sun, from the rain and violent winds, and the needful attention can easily be bestowed on them.

Educators in the open air must not be hasty in their operations; the worms must be set to hatch only when the mulberry has

Incubation of the grain.

put forth abundant shoots and there is no cause to fear severe cold. In the latitude which I inhabit, about two miles from the Jura, I do not hatch my silkworms before the beginning of June, which is likewise the epoch when the worms reared on the tree begin to make their appearance. In a warmer climate and a less variable temperature there would doubtless be no objection to the hatching process being left to take place naturally in open air; indeed, I think it would be preferable. But in the central and northern parts of Europe, and especially in the neighbourhood of mountains, this would be almost impossible. In short, if one could count on a fortnight of uninterrupted fine weather, the hatching would also go on regularly; but in our country, at the desired season, some few fine days are often succeeded by heavy rains and a return of cold weather; it is therefore impossible to carry on the hatching regularly elsewhere than in a room.

The hatching-room must be well aired, and provided with a stove of earthenware or iron-plate, but never of cast-iron.

The grain is to be regularly spread over a cloth stretched on a frame, hung from the ceiling, 1 metre (about 3 feet 3 inches) from the ground, so that one may easily examine it, and take up the worms as they are hatched; in this manner it will also be safe from mice. As soon as the external heat reaches 20 deg. Centigrade (68 deg. Fah.), a temperature which must never be exceeded by any artificial heat, the doors and windows must be opened. For the first days it is sufficient to heat the stove in the evening, taking care to put on it a vessel of cold water, to be renewed every day. After the lapse of a few days, the fire must be lit morning and evening, and when the proper degree of heat is attained, the floor must be sprinkled with cold water. This heating must be continued, morning and evening, until the hatching is complete, care being taken never to exceed 20 deg. Cent. (68 deg. Fahr.)

Hatching will take place, after an incubation carried on as we have just described, at the end of 20 days.

The first issue is insignificant, and the worms may be rejected, for which purpose a tulle net, on which some small shoots of mulberry are laid, is to be placed upon the eggs; to these the worms attach themselves, and the net is to be removed when the day's hatching is over.

The second day's issue is much more considerable, and the net must be laid in its place very early; as soon as the shoots seem to be sufficiently covered with worms, the net is to be raised, and immediately transferred to the magnanerie, whatever the weather may be, not forgetting to put another net, as before, to be removed as often as it is properly covered with worms. The same course must be pursued for the successive days; on the last day the issue will be so trifling, that the worms may be rejected as on the first day. The entire process of hatching will be completed in five or six days.

Education.

In the magnanerie the worm must be fed six times a day, from the beginning of the first age to the time of mounting, a.m. at 5, 8, 11, and p.m. at 2, 5, 8 o'clock. The feeds should be given with great regularity, the leaves being spread equally over the trays, and at the fifth age in great abundance.

As the air is cooler at night, the worms naturally have less appetite; besides, I have observed that on the tree they do not feed during the night.

The leaf must absolutely be gathered every day after the dew is evaporated. If the leaves are very wet from much rain, they are placed in a shed, and after being turned over several times are fit to be given to the worms for food.

During the entire period of the first three ages, I greatly prefer the leaves of the wild mulberry to those of any other species; in the fourth and fifth ages I give them the leaves of the grafted mulberry, the *Lhou* (*Japonicus*), and even of the black mulberry.

If during the first age the worms seem to be too crowded on some of the nets, they must be separated; and this can easily be done by allowing about half the numbers to come up on the upper net covered with leaves. A similar process may be needful at the other ages, for it is a matter of the greatest importance not to allow the worms to be heaped one upon another.

After each moulting the worms must be thinned out (*dédoublés*) in this manner, in the first place, because of their increasing size, and secondly, in order to have a greater degree of regularity in the series.

After the third moulting, that is, on entering the fourth age, I count them; for, having set to hatch double the number in grain which my magnanerie admits of my rearing at the fourth age, purposely to have the series of the greatest regularity, by rejecting those which are behind-hand in growth, there still remain too many to spread out on the large nets. I put 400 on each net, which gives 100 silkworms to the square foot—the maximum never to be exceeded, for even this is a very high rate. This operation, which is not so long as one might suppose, is performed by very delicately taking up the worms, one by one, as they wake up, from the most advanced series, and placing them on a net covered with mulberry leaves. This operation has also the very great advantage of affording the means of keeping an exact account of the number of silkworms in the magnanerie; and subsequently, by counting the cocoons, of seeing the proportion of worms lost in the last two ages, which are, as is well known, the most critical.

The education is generally completed in the space of fifty days, though, of course, much depends on the weather.

As soon as the silkworms have mounted, the nets must be removed, and the magnanerie be cleaned out; but it must necessarily be kept as clean as possible throughout the whole period of education, for from the very beginning to the end of the time there must be no unpleasant smell in the place.

Cocoons.

From the mounting to the removal of the cocoons a space of eight days should be allowed to intervene, so that the worms which mounted last may have sufficient time to finish their cocoons properly, and to transform themselves into chrysalides. This period having elapsed, the business of removing and cleansing the cocoons (*décoconnage et débourrage*) must be proceeded with. These operations, as well as the laying of eggs, may perfectly well be attended to in the magnanerie, but I prefer doing them in a large shed specially appropriated to the produce of grain, so that the magnanerie being left free, the *échelettes* may be immediately singed, in order to remove the thick flue which adheres to the laths, and to admit of the whole building being thoroughly cleansed. The cocoons, being cleared of flue (*débourrés*), must be weighed, an important operation to separate the sexes as much as possible, and thus prevent the coupling of imperfect moths. This somewhat tedious operation consists in weighing separately several hundred cocoons, as soon as the average weight has been obtained—two centigrammes; for example, all those cocoons which are over this weight are put on the side of the females, and the others with the males. The weighing being completed, the cocoons are to be strung in wreaths of a hundred, which, when they are arranged, will enable one to know the sum total of the crop. Each wreath is to be hung on a peg, receiving the air on all sides, the males on one side the females on the other, a sufficient space being left between the chaplets to prevent them from touching each other. In describing the mode of education on the tree, I spoke of the cloths to be used for the laying eggs (*ponte*); similar ones are to be used in the magnanerie; but to avoid any loss of grain, for some always falls off at the time of laying, the bottoms of the cloths must rest in wooden boxes. A space of 30 centimetres (one foot square) of cloth, is sufficient for placing 25 couples of moths. Having already spoken of the coupling and deposit of grain, I shall not return to the subject. The same process exactly must be followed for moths reared in the magnanerie, as for those which are produced on the tree. The couples must be watched, and the refractory males brought back to the females.

The shed which I use for the incubation of crysalides and the laying of the grain is large and well-aired; openings pierced in the top and bottom of the walls allow a constant circulation of the air, and a suitable degree of light, for too strong a light disturbs the couples.

From the mounting to the issue of the moths from the chrysalides there are, on an average, 20 days, but much also depends on the state of the weather. The entire *ponte* is accomplished in about ten days.

Grain.

When the grain is laid, the cloths are immediately transferred to the magnanerie, previously cleansed thoroughly. They remain there, freely exposed to the air, until the time when the grain is to be taken off. The frames on which the grain has been laid must be put in a sloping position towards the *claies*.

The result of numerous experiments has convinced me that the grain may be taken off a month after it is laid. An English naturalist, who lives in the neighbourhood of Sydney, confirms my opinion in this respect, for he writes to me that, as the result of many experiments, he has acquired the conviction that the eggs may be taken off the cloths 20 days after they are laid, without fear of adverse consequences. It is a fact that the grain taken up before the autumn fogs and the winter frost will dry in a shorter space of time. For my own part, I take it up in the course of the month of October. When the time is come to remove the grain, the cloths are to be taken off the respective frames, and plunged in a vessel of water that has been boiled the previous evening, and remains at the temperature of the surrounding air. To this water spirits of wine must be added in the proportion of one litre (one pint and a-half) of spirit to ten litres of water (15 pints)—one to ten, in fact. This is necessary to clear the grain of all contamination.

Each cloth, being well steeped in the water, is then to be stretched on a table, and two persons opposite to each other are to scrape off carefully with paper-knives the grain from the cloth. The grain thus detached is to be again plunged into a vessel of boiled water, mixed with spirit as before, at the temperature of the air. The good grain will fall to the bottom; that which is barren, or has been injured in removal, will float on the surface, and is to be skimmed off. The whole is then to be poured into a sieve of fine wire gauze, to let the water run off.

The last operation consists in spreading out the grain in thin layers upon muslin stretched on frames hung from the ceiling; then it is to be frequently turned over carefully until it is quite dry, which, if the weather be fine, will be the case in three days.

Preservation of the grain.

When the grain is quite dry, I use, in order to preserve it, large boxes of wire gauze, having the inside fitted with drawers of fine perforated zinc, which are to contain a layer of grain, one centimetre thick. These drawers are so placed one above the other as to leave intervening spaces of three centimetres, so that the air may circulate freely. The boxes are hung from the ceiling of the magnanerie, being so fixed that the wind may not sway them about. The grain is thus preserved in the open air until the moment of incubation or of consignment for sale.

In this manner I preserve grain, which remains through the winter exposed freely to the air; and which has resisted—18 deg. Cent. (2 deg. above zero Fah.), especially in the winters of 1869-70 and 1870-71. Notwithstanding this rigorous and prolonged exposure to cold, the subsequent hatching was on each occasion all that could be desired.

Consignment of the grain.

When the grain is to be sent to a comparatively short distance, as for example to the south of France, or to Italy, wooden boxes suffice for the purpose, care being taken to fill the space between the grain and the cover with very clean wadding. Each consignment must be made by express train. But if the grain is to be sent to a great distance, especially over sea, it is indispensably necessary to take various precautions. In this case, a contrivance of which I will give the description must be employed.

Take a box made of wire gauze, or perforated zinc, in the inside of which other boxes of similar material, and fitting to the size, are made to slide in. The inside boxes are at intervening spaces of three centimetres, and contain a layer of grain only one centimetre thick. They are then to be closely shut up, having been filled to the top with grain, to avoid all shaking.

This box is then to be placed in a strong wooden case, pierced with several holes, covered with wire gauze, or perforated zinc. Between the sides of the outer case and those of the enclosed box, there must be a space of two inches, to be filled entirely with small pieces of charcoal. The charcoal will allow the air to circulate amongst the grain, and, what is equally important, will prevent any damp from getting to it. As soon as the grain reaches its destination, whether after a long or a short journey, it must be immediately exposed to and kept in the air in boxes similar to those described in the first instance.

In drawing up this paper, I have been as concise as the subject would permit, avoiding all essentially technical terms, so that any one may understand my statements; and I sum up my system in these words:—"Do not attempt to cure the disease in the minute silkworm; it would be lost labour. Prevent it by a reasonable system of education, and you will succeed. Prevention is better than cure."

A few words on the difference between education for grain and education for silk. As the course of education in the open-air for grain must necessarily be long, so that for silk must be speedy. Education for grain should have but one object in view—the strength and health of its productions. That which is for silk, on the contrary, aims at obtaining, with the least possible expense, that is, in the shortest space of time, the most abundant supply of cocoons. Anyone may, therefore, easily understand the immense difference which exists between the two kinds of education.

Artificial heat is required in a magnanerie which is to produce silk, for fear of the education being protracted too long, and the profits of the undertaking being absorbed in the attendant expenses.

Any one living in the country may, with good grain, easily obtain a profitable supply of cocoons; but, although the system is very simple, and, with the help of two *manchons*, any peasant may produce the grain he requires, still no chance speculator will ever make good grain in any considerable quantity, for the reason, simple enough no doubt, but, nevertheless, very true, that he rarely pursues art for its own sake; and the mercantile element will always prevail with the multitude over the scientific and the reasonable.

I therefore consider it a matter of great importance for the future advancement of sericulture that a considerable number of persons should devote their attention to this open-air education for grain. They will find in it both profit and satisfaction; profit—because the protracted and numerous cares which it requires are amply remunerated by the sale of good grain, always in great demand; satisfaction from the scientific and philanthropic side of the question; for, by furnishing the silk-producing population with the means of obtaining good supplies of our former beautiful indigenous races, great sufferings will be relieved.

Certificate.

I consider it my duty to append to this paper the honourable certificate, which I received from Monsieur A. Gaydou, of the house of Gaydou and Co., Turin.

The year 1872 was, as is very well known, most unfavourable to sericulture; the mulberry leaf, being too watery, in consequence of the incessant rain, caused an alarming extent of disease amongst the "educations;" however, M. Gaydou, who reared nearly a hundred ounces of grain, produced by my system of education in the open air, has nevertheless obtained splendid results. I quote his words:—

"The educations made this year (1872) with grain produced by the open-air system of M. Alfred Roland, of Orbe, Canton de Vaud, Switzerland, have given on an average 40 kilogrammes of cocoons for 30 grammes of grain—that is to say, 1 oz. troy weight produced 107 lbs. troy. The yellow cocoons of M. Roland yield one kilogramme of *grège* silk per twelve kilos. of cocoons. About 160 cocoons go to make up the kilogramme (2.2 lbs. avoir.). This race does not contain more than eight per cent. of double cocoons.

"Signed,
"A. Gaydou and Co.

"Turin, September 12th, 1872."

Future prospects of sericulture in England.

If the data which I recently received from England are exact, and it is really a fact that in the environs of London alone there exist more than 30,000 mulberry trees, we have here a sufficient proof that this precious tree flourishes wonderfully well in the South of England; and wherever the mulberry thrives vigorously, the silkworm may be reared advantageously.

Whether for grain or for silk, from the moment when the production of silk, as a branch of commercial industry, can easily be introduced into any country, the opportunity of doing so should not be disregarded; for, as it is one of the most beautiful and most interesting branches of agriculture, so is it also one of the most profitable.

England, by the production of good grain and fine silk, would add a brilliant flower to her agricultural and industrial chaplet.

DISCUSSION.

Sir Daniel Cooper, Bart., said, he had no practical experience in the rearing of silkworms, but as Chairman of the Committee on Silk and Velvet at the Exhibition, and being aware that M. Roland had been carrying out this open-air system for some years past, he had thought it only right to visit him and learn what he could of the process. Unfortunately, at the time of his visit there was nothing going on; the small mulberry-trees looked like so many sticks in the ground, and there was nothing to be seen but the eggs. Still, M. Roland had given him every possible explanation, and he could therefore thoroughly endorse what was said in the paper, particularly the statement that in a climate like that of England, where the mulberry-tree would thrive, silkworm grain might be reared, so that if a good quality of silk could not be obtained, at all events the most profitable part of the business—that of growing healthy grain—might be carried on here with success—much better, in fact, than in more southern countries. He hoped that magnaneries would shortly be set up at the Exhibition, so that the whole process might be seen in operation, and that many persons might be induced to take it up. Some had tried sericulture under the old system, and had not been very successful; and these, perhaps, might find a difficulty in adopting a new system; but those coming first to it would not be embarrassed in that way, and he felt sanguine they would succeed.

Mr. B. F. Cobb said there was no doubt that M. Roland's plans afforded a natural system of restoring the silkworm to health from the state into which it had degenerated, and producing much better grain than had been supplied for some years past; at the same time it opened a large field for educators in countries where it had never before been attempted, especially in the colonies and in England. He believed the process could be carried on as well here as in the heights of Switzerland. The first objection hitherto had been that the *Morus alba*, which was the species of mulberry particularly adapted to feed the silk-worm, could not be grown in England; but M. Roland found that in the early stages the wild mulberry was the best. Mrs. Bladen Neill deserved great praise for the energy with which she was trying to introduce sericulture into the colonies; it had been tried before, and the Silk Supply Association had endeavoured to find a market for the cocoons, in order to save the producers the necessity of reeling the silk, but it was found that the cocoons soon degenerated. To remedy this, grain was exported from the South of France and Italy; but there was this difficulty, that it being subjected to great heat in crossing the tropics, the worms hatched immediately on arrival, sometimes even before. True, they hatched in the spring, which was the natural time; but, leaving Europe in the spring, they arrived in the colonies also in the spring, which was equivalent to the European autumn, and lost the winter for hybernation, which M. Roland appeared to attach great importance to. It was not to be wondered at, therefore, that the race degenerated. Mrs. Neill was now taking out seed in ice-boxes, constructed on purpose, with great care, by Mr. Ashe, of Oxford-street, so as to produce a kind of artificial winter, the temperature never being allowed to exceed 40°. By this means the seed had arrived in the colonies in perfect condition, and it was now being tested there. M. Roland also spoke of education under heat, however necessary for the production of silk in a short time, having a tendency to produce disease in the worms, and this was precisely what had happened in taking grain to the colonies. He did not quite understand what difference it could make whether the stove was constructed of cast-iron or of iron plate, but no doubt it was of great importance that the hatching-room should be well aired. The necessity of only supplying dry leaves was also referred to, but if that were so he did not know what the worms who lived on the trees in the open air would do in wet weather. He gave the time of education at 50 days, dependent on the weather; and Mrs. Neill had found that the period often extended to 60 days, or even longer. The time usually occupied, however, in the production of silk was from 25 to 30 days, which made a vast difference in the cost. It must be borne in mind, however, that the production of the greatest quantity of silk at the least possible expense, and the production of the most vigorous and healthy grain, were two totally distinct objects, and to the latter alone had M. Roland devoted himself. Some time ago the best European grain that could be procured was sent to Cape Colony, Victoria, and New South Wales, and, though the worms came out very slowly, very fine cocoons were produced. Some of the resulting grain was sent to the South of France and North of Italy, when it was found that instead of the whole of the eggs being hatched within five or six days of each other, 100 would come out one day, 100 the next, and so on, until the educators got tired of waiting and condemned them. The cocoons produced were excellent, and the grain would have commanded a high price if it had been hatched with certainty like the European. The difficulty, no doubt, was that in consequence of crossing the tropics it never properly hybernated. If Mrs. Neill's project succeeded the eggs would be sent back to Europe in the same boxes which took them out, so as to secure a low temperature. In conclusion, he drew the attention of the meeting to several specimens of silk from the Cape, Natal, the Mauritius, Egypt, and Japan, the latter being the finest quality possible, though some of the Egyptian from Japanese seed was very excellent. There was also a very fine specimen of English silk, and a scarf made in Macclesfield from silk produced at the Cape.

Dr. Mann said, with reference to the statement by M. Roland, that heating by the use of cast iron was deleterious, and that plate iron must be used for that purpose, it was now a well-ascertained fact that this difference between cast and wrought iron really existed, cast iron, when heated, becoming, as it were, porous, and permitting carbonic oxide or other noxious gases, the products of combustion, to pass through. Lately a gas stove had been invented by Mr. George, the principle of which was the continual introduction of fresh air through a warmed iron tube, and he stated that cast iron could not be used for this purpose, and especially where the stove was intended for greenhouse purposes, though with iron plate tube it answered admirably. The great principle at the root of M. Roland's plan seemed to be the education of the worm in the open air, when it was intended to reproduce its kind; and no doubt that was the real secret of success in the artificial production of creatures like the silkworm. It was a question of great importance whether the process could be carried out in England, and therefore he looked forward with great interest to the experiments about to be conducted at the Exhibition. He believed, however, that the great difference would be the uncertainty of the climate, and feared that though some seasons were successful others would be the reverse.

Mr. R. Rawlinson, C.B., remarked that the paper of M. Roland confirmed him in a view he had long held, that if life was to be enjoyed in the greatest perfection in any form, attention must be paid to the laws of nature from the very cradle onwards; and he could not but ask himself what would be the condition of the inhabitants of that great city if but a hundredth part of the care which M. Roland had devoted to the rearing of these silkworm eggs were bestowed upon them. If fresh air, freedom from over-crowding, proper food, clothes, and climate, were all properly attended to—as they might be—a state of things approaching the Millenium would be the result.

Mr. Walduck observed that M. Roland's process seemed to consist in returning to a state of nature, but this could hardly be carried out with the human species.

Mr. Hale said he should like to know whether the cultivation of silkworms could be carried on in England profitably, and thought it would have been as well if some idea had been given of the mode of cultivating the trees in Switzerland. He was not sure whether the soil of this country was favourable to the growth of the mulberry, but if it appeared likely that silk could be produced here at a profit, there was no doubt the attempt would soon be made.

Mr. Cobb remarked that M. Roland expressly drew a distinction between rearing for silk and rearing for grain; the one was a long process, whereas the other had to be hurried over and forced on, in order to obtain good commercial results. He much doubted whether the production of silk cocoons would ever be a commercial success in this country; but, with regard to the rearing of grain, he saw no reason why it was not practicable and would not be profitable. There was no doubt mulberry trees could be grown in many parts of the south of England quite as well as in Italy or France, and, indeed, Captain Simpson's experiments had shown that they were not even confined to the south of England. He had two or three acres under cultivation in Shropshire with mulberry trees; and on the table was a specimen of silk which he had produced, equal to Italian. Whether it could ever be done profitably was a question; but there could not be a doubt about the culture of the grain. The variety of the mulberry always considered best adapted for the production of silk was the *Morus alba*, and some Japanese kinds, but M. Roland found the wild mulberry best for rearing seed, and that being so, there could not be a better kind than the black mulberry of England, which contained in the leaves more resin and saccharine matter than any other.

Sir Daniel Cooper said small mulberry trees should be planted one to a square yard; but large ones might be planted along the road-side, or the borders of market gardens, or other cultivated lands, as was done by M. Roland. They were lopped as winter came on, like pollard oaks or willows, and in spring they put out a thick crop of young shoots covered with leaves.

Mr. Smartt thought mulberry trees would not thrive everywhere. There might be something peculiar in the soil or in the different trees. The mulberry was a tree of slow growth, and therefore it would entail considerable expense, in the shape of rent for ground and attention, before any considerable quantity of leaves could be obtained. He should like to know how many years it would be before the trees would bear a tolerable crop of leaves; also where and at what cost trees could be obtained.

Sir Daniel Cooper said there was no difficulty in getting any number of trees from France at 1, 2, or 3 francs each, according to the age and the way they were pruned. They would grow nearly anywhere, but clay did not suit them, nor did chalk; what they required was a moderately light soil, not too rich.

Sir Walter Stirling, after remarking that in that room discussions always took a practical turn, said the principal question appeared to be, not whether silkworms could live in England, but whether sufficient and suitable food could be found for them. He doubted very much whether there were 30,000 mulberry trees in the whole of England, leaving London out of the question. In fact, their growth depended more on climate than on soil, for they never came into the market at all in Edinburgh, and even in England they were difficult to rear, and required the greatest care and attention. It was always desirable to arrive at some practical conclusion from such a discussion, and his opinion was, most distinctly, that there was very little chance of growing silk in this country with any advantage.

Sir Daniel Cooper agreed that it was useless to expect silk to be grown in England, but he did think grain might be produced here; and as an ounce was worth from 30s. to £2, he thought that was the most profitable part of the business. He did not believe good silk could be produced in England, but a rude climate was the best for the grain, as it destroyed the diseased worms, and only allowed the healthy ones to live. In fact, the same rule held good with the silkworm as with human kind, the dwellers in a harsh climate, such as the English, and especially the Scotch, had more energy and stamina than the inhabitants of warmer regions.

Mr. J. T. Wood inquired if it were possible to delay the birth of the silkworm until the mulberry tree was in leaf, for it often happened that the worms were hatched before there was anything for them to eat. His experience was that there was hardly a lawn in the neighbourhood of London without a mulberry tree on it, and he believed the culture might ultimately be made successful here.

Mr. Cobb said that experiments were made two years ago, which showed that if the eggs were kept in a dark, dry cellar, at a temperature not exceeding 50°, the grain did not germinate, and it could thus be preserved until June, when there was plenty of food.

The Chairman, in proposing a vote of thanks to Mr. Roland, said he was reminded by Mr. Davenport that the silk culture was no new thing in England, for in the reign of George II. extensive mulberry gardens were established at Chelsea, and silk was produced there for many years, though with no very great success. More recently also Mrs. Whiteley, of Newlands, produced a quantity of silk, for which, in 1867, she received the Society's medal. He thought the moral of M. Roland's story seemed to be that luxury was not good for silkworms any more than for beings of a nobler growth. He would add that a few months ago the Council of the Society of Arts, being desirous that the good work begun by the Silk Supply Association should not be allowed to drop, appointed a committee to keep in motion the machinery established by the association, of which Council he had the honour to be chairman. He begged to say that the columns of the *Journal* would be always open to any communication of real interest on the subject, whether from persons engaged in the trade or others. He must confess he did not think the position of the silk trade in England had ever been one which reflected much credit on so great a commercial country, nor did he think the same ingenuity, enterprise, and energy had been applied to it as to the manufacture of cotton. Those engaged in the trade seemed more slow to adopt improvements in machinery, or to introduce change in their mode of manufacture, than those engaged in the spinning and weaving of cotton, and could not but think that there was a better field for enterprise now in the former than in the latter branch of industry.

COMMITTEE ON THE MEANS OF PROTECTING THE METROPOLIS AGAINST CONFLAGRATION.

The following evidence was given before the Committee by Captain Tyler, R.E.:—

Q.—As an engineer of the Board of Trade, you have paid a good deal of attention to the subject of the water supply of the metropolis, have you not?

A.—Yes, I have. I have been required to report on the operations of certain water companies with regard to their efficiency or deficiency of supply as to quantity or quality, and with regard to certain extra means and appliances which were required, and we have been obliged to give them notice to supply from time to time upon the complaints of householders under the Act of 1852. As a member of a committee with Lord Methuen and Mr. Rawlinson, I have also had to hear and decide between the public and the water companies as to the regulations which should be drawn up and promulgated by the Board of Trade with reference to constant supply.

Q.—On the subject of constant supply we would recall your attention to a report of yours, from which it would appear that you made a very particular investigation of the eastern part of London.

A.—That was an inquiry in regard to the East London Company's supply. I took a great deal of trouble in that matter, thinking it was very important to the inhabitants of the metropolis. The East London Company was the company of all others which had introduced the constant supply to a considerable extent over its district, and had done so with very good effect. As the result of this inquiry and of other inspections and inquiries, I have not the slightest doubt in my own mind of the very great advantage, particularly to the poorer inhabitants of the metropolis, which would result from constant supply. Many of them are taking water from receptacles which are more or less filthy, which very often are not covered over at all, which very often are not cleaned out from one year's end to the other, and the water that they might get clean and clear from the mains is therefore delivered in a bad condition, and at a temperature which, instead of being cool and refreshing, is in summer mawkish and disagreeable.

Q.—On the important question of the cost of a change from the intermittent to the constant supply we would submit to you some evidence by Mr. Henry Marten, an engineer specially versed in the subject of water supply, given before the Board of Health in relation to the proposed change of system in the metropolis. This runs as follows:—

"With whom did you serve your time as a water engineer?—With Mr. Wicksteed, the engineer of the South London Water Works. Whilst with him I assisted in the construction of the Hull Corporation Water Works, and was afterwards appointed by him to see his plans carried out for the construction of the Wolverhampton Water Works. *Q.* What will be the cost of the proposed alterations?—*A.* The cost of the above-mentioned alterations, for giving the constant instead of the intermittent supply at Wolverhampton, will not exceed 6d. a head of the population within the district. This is exclusive of the reservoir which would have been essential to the continuance of the supply under the old system; including this, however, the whole cost will not exceed 2s. per head of the population. I think there are very few towns in which the cost of the alterations necessary for the introduction of the constant supply system will exceed 2s. per head of the population, and that in general it will be found much under that amount. *Q.* What would be provided under that charge of 2s. per head ?—*A.* Where none have been previously provided it will cover the expense of providing the necessary reservoirs and the alteration of the street-mains, with the introduction of the additional stop-cocks, and will be sufficient to prepare all the internal house-fittings for the reception of the constant supply. In almost all towns in which the intermittent supply is in force the fittings are in a very defective state. The water being on so short a time, it has been thought hardly worth while to see that these are kept in good repair, consequently they will, as far as the taps and stop-cocks are concerned, require almost a complete renewal. The useless piping and tanks and old metal, however, which may be removed on the introduction of the constant system, will more than pay for these matters. *Q.* You state your belief that the wear and tear of street-cocks will be less under a system of constant supply. Have you observed any difference in the wear and tear of these in streets of much traffic compared with those of little traffic ?—*A.* I have not observed any perceptible difference between the wear and tear of the valves of cocks placed in a street where there is much traffic as compared with the valves of those placed in streets of less traffic; but in the former case the iron boxes which cover them are more subject to injury, and we find them sometimes filled with dirt or sludge from the road. *Q.* Supposing the levels to be the same, will not the strain and damage of pipes and taps, from the hydraulic jerks, be greater on the intermittent than the constant supply system ?—*A.* Yes; because under the intermittent system the whole pressure of the works is brought to bear upon one particular spot with a suddenness which often causes considerable damage from the recoil. Under the constant system, however, the pressure will only vary by imperceptible degrees, and there can be no jerks on the mains and pipes. In the houses none of the common bib-taps should be allowed to be used, but should be of the kind termed screw-down, as they are every way better adapted for high pressure, and do away with all recoil."

A.—I cannot say whether 2s. a-head of the population would cover all the expense. That is a very difficult question. But what we attempted to do when we sat as a committee upon that question was to require the least possible amount of alteration consistent with efficiency of service, and to provide that fittings should not be altered at all for the constant service except where it would be necessary to do so in order to prevent constant waste. We came to the conclusion that a waste-pipe should in each case be placed in such a position that waste could be readily detected; and, if possible, so that the inspectors of the water companies, as they passed the houses, might hear a dribble going on. That would overcome the only difficulty of constant supply. The companies would prefer it, and I dare say they would save thirteen out of thirty-three gallons per head per day of the population, if only this matter of the waste-pipe were properly attended to.

Q.—In your report on the sectional water supply of the eastern part of the metropolis you state, as the result of your examination, that you found there, or it was found, that about 23 per cent. of one of the worst districts would require alteration?

A.—I made many other examinations of many other parts of the metropolis, particularly the Southwark and Vauxhall Company's districts. I stated in my report of the 27th of May, 1867, with regard to the district supplied by the East London Water Works Company, that on the last complete examination in 1866, the proportion out of order in regard to the condition of the fittings was, on the average, 23.89 per cent., and that in many of these cases the state of affairs was so bad as to justify the extreme penalty of cutting off the water, but the penalty was only resorted to in twelve cases in a year when the landlords refused to execute repairs.

Q.—In the returns presented to you, as one of the commissioners, it appeared that none of the companies but one had really thought of making a particular examination, but the requirements for every house were upon assumption only. One company, however, did make a particular inquiry—that was the West Middlesex; and that particular inquiry, stating it in round numbers, resulted in the fact that out of 44,000 houses there were about 11 that were found to be defective.

A.—I have no doubt that was so.

Q.—It is stated that the expense of remedying those defects would be from 3s. to 6s. That being so, in the case of the eastern part of the metropolis, would not an average of 2s. per head of the population cover those defects which were found to be, as it were, in 23 per cent. of the population ?

A.—It might do so, but I believe that no one can give that information very accurately. Whatever any one may say upon the subject, it is still in the nature of a guess.

Q.—Mr. Rawlinson expresses his opinion that probably 2s. per head of the population may be deemed tolerably fair.

A.—I think it quite possible, but I never like to give an estimate unless I have very accurate means of doing so. The population of the metropolis is very closely packed in many parts, and a very moderate amount of expense is necessary for cases where you have not got complicated arrangements, and the constant supply might be given more cheaply probably than the intermittent supply is given at this moment. If you have got good fittings you want no large cisterns. A tap direct from the main is all that you want, not only in the City of London, but in other parts, for drinking purposes. I think where you go down to the lowest classes, and where you cannot trust people with brass taps in their houses—as you cannot in some cases—the best mode of supplying them would be by a waste preventer in the court outside the houses altogether, to which nine or ten houses might resort. Then they would get the water clear and fresh from the main, just as they want it, and there would be no chance of the fittings being out of order.

Q.—It has been stated to us that in twenty instances in the towns where the constant supply has been put on, a reduction below twenty gallons a-head has been effected, simply upon the system of direct introduction into the houses.

A.—The waste that goes on now in many parts of London is abominable. I have myself seen constantly, that as long as the water is turned on it runs away—there is nothing to prevent it. That is in the case of intermittent supply.

Q.—Under an examination by the General Board of Health, the amount of waste was determined by gauging the sewers on a dry day when the water was on and on a dry day when the water was off. At that time it appeared that three-fifths of the water was pumped to waste.

A.—Many people use very little water for legitimate purposes; they do not use enough. They use very little for washing, and not much for drinking and cooking.

Q.—Twenty gallons per head of the population would be, in a house of five persons, 100 gallons. In the best houses you do not use so much?

A.—Nothing like it, unless in the case of baths, and even 20 gallons may be deemed to be an excess. In the lower class of houses I do not believe they use above six or seven gallons per head per day for any useful purpose.

Q.—It is stated that the most intense opposition to this measure comes from the small owners, who will be subjected to much outlay consequent upon bringing in a plumber to do the work.

A.—That is quite true. You mean opposition to the regulations which were drawn by the Committee, of which I was a member. I can quite understand that there should be some opposition of that description, and all the more so, because in going round a district I have found, over and over again, that where people have complained of the water companies, those very complainants have been themselves very seriously to blame in not having the fittings in their houses in proper order.

Q.—If a measure can be proposed which will enable the fittings to be put on at the public charge, without charging the occupiers or owners anything, that may be expected to remove the opposition?

A.—It would be a very beneficial measure, no doubt, to poor owners—not that the poorest class of houses are always in the hands of poor owners. They are very often owned by people who are very well off, but who will not spend any money on their property.

Q.—It is stated that in the East of London a great many of the lower class of tenements are very largely held by those people who gain a living by making the direct collection of the rents.

A.—No doubt that is so to some extent. You have got to contend also against the prejudices of people. Upon economical grounds the introduction of the constant supply is no doubt to be desired as a matter of avoiding waste, and as a matter of health to a great mass of the population.

Q.—Have you directed your attention especially to the question of prevention of fires?

A.—In some of my inquiries I have found it stated that water could not be obtained in cases of fire, and there was a good deal of truth in those allegations. For want of the water being constantly in the mains, it could not be obtained when wanted. In order to provide against fire there is more than the water wanted. There is the means of drawing it, and that is much required in a great part of London. You want stand-pipes in different parts of London to enable the hose to be fixed on at once, and the water to be supplied readily in case of fire. It may be taken as an acknowledged fact that if you can only get at a fire very quickly and begin to pour water on a small fire before it becomes a large one, that is the best way of avoiding conflagrations.

Q.—In the city of London trials have been made of the use of the jet for washing the streets, as in Paris. Would it not be one great advantage of such a method of cleansing which, on previous trial works by direction of the Board of Health, was found to be cheaper as well as more complete than cleansing by the broom, that it must ensure an apparatus in constant use that would be in constant readiness in case of fire?

A.—It would be a very great advantage, and if you could devise a means of watering the streets by stand-pipes, so much the better.

Q.—Are you not of opinion that the supply of water to the metropolis ought to be put under a unity of management and on a public footing?

A.—There is enormous difficulty in getting things done properly when you are in the hands of eight or nine companies. If I had my way, I would put the gas and water supply of the metropolis under a commission. I would have certain people appointed with nothing else to do but to regulate the supply of water and gas to the metropolis. It ought to be a special service. Even if you did not put it under a public body, but combined all the nine companies into one under proper control, with somebody to look after them, that of itself would be an enormous advantage. It would save a great deal of expense, and by combining the mains, in case of an accident to one, you would have others to fall back upon. They would not want to duplicate their engine-power as they do, and with a united concern they would give a very much better water supply to the metropolis, and be always ready in case of emergency, and do it more economically.

Q.—An extended service being needed for public purposes, such as street-watering, street-washing, and the complete arrangements for fire-prevention at the cost of the service, instead of for a trading profit, can those objects be obtained economically, and apparently under the existing conditions under which every extension is a matter of conflict in all the eight sections? In the city of London the trading company charge 6d. per thousand cubic feet for street watering; elsewhere 1s. a thousand cubic feet is charged, whilst as a service the expense would be under a halfpenny per thousand gallons?

A.—Yes, public bodies would not be obliged to be so economical of water as they are now, and therefore the water service of the metropolis would be more efficiently performed. I see no difficulty, in an administrative point of view, in getting the eight sections together under a good, trustworthy, and competent authority. I think the difficulty is rather in getting efficient service with so many companies. I do not think there would be any practical difficulty about it if it were done in a business-like and proper spirit, and I think it would be to the advantage of all parties. It would benefit everybody—companies, shareholders, and the public.

Q.—The terms which are stated to be applicable are that the shareholders should be paid their existing dividend, officers their compensation, and to put it under a public trust?

A.—That is one way of doing it. I do not know that it is necessary to go into the details as to how it should be done, but I think there would be no difficulty in working it out.

Q.—Then we take your general conclusion to be, from your experience and observation, that you have no doubt of the expediency and of the practicability, and of the urgency as regards public security, of putting the whole system of supply under unity of management and on a public footing?

A.—None whatever.

ANNUAL INTERNATIONAL EXHIBITIONS.

The number of visitors admitted to the Exhibition for the week ending Saturday, April 19, was as follows:—Season tickets, 2153; on payment of 2s. 6d., 1357; on payment of 1s., 24,638; total, 28,148.

This week the numbers of visitors were, on Monday, season tickets, 246; on payment of 1s., 2,853; total 3,099; on Tuesday, season tickets, 203; on payment of 1s., 3,357; total, 3,560; on Wednesday, season tickets, 356; on payment of 2s. 6d., 1,344; total, 1,700.

The *Lancet*, commenting on the display of surgical instruments, says the Exhibition contains a display of surgical instruments and appliances which cannot fail to be highly interesting to the medical profession. The instruments are arranged in the "West Theatre," which is on the balcony floor of the Albert-hall, a little to the west of the royal entrance, and the whole of the theatre is devoted to them. At one time there was, it will be remembered, some difficulty with the principal makers, who objected to the power of rejection placed in the hands of the Committee. It was explained, however, that this power was absolutely necessary, to prevent the admission of improper objects, and that it would be practically a dead letter in the case of makers of repute, whose applications for space would be granted as a matter of course. This explanation was accepted as satisfactory by the trade in general, but amongst London makers Messrs. Weiss and Son, and Coxeter, have held aloof, and are entirely unrepresented. Messrs. Arnold applied for space, but the case allotted to them was still empty on Saturday. Of surgical instruments proper, the chief trade exhibitors, taking them in alphabetical order, are Blaise and Co., Evans and Wormall, Hawksley, Krohne and Sesemann, Lynch and Co., Matthews Brothers, Mayer and Meltzer. and Salt and Son. all of whom have cases replete with examples of the highest skill and the most finished workmanship, alike in instruments for daily use and in those manufactured to meet the special needs of particular operators. Messrs. Blaise, and Evans and Wormall, also exhibit cases of old and obsolete instruments, and similar collections have been lent by the Royal College of Physicians, the Royal College of Surgeons, the Royal Medical and Chirurgical Society, the Royal University of Berlin, University College, and by her Majesty's Commissioners. who have employed Signor Alessandro Castellani, of Rome, the well-known art jeweller, to make facsimile reproductions of the instruments discovered at Pompeii, including the famous speculum vaginæ. Signor Castellani has added to his copies a collection of old surgical instruments made by himself in his explorations among remote and ancient Italian villages. Mr. White Cooper lends Heister's "General System of Surgery;" Dr. Hall Davis "a collection of obstetrical instruments which belonged to the late Professor D. Davis;" Mr. Charles Hawkins, "instruments for the removal of stones from the bladder without cutting;" Mr. Prescott Hewett, "instruments for lithotrity;" Dr. Morell Mackenzie, instruments for examining and treating diseases of the throat, including the original laryngoscopes of Babington and Avery;" Sir Anthony de Rothschild, "a circumcision-knife of the fourteenth century;" and Mr. T. Wormald, "surgical instruments for lithotomy which belonged to the late John Abernethy." These individual contributions are mostly of historic interest; but the absence of Messrs. Weiss from the exhibition has induced several members of the profession themselves to exhibit instruments which Messrs. Weiss have made for them, and which would have been more fitly shown by the firm. Among this number may be placed Dr. Allen, Mr. Greenway, Mr. Charles Hunter, with perhaps a few more. We have no space in which to dwell upon the huge size and uncouth forms of some of the instruments of antiquity, or even to express compassion for those upon whom they were applied. It is sufficient to say that the contrast between ancient and modern instruments is at once pleasing and instructive; and that many of the latter seem to arrive at something very near mechanical perfection.

The following circular has been issued by the Council of the Royal Horticultural Society, on its own authority:—"The Council beg to inform the Fellows generally that it has entered into the following temporary arrangement, for this year only, with the Exhibition Commissioners. The Council wish the Fellows to bear in mind that it has been much hampered in making the following arrangement by engagements previously entered into by the Commissioners with other persons for the use of the arcades and upper story of the quadrants. Arrangement for 1873—The Fellows and their friends to retain the private enjoyment of the gardens and conservatory. The Exhibition visitors not to enter without the usual payment of the day. The Lower Quadrant Arcades to be for the Fellows and their friends only. The Upper Story of Quadrant Arcades, with a communication across the back of the conservatory, will be entirely fenced off for the Exhibition visitors. The Commissioners to open forthwith, at their own expense, a new entrance for the society at the south-west side, and to allow the society to use, without payment, until the 1st April, 1874. the north-western and north-eastern entrances in Prince's-gate and Queen's-gate respectively. The society to permit the Exhibition visitors until 1st November, 1873, a passage way across the gardens, so as not to interfere with the privacy and freedom of the Fellows and their friends. The Fellows and their friends and debenture-holders to have a joint right with the Exhibition visitors of using the central arcades. The Commissioners to pay £1,000 in cash before November, 1873, to the Royal Horticultural Society.—By order of the Council, W. A. Lindsay, Secretary.—South Kensington, 10th April, 1873. Although the outlines of an agreement were arranged, we have reason to believe that the "agreement" is still in the hands of the lawyers of both sides.

EXHIBITIONS.

VIENNA EXHIBITION.

The *Engineer* has the following:—"In confirmation of what we lately stated as to the probability that this Exhibition will be only formally opened on the 1st of May next, we now understand that the machinery department will have to be closed for at least a short time after the opening. A great part of the machinery has not yet been even unloaded. It is possible that even other departments may not be completed in due time." In contradiction to the above, the *Eastern Budget* says:—"An absurd report has been circulated in Vienna to the effect that so much still remains to be done in the Exhibition that the opening on the 1st of May will be only a formal one, and that the building will then be again closed for some time to the public until the internal arrangements are completed. We are enabled to state that there is not the smallest foundation for that rumour. There is every reason to believe that everything will be ready by the end of this month, and it is certain that after the 1st of May the public will be admitted without interruption." We understand that the latter statement is the correct one.

The Vienna correspondent of the *Patrie* says the quickest route from Paris to Vienna is by the Eastern Railway, and the most suitable train is the 8·35 p.m. The traveller does not need to change carriages till he reaches Vienna. He arrives at Avricourt, on the French frontier, at six a.m., and there is then time for a light breakfast. At nine Strasburg is reached, and there is a stoppage of an hour and a-half—the only serious delay on the journey—so that dinner must be taken in the carriage. Siembach, on the Austrian frontier, is attained at one o'clock next morning, and at half-past nine the traveller arrives at his destination, having made a journey of fourteen hundred kilomètres in thirty five hours, and traversed France, Prussia, the Grand Duchy of Baden, Bavaria, Wurtemburg, and a part of Austria.

Messrs. Thomas Cook and Son have received the official announcement by telegram from Vienna that the season tickets for gentlemen will be 100 florins, and for ladies 50 florins, giving admission to the opening ceremonies and the distribution of prizes. Admission on the opening day will be 25 florins; admission daily will be one florin. On Sundays half-weekly tickets will be admitted at a charge of five florins each.

A correspondent of the *Daily News* writes:—As far as the Exhibition is concerned all is chaos, and everything a month or weeks six behindhand. The English department is the most forward; but with the exception of some agricultural machines, and the fitting up of sundry exhibitors' stalls in progress, nothing is advanced. Goods sent from England by fast trains six weeks since have not come to hand. Many of the exhibitors from England are here with their skilled artisans, but they are idle for want of their goods. The Agricultural Department has a few implements and steam engines in it. Packing cases are there by the thousand, but labour is scarce, and those who have taken the precaution to import their own assistants have done wisely. They will soon make up for lost time when their consignments come forward. In the other departments of the Exhibition less progress has been made; about a thousand English workmen would put the whole place to rights in ten days. In the grounds surrounding the "Palace" the flower-beds are only being stumped out. The turf, which has been in readiness for laying down weeks since, is still coiled up, dry and dead, and, with the exception of some dozens of fir and box trees, and some withered lilac trees, which have not even yet budded, owing to their being so long out of the ground, the intended plantations are in a very pitiable state. The hotels, which are very large and really good, are by no means crowded. The cost of living here may be set down at about 20s. a-day, and I am informed that as soon as the Exhibition opens it will be at least 30s. I believe that Mr. Gaze and Mr. Cook, the tourist agents in London, are doing their best to accommodate all their clients here. As a rule, most of the packages which have arrived at the Exhibition appear in good condition, but I regret to say that some of the earthenware goods from our British possessions in India have come to grief. All the regimental bands in garrison here will take part in the opening ceromony. The Austrian Hymn will be sung first, and afterwards the other national hymns of the exhibiting countries. The Emperor and Empress will visit some of the principal departments after the opening. The Krupp guns are here; the largest is 21 feet long, and weighs about 30 tons, the ball 600lbs., and calibre 12 inches diameter.

Mr. Thomas Jacob, one of the workmen appointed to report upon cabinet work at the Paris Exhibition, and to whom the Society's Silver Medal and a prize of £50 was awarded for an inlaid loo table, has just completed a small inlaid table, of fine and elaborate workmanship, for the Vienna Exhibition, in amboyna, ivory, and various natural-coloured woods, which is likely to compare favourably with any other work in the cabinet department. The table is of considerable beauty, and is a satisfactory evidence of the good results effected by the efforts of the Society to encourage fine-art workmanship.

THE PURCHASE OF RAILWAYS BY THE STATE, PROVIDING A LARGE AND EFFICIENT ARMY OF RESERVE, WITH GREAT REDUCTION OF TAXATION.

By David Ker.

The purchase of the railways by the State has been a subject more or less mooted from the great starting-point of the system—viz., in 1846—to the present time, and it is now two years since I first began to introduce my proposal to members of both Houses of Parliament.

It was during the premiership of the late and lamented Sir Robert Peel that, in granting all succeeding acts, it was provided, in case the State desired to take possession of the railways, power was reserved for them to do so. Thus, even at this early period, it was almost a recognised necessity, and it has been a great loss to the country at large that the State did not take possession; for had it done so, the railways never could have cost more—probably less—and at this moment we might have been freed of nearly all our national debt. The golden opportunity was, however, let slip; yet there is time even now to benefit considerably by the purchase, of these truly national undertakings.

I will, then, with your permission, first draw your attention to the present system, with its disadvantages, placing in contrast the advantages that would accrue to the public from the purchase by Government; and I think all must admit the State could give greater facilities, combined with safety, better accommodation, and cheaper fares; and in proving this, if you will kindly follow me over some of the existing lines, you will see—First, the London and North-Western competing with the Great Western; then the Great Western, Midland, and London and North-Western against each other; the Midland to be competing with the Great Northern; the Great Western with the London and South Western; and the London, Chatham, and Dover with the South Eastern, &c. Each and all of these are doing their utmost to get the traffic the one from the other; the consequence is, the trains are run in duplicate and triplicate, twice and thrice a day, at about the same hours for the same termini, so as not to allow the slightest advantage to be gained by their opponents. And it has even been proposed that greater powers shall be given to railways generally, so that any company choosing to run *through* trains over their neighbour's lines, on paying, of course, the usual mileage, shall be at liberty to do so.

It is self-evident such a result must not only increase the liability to accidents, but, if carried out, to a sure and certain diminution of the dividends; for it is clear these increased facilities would only stimulate the railway companies to rival their competitors, and so they would exercise the running powers; and where one train suffices now, in all probability two would be required, with far greater chances of collision on account of the increased number of special trains; as no doubt the companies on the north side of the Thames would very much like to run *through* trains to the end of the southern and western termini, and the lines on the south side would likewise compete with their neighbours by running trains through to the north. Now consider for a moment the distances the majority of these trains have to travel before reaching London, and is it at all likely the railway companies, were the through trains if late, would detain their regular local trains for the arrival of the through from a foreign company? Certainly not. So, on the arrival of the late through, a special would be required for the conveyance of the passengers in it; hence a vast increase in the number of specials, at the cost of the shareholders, and with increased danger. How different, however, would it be under one management. Then there would be no competition; and the advantage of travelling from north to south, and *vice versâ*, would be greatly esteemed as only the journey or continuation of one management, without the fear and prospect of being late for an opposition company's train.

Now, if this holds good with passengers how much more so in respect of the luggage; these and the coal trains are running day and night, mixed in and out with the passenger trains, stopping here, shunting into a siding there, for the purpose of allowing the passenger trains to pass. And now let me beg your attention for a moment to the signalmen, with this increase of work and strange company's trains; men entrusted with the lives, you may say, of the passengers; and bear in mind the long hours they are at present on duty to attend to this responsible work, and yet these men are expected to conduct the signals without accidents, from year's end to year's end, for ten, aye, for twenty years; imagine the number of solitary hours they have to pass, with but the one thought of their work, trains flying hither and thither, up and down, some before, some behind time. I would appeal to all, is there a single being who could undertake to act throughout his whole life, no matter in what capacity, without making a single mistake, aye, even for one year? Not one, and yet these men, confined in a solitary box, are expected to do so. I say it is wonderful how few the accidents are, considering the mental anxiety and monotonous strain on the brain; with nothing but the one thought ever before them. Men's minds will wander—they cannot help it; and yet let the unfortunate man, after perhaps some twenty years' service, fail but once, and he is a criminal. Of course companies like to get as much work out of a man as they can, and so does the State for that matter, with this great difference, the State would not have to provide a dividend, and it could afford to make the duties of this class of officers, and indeed all where it was necessary, alternating; and I should say a signalman ought never to be on duty more than four hours at one time where the trains are numerous, and not more than eight hours a day altogether.

Let us now, however, examine the other side. If the railways were in possession of the State I would suggest an arrangement somewhat after the following, and by this arrangement I do not doubt the public would be greatly benefited:—

The main line of the present Great Northern Railway runs almost straight to Edinburgh; therefore this same line, and all east of it, and on to Inverness, &c., should be worked as *No.* 1 *District.*

The Second District might well be represented by the present "Midland" main line, and all east of it to the main line of the present Great Northern Railway, including the Leeds district, thence to Manchester, on to Carlisle and Glasgow, and from this port conveying all the traffic for the North of Ireland down as far as Drogheda.

The Third District would be the present London and North-Western to Birmingham, Shrewsbury, on to Chester, Liverpool, and all north and east of it to the Midland, or Second District, conveying all traffic from England to Ireland for Dublin, up as far as Drogheda, accross the country to the west, down to the south as far as Carlow and Limerick Junction. This district would have two ports, Holyhead for passengers, and Liverpool for goods.

The Fourth District.—The present Great Western Railway and all north of it to the London and North-Western, or Third District, the south of Wales on to Milford and Pembroke, and on to Bristol, conveying all traffic from England for the south of Ireland to Waterford, thence up to Carlow, over to Limerick and all south of this. This district would likewise have two ports, viz., Milford Haven for passengers, and Bristol for goods.

The Fifth and last District would be for the remainder of England, viz., all south of the Thames and beyond Bristol.

In considering the advantages to be derived from such an arrangement, when the whole is under one management, there can be but little doubt of the enormous saving, to be alluded to hereafter, and the increased accommodation that could be given to the public. First and foremost is the latter; and whereas now three companies are striving for the Scotch traffic, and running about eleven through trains daily to Edinburgh from the three companies, in four batches, starting about the same hours, it is evident if the Government gave six at different hours the public would be gainers by two, at a saving of five through trains; this is but a sample of the general opposition system—of course the local traffic could be so arranged as to suit the district. The next is the goods traffic. In London alone there are upwards of 10,000 horses and vans, with offices and clerks innumerable, for the collection and delivery of goods for the several companies. Some of these vans go about full, some with half, some with quarter of a load; it must be so when there are so many in opposition, and if it is so with the vans how much more so with the trains, when the London and North-Western, the Great Western, the Great Northern and the Midland are all striving for the Liverpool and Birkenhead traffic, as well as for the Scotch; this is but another sample of the rest. Now, if the lines were in Government hands, and the district arrangement in force, the whole would be simplified; the trains would be well filled, and full trains, that is, as much as an engine could draw, be started off when ready, reducing the number of trains from the concentration of the goods, and every engine made to convey a tonnage equal to its power; then with perhaps only one pick-up train for the main line of each district, see what an immense saving there would be; and I verily believe the whole of the goods traffic from this concentration, and the chief portion of the coal traffic, might be run at night, freeing the lines of these dangerous travellers during the day, to the confusion and risk of the passenger trains, so that the public would be better served, both in the passenger and goods department.

I will now investigate the terms of purchase. When I made my calculation, more than two years since—and the amount has not materially increased since then, or if it has, the receipts have increased in a corresponding ratio—I found the railways had already cost the public some £520 millions. Before, however, I proceed further, let me explain that as some lines were at a premium, and some at a discount, I estimated the one would as nearly balance the other as possible—that is to say, the amount of the premium to be paid for those lines at a premium, would just correspond to the amount to be deducted from those lines at a discount, taking the market prices of all, thus, their quoted market value would be about the same as they cost in construction. Then I found by the Board of Trade returns that the net income of the whole of the railways, available for dividend, after paying all expenses (and this no less than 49 per cent. of the receipts) amounted to 22 millions: now, if the State purchased the railways, I suggested in a communication I sent to the Premier when I had the honour of submitting my plan for his consideration in November last, that the Government should do so by the State making a distinct and final offer, of taking all, at the prices quoted the same day the offer is made known in the House of Commons, and giving a bonus of 20 per cent. or whatever they intended. This I considered would prevent the possibility of the mad speculation, to the ruin of thousands, that must ensue when the proposed purchase became known, unless protected by some such final and decided offer.

The original capital, then, being 520 millions deduct about one-third for debentures (174), leaving 346 millions as share capital. Add to this 20 per cent. bonus, 69 millions, and you have a total of 415 millions, to be paid by the Government for the share capital; this, at 4 per cent. stock, would amount to £16,000,000 for interest

And as the debentures fall in, issue 3 per cent. stock for the £174,000,000, which would require for interest £4,920,000, still leaving a balance of £480,000 to make up the £22,000,000 net revenue to the credit of government.

Now, let us see how this will act. Take the Great Western, for instance. At the time I am now writing the price is £125 in the share list for every £100 stock, and paying a dividend of 6½ per cent., on the £100, subject to variation. This, then, would give an interest of £6 10s. per annum, as paid by the Great Western Company.

Now take my proposal. The price is £125, add 20 per cent (£25), or a total of £150, this, at 4 per cent. stock, would give £6 permanent interest, government security, or at a loss of only one-half per cent. I put it to any one—which would the shareholders of this railway prefer £150 cash, as against £125, the present price, if they choose to sell out, or £6 per cent. government, as against the £6 10s. railway company's interest, subject to fluctuation? Of course, all the railways are not exactly like this, but they approximate sufficiently to offer inducement enough for the shareholders to prefer either selling out or retaining government in preference to the railway stock. These are facts resulting from the simple purchase, but we must take into consideration the immense saving that must ensue, by the doing away with directors, lawyers, managers, secretaries, superintendents, and all the secretarial clerks, abolishing the registration and audit department, with their immense staff of clerks on every line, retaining only a number about equal to those at present employed in the clearing-house. According to the simple plan I propose, viz., instead of the present cumbrous system of tickets to each class for every station, and there are no less than 4,600 requiring 1st, 2nd, and 3rd single, and 1st, 2nd, and 3rd return, six for each station, or 27,600 different sets, accounts of which from the manufacture to their use and destruction have not only to be kept by the several railways but by the clearing-house as well. Now the plan I propose is so curtailed that one good-sized ticket case might be made to hold all the tickets requisite for booking to any distance and over the whole kingdom, viz., by 52 different mileages, as shown in this table, giving the charges for all tickets up to two, three, and five miles or short distances, then for distances up to 10, 15, 20 miles, or every five miles up to 100, when I increase the distances by 10, thus 110, 120, 130 up to 300, when I increase it again by 20, and lastly by 25 miles; but in making these calculations I must distinctly state it is only to show how I propose working the system; the rates might be lowered and the distances increased to reduce even the number of mileages; this would, however, rest with the government; at any rate this plan would only have 52 different sets, and these multiplied by six would only require the accounts to be kept for 312 sets of tickets as against the 27,600 of the present; and the tickets I propose should be uniformly printed for use all over the kingdom, though in different colours, according to district and class, and the issuing station should stamp its name and date on it thus:—

CLASS.	MILES.															
	2	3	5		10		15		20		25		50		100	
	d.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
1st	3	4	0	8	1	0	1	10	2	8	3	6	7	8	16	0
1st Return	4	6	1	0	1	6	2	9	4	0	5	3	11	6	24	0
2nd	2	3	0	5	0	8	1	2	1	8	2	3	4	10	10	0
2nd Return	3	5	0	8	1	0	1	9	2	6	3	5	7	3	15	0
3rd	1	2	0	4	0	6	0	11	1	4	1	9	3	10	8	0
3rd Return	2	3	0	6	0	9	1	5	2	0	2	8	5	9	12	0

&c., &c., &c., to 600 miles and upwards.

Parcels, horses, carriages, &c., treated at mileage rates as the passengers.

STAMFORD,
1st January, 1873.

AVAILABLE
for
95 MILES.

1st Class.

No. 0125, 1873.

Or 2nd or 3rd as the case may be.

And if sold at the post-offices they should likewise stamp their mark or No. on it.

The same plan of mileages would apply for the goods traffic.

Then in the reduction of the number of trains to be actually abolished or saved in consequence of non-competition, and the lesser number required by the district arrangement, I estimate at too low a figure, but say four million. Next in the matter of stores saved on 15,000 miles, say £500,000. Lastly in the purchase of coal, as there would be no competition and but one purchaser; then again the saving as between coke and coal now used on some lines, for the government could then convey coal free to all, say £2,000,000

£480,000 say £500,000
3,000,000
4,000,000
500,000
2,000,000

This would give a total of £10,000,000

Surely this vast sum is worth saving for the nation; it is true many object to the state taking possession, as interfering with private enterprise, but I must say private enterprise has already had its advantages, and benefited to a very great extent, and it would still further be benefited by an immediate advance of £20 on every £100 value, a thing not very likely to occur for years upon years, in the ordinary course of affairs; but I say, why should not the people at large get some advantage as well out of these truly national undertakings, and by the government taking them we can be relieved to the extent saved, by a corresponding reduction of taxation. So the buyers and the sellers would be equally advantaged.

But I have not finished. There is yet another very important proposition I have to make, still further reducing taxation, and providing a great want, viz., a large reserve army for home defence at no cost to the country.

Our regular army at present numbers some 130,000, at a cost of about £15,000,000 per annum. There is a difficulty, everyone knows, in getting recruits, and a greater difficulty still in keeping them, on account of the lowness of the pay as compared with labourers. This is fully borne out by the number of desertions published in the *Police Gazette*, and various have been the remedies suggested; all have failed; but the plan I propose cannot well help succeeding, as it would eventually benefit the pockets of the men themselves.

I propose, then, that the railways be purchased by the State, and our recruits engaged for three or four years, as the case may be, by which time they would be thoroughly drilled soldiers, on the distinct understanding that when their period of service had expired the government should provide situations for them on the railways as porters and policemen. I need scarcely say this would at once secure a far better class of men, who would join solely for the purpose of obtaining a permanent situation hereafter.

Now let us look at the results flowing out of this proposition. At present there are some 300,000 men employed on railways; I do not propose to interfere with these at all, and I should say there are from 10 to 20,000 who annually leave or are dismissed. I would suggest, therefore, that from the time government took possession all new men engaged (not being retired soldiers) should only be taken on as supernumeraries, to be replaced by retiring soldiers as they left the service; there could be no hardship in this. Estimating, then, a retirement of 15,000 per annum of soldiers from the line, the one would about balance the other, and without any injustice to the working man generally, because it would be these very working men who would be induced to join the army for the sake of a permanent situation hereafter.

I do not propose to amalgamate the army and the railways by any means; they should be kept separate; I propose that, after the soldier has served his short service, without a pension, he is to be provided in another department of the State with a situation, as a reward for those services; and with what a glorious result to the country! Why in the course of a few years we should have an army of 300,000 thoroughly-trained soldiers, always ready, in case of invasion, at no cost, and, better still, as the trained army of reserve increased, I propose gradually to reduce the regulars, either by one-half or one-third; let me take the latter, and at a saving of five millions per annum; add this to my previous ten millions, and you have a total of fifteen millions for the reduction of taxation. Away, then, with the income-tax, &c., &c.

But to proceed on the further consideration of this important subject, if the men will be benefited, so will the officers, as I suggested that they likewise should be transferred to the railways after having attained a certain rank or served a given time, to be decided on hereafter; then the corporals, the sergeants, and sergeant-majors, these could be appointed to the position of foremen, inspectors, and station-masters of small stations;

the officers according to rank, as superintendents, district-superintendents, &c., &c., thus always keeping alive a movement of promotion in the army, so much required at present, as the officers on the railways would still go on with their promotion in the Reserve.

Taking, then, the reduced regular army, after the saving of the five millions has been effected, at about—

	90,000 men,
Then add	300,000 railway reserves.
To this number the....	140,000 militia.
And	150,000 volunteers.
We should have a grand total of	680,000 men,

at a cost of only ten millions per annum, or two-thirds our present charge. What about invasion then? I think very few would like the venture, and though I do not believe in it, yet it is a fact, the dread panic, like some mighty scourge of cholera, seizes hold of the nation periodically, damaging our commerce, deranging everything and ruining thousands; these, then, would be things of the past, as an amount of security would be felt in the presence of so large a force. Surely all these arguments are well worth the consideration of our statesmen.

It has been urged we ought not to trust military power in the hands of so many men. What! Can the Prussians and the French, yes, even the Turks, trust their countrymen in larger numbers, and England cannot trust her sons?

Are we so degraded? Out upon such a thought! Why, these men would be the choice, not the scum, of of our country, ever ready to uphold order. And it has been given as a reason why the State should not become possessed of the railways, that they would have too much patronage; but by adopting my proposal the patronage would be gone, as the railway officers would only continue to progress in the ordinary course of promotion, so the original patronage would be no greater (and it is nil now on account of the competitive examinations) than in any country having a similarly sized army. Then that it would control the elections. Why, I thought the ballot would protect us from all this; therefore this is a mere excuse.

Again, it has been objected that in time of war these very men would be required to attend to the work on the railways; this, instead of being an argument against, is actually one in favour of my proposition; for by the new system of warfare, in case of invasion, the first thing an enemy does is to seize the railways, and, according to his power and numbers so will he seize the larger or smaller district. Now mark this—by my plan every mile of line the enemy lays hold of liberates so many trained soldiers to fight against him; thus, if he seized one half of our railways (as the Germans did in France) he would liberate 150,000 soldiers; moreover, this is still further important, as these very men would otherwise become paupers, or be thrown on the country for support. So you see a chief feature in this plan is the promptitude in collecting our Reserves, and we might even safely withdraw all the non-responsible men, such as the porters and police, the mere labourers, who have nothing to do with the working or safety of the lines, from the other half, replacing them by supernumeraries for the time, thereby increasing our Reserves in the field to some 250,000 soldiers.

To carry all this out, however, there must be head-quarters located somewhere. I propose then to establish three; these need not interfere at all with the present military centres; they naturally belong to the army proper; the three would belong to the railways and the railway reserves. The first, then, I would locate near the coal mines of Newcastle, for the manufacture of all the engines, carriages, &c., required for No. 1 district, as before explained. The second near the Mersey for No. 2 and No. 3 districts. The third at the head of the Severn for Nos. 4 and 5 districts. At each of these head-quarters the staff should be located, who would superintend the whole of the military arrangements and periodical drilling.

Ireland would, of course, require a separate establishment—say on the Curragh.

Let me now, in as few words as possible, as it is connected with this proposal, allude to the army in India; and these, being a part of our regulars, would ultimately have to be taken on to the railways.

I would therefore suggest the keeping of certain regiments always in India, and instead of sending out the recruits in small detachments, as at present, some arriving five, some four, three, two, and only one year before the return of the whole of regiment, to the great expense of the country, I say the men for Indian service should all be enlisted for eleven years, be drilled one year at home, and all to be uniformly clad; then at the end of the year, as they would require new uniforms, let them be despatched in large batches, giving 100 to each regiment they enlisted for, relieving 100 of the same regiment returning home after their ten years' service, these men so returning to be pensioned with half the pension formerly allowed to soldiers after 21 years' service, and the government to find places for them on the railways likewise. By this means the regiments would be kept supplied with fresh drilled recruits, to the advantage of the service, and the men would all serve their ten years in India to the saving of the tax-payers here. Thus, you will see, I could not have omitted this without upsetting the plan I laid down—viz., the finding recruits for all our army, and providing for and keeping them together on the railways afterwards, for future service in our reserves.

But to touch on another part of this interesting subject, much has been said about monopoly, and many say if the State took possession it would become one. No such thing—if the railways fell into the hands of the State, it would cease at once to be a monopoly in a commercial sense, because the House of Commons would control the fares and rates, and prevent too great a profit being made.

Take the telegraph as an instance. Should we ever have had 1s. telegrams from the public companies? Never; and now the State are in possession we shall yet have them at 6d.

So must it be with the railways, the State would be controlled by its representatives. No—the real monopoly would be when the various large lines became amalgamated, and each had its own district, on the understanding that one was not to interfere with another, then a monopoly pure and simple would be established, and the amalgamated companies would exact the highest rates and fares they could to provide the highest possible dividend, and run fewer trains to increase it for the shareholders, there being neither opposition nor control after the passing of these Acts. You will see even now Government does not object to amalgamation of railway with railway, only to canals with railways; here is a danger entirely overlooked, and which every individual will feel personally if it is allowed to go on.

Railway with railway amalgamation is not objected to; consequently, the five divisions or districts I have pointed out may become an accomplished fact, unless government takes possession, but how about passenger fares then? This important matter has been altogether lost sight of by the government; they only object to the amalgamation of railways with canals, because, forsooth, it would affect the carriage of goods—the dead freight, leaving the living, and amongst these millions of artisans, to the mercy of the amalgamated companies, who, if they lose by the competition with the canals, must make up the difference somehow, and they will most decidedly do it in the passenger fares. This argument ought to be sufficient to stop further railway and railway amalgamation, if government does not take possession, and I cannot see how they can escape from it when it is proved to be to the advantage of the nation.

There is yet another objection to our present critical position, viz., the terrible danger of a strike amongst the railway men; this danger would be got rid of were the men all under military law. Depend on it, the railways, as now spread over the whole country, ought not to be considered private undertakings; they are truly national. Conceive a strike of all the railway companies in London, how could we be supplied with food? Thousands must starve; but we are told and soothed by the present managers of the Railway Servants Amalgamated Society that they do not intend, and would not strike, but the language used led me to infer there were circumstances under which they would strike. Can any one answer for the temper of a large body of men? Every one knows how a mob are sometimes most irrationally led—a temporary blindness or passion seizes them, and they rush forward to their own destruction and that of others. Are we, then, to be left to the mercy of these men? Are we to be told that so long as we satisfy their demands they will consent to work and allow us to live? Surely we ought to have securer guarantees than these; it is far too serious. Parliament ought not to allow this session to pass without some certain death for this hydra-headed monster, else, as we have had a strike in the coal mines this winter, the next may bring one amongst the railway men; nothing more likely, the warning note having been sounded this winter; but oh! the result—sheer starvation to multitudes. The probability even ought not to be allowed to exist, much less the possibility; let the unions say what they like, we have been already threatened.

Next and last, there is the question as to how the railways should be worked, alluded to in the Premier's letter to the Marquis of Clanricarde, where he frankly states he fears the government would have to work them. If, then, they purchased them and did not work them, it follows they must lease the working. This system would undoubtedly ease the government of the trouble; but, let the arrangements be drawn as carefully as they may, yet I will venture to say the smallest opening, only the size of a pin's head, might be worked and worked till a coach and four, or, better still, an engine and train be driven through it at the expense of the public. No; leasing means a loop hole, to be found somewhere, and when found it would cost the State not a little to buy back the arrangement, or else the public would be surcharged fearfully; then, as to the officers engaged on the railways under the leasing system, government could not undertake the supervision of so vast a system carried out as per agreement, they might as well do it altogether; so the officers would be badly paid, harder worked, and the public worse served.

The only course is for the State to take possession and to work them, then, having all in their own hands, matters can be so simplified there would not be the slightest difficulty; the whole appears to me to be plain and simple, easy and straightforward; this may be from the years I have studied the question; and the more I have studied it, the more have I become convinced that the only way to escape the difficulties we are approaching as a result of the present management, is by the State taking possession of the lines and working them likewise, then we may expect better accommodation, greater security, lower fares, and a reduction of taxation.

CONTINUOUS RAILWAY BRAKES.

A paper read before the Society of Engineers, by Mr. W. H. Fox, has directed the attention of engineers to this most important subject. The continuous chain brake, as at present applied on the North London Railway, invented by Messrs. Wilkin and Clarke, consists of a chain secured to the end carriage, passing under and over pulleys to the drum on which it is wound beneath the guard's van. When the chain is wound up in the guard's van, it acts simultaneously upon the lever brake of each carriage. This system acts very well on the North London Railway, but it is said not to answer for fast-travelling trains, whether long or short. Mr. Fox puts forward 13 conditions that are necessary for a perfect brake; the chain brake does not comply with the whole of these, but fairly so with most of them when not more than six carriages are in the train. The Barker hydraulic brake is used on some portions of the Great Eastern line; in this brake the power to press the blocks against the wheel is obtained by an accumulator worked by a pump, the accumulator storing up its power in helical springs that directly press the blocks against the wheel. The great objection to this brake is the liability of the water to freeze, in the communicating pipes, in cold weather. The Westinghouse pneumatic brake is said to be superior to Barker's brake, and it is worked by the steam which would otherwise be blown away to waste. Chapin's electric brake is being experimentally worked on the North London line, and, although working well, has not been a sufficient time in use to prove the extent of its value. In the discussion upon Mr. Fox's paper, it appeared that cast-iron brake blocks were preferable to wooden ones, and that a totally skidded wheel has not the resistance or brake power that a slowly revolving wheel has, in the proportion of about 9 to 11. The public are quite as much interested in the question of a perfect brake as the railway companies are.

OBITUARY.

Baron Liebig.—The death of this eminent chemist took place on Friday last, 18th instant. He was born at Darmstadt, on May 12th, 1803, and received his early education in the Gymnasium there, but he was afterwards removed to the University of Bonn, and subsequently to Erlangen, where he received his degree as doctor of medicine. In 1822 he was enabled to proceed to Paris, where he studied for two years with the French chemists Gay-Lussac, Dumas, and Pelouze, and with Mitscherlich, professor of chemistry at Berlin. The first important work by Liebig was a memoir on fulminates, communicated to the Academy of Sciences at Paris in 1824. In 1824, at the early age of 21, he was appointed to the post of extraordinary professor of chemistry in the University of Giessen. In 1828 he became ordinary professor of chemistry at the same University; and he established a laboratory at Giessen wherein to teach practical chemistry. In 1838, Liebig visited England, and attended the meeting of the British Association, which was held that year in Liverpool. He there read a paper on the composition and chemical relations of lithic acid, and in consequence he was invited to draw up reports on two important branches of chemical research, which appeared in the proceedings of the British Association for 1839. In 1840 Liebig produced his work on "Chemistry, in its Application to Agriculture and Physiology." This work was in reality part of one of the reports which he had been requested to draw up. An abstract of the complete report was read by Dr. Lyon Playfair, in 1842, before the chemical section of the British Association, then in session at Manchester. The report itself, entitled by Liebig "Animal Chemistry; or, Chemistry in its Application to Physiology and Pathology," was published in the same year. In 1849 Liebig prepared for the English press his work entitled "Researches into the Chemistry of Food." In 1855 appeared the treatise on the "Principles of Agricultural Chemistry, with special reference to Researches lately made in England." In 1848 Liebig proposed to his colleagues at Giessen to draw up an annual report on the progress of chemistry. The first four volumes were ably translated into English by Dr. Hoffmann, Mr. Warren De La Rue, and Dr. Bence Jones. The work of translation was not continued, however, beyond the period we have mentioned. These are some of his more important writings, but perhaps the work by which, of all others, Baron Leibig is best known in this country is his "Familiar Letters on Chemistry," a popular but admirable treatise on the subject. In 1845 the Grand Duke of Hesse made Liebig an hereditary baron. He was elected foreign Fellow of most of the scientific societies of Europe and America that recognise chemistry. In 1840 he was elected to the Royal Society of Great Britain, and in 1861 he was named Foreign Associate of the Academy of Sciences at Paris. He was repeatedly invited to fill the chair in English and Continental Universities, and was persuaded in 1852 to accept the Professorship of Chemistry in Munich, with the position of President of the Chemical Laboratory. He was also Chevalier of the Legion of Honour. In the year 1854 the sum of £1,000 was raised by subscription in Europe for the purpose of presenting Liebig with a testimonial. In 1869 the Albert Medal of the Society was presented to Baron Liebig, "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

Sir William Tite.—We regret to announce the death of Sir William Tite, C.B., M.P., F.R.S., which happened at Torquay, on Sunday, from inflammation of the throat supervening on an attack of bronchitis. At the time of his decease he was upwards of 70 years of age. Sir William Tite's earliest known labours were in connection with the church of St. Dunstan's in the East, the rebuilding of which was carried on largely under his superintendence. In 1820 and 1829 he was employed upon the Scotch Church, built in Regent-square, Gray's-inn-road, for Edward Irving, and subsequently in the erection of some of the most important of our earlier railway stations. But it was not until the year 1841, when he was chosen as the architect of the new Royal Exchange in Cornhill, that Sir William Tite's name became generally known. This was his chief work, and all his others are comparatively unimportant. The best known of them are the London and Westminster Bank, in Lothbury executed by him in conjunction with the late Professor Cockerell; the original Vauxhall Terminus of the South-Western Railway, and the terminus of the same line at Southampton; the Blackwall Terminus of the London and Blackwall Railway; the termini and most of the stations on the Caledonian and Scottish Central Railway; the London station of the Woking Cemetery Company, &c., and several other buildings intended for commercial purposes. Sir William Tite was Vice-President of the Administrative Reform Association, chairman of the Bank of Egypt, a director of the Globe Assurance Company, and of the London and Westminster Bank. In 1855 he was returned to Parliament for the city of Bath, which he has since represented without intermission down to his decease. Sir William has discharged the offices of president of the Architectural Society, and of the Royal Institute of British Architects, and that of honorary secretary to the London Institution. He was also for many years one of the Governors of Dulwich College, in the reconstruction of which he took the greatest interest. He received the honour of knighthood in 1869. He became a member of the Society in 1844, and he also filled the office of Vice-President.

Dr H. Bence Jones, F.R.S.—The death of this eminent physician took place on Sunday last, the 20th instant after a long and latterly severe illness. Dr. Jones was consulting physician to St. George's Hospital, and secretary to the Royal Institution. He was well known for his biography of Faraday, and by his many and valuable contributions to the advancement of science. Among these may be mentioned his "Croonian Lectures on Matter and Force;" "Animal Chymistry in Relation to Stomach and Renal Diseases;" "Lectures on Pathology and Therapeutics;" "The Royal Institution, its Founder and First Professors," &c. Dr. Jones, was a member of many learned and scientific societies at home and abroad.

GENERAL NOTES.

Artificial Stone.—The use of this building material is on the increase. The Rausome Patent Stone Company have recently published a pamphlet, descriptive of the process of manufacture and the application of their artificial stone. Flints are dissolved by means of caustic alkali, under high pressure, so as to form silicate of soda, a kind of water-glass. This is then rapidly mixed with a proportion of very fine and sharp siliceous sand in a pug mill, so as to form a soft plastic mass, which can be moulded into any shape that is desired. The soft stone is next immersed in a bath of chloride of calcium solution, which is made to penetrate it by hydraulic or atmospheric pressure. Whenever this solution comes into contact with the silicate of soda, the two liquids are decomposed, the silica taking possession of the calcium and forming the hard solid silicate of lime, and the soda uniting with the chlorine to form chloride of sodium in a small quantity. Instead then of the particles of sand being covered with a thin film of the liquid silicate of soda, they are covered and united together with a film of solid silicate of lime, one of the most indestructible substances known. The small quantity of soluble chloride of sodium, one of the results of decomposition, is then washed out of the stone by a douche of clean water, or by hydraulic pressure, its complete removal being ensured by chemical tests. The stone is then dried and is fit for use.

Technical Education.—On Saturday evening last, the Rev. H. Solly presided over a conference at the Artisans' Club, which had been called with a view of assisting in the establishment of a Trades Guild of Learning. After some discussion, a resolution was passed, hailing with satisfaction the proposal to form such an institution, and a committee was appointed to co-operate with the Syndicate of the University of Cambridge, and with all other bodies willing to aid in the education of the people.

The Manufacture of Steel by means of the Siemens Furnace.—At the meeting of the Chemical Society, on the 20th March last, Dr. Siemens delivered a masterly lecture "On Iron and Steel," in which he pointed out the use of his high temperature or regenerating gas furnace in the manufacture of iron and steel. The formation of metallic sponge which takes place at the low temperature of the ordinary blast furnace is avoided in the Siemens furnace. The ore is heated in a revolving furnace, which revolves very slowly at first; the temperature is very high, but is insufficient to melt the peroxide of iron. A portion of the coal is now introduced so as to reduce the change to the state of magnetic oxide, which is comparatively fusible; the rest of the fuel is then added and the furnace caused to rotate rapidly, so that the particles of iron precipitated in the mass may ball together. The wrought iron thus produced is free from sulphur, and dissolves freely in pig-iron fused upon a hearth, forming a steel equal in quality to that obtained from the best Swedish bar.

NOTICES.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. The following meetings have been arranged :—

April 29 (Tuesday Evening*).—"On the British Settlements in West Africa." By His Excellency Governor Pope Hennessy C.M.G.

April 30.—"On the Condensed Milk Manufacture." By L. P. Merriam, Esq.

May 7.—"On Improvemements in the Manufacture of Gun-cotton." By S. J. Mackie, Esq., C.E.

May 14.—"Improvements in Rifles." By Capt. O'Hea.

May 21.—"On Recent Processes for the Production of Gas for Illuminating Purposes." By Thomas Wills, Esq.

CANTOR LECTURES.

The Third Course of Cantor Lectures for the present session is "On Wines; their Production, Treatment, and Use," by J. L. W. Thudichum, Esq., M.D. The Course consists of six lectures, the second of which will be given on Monday evening, the 28th of April, the remaining four on the Monday evenings succeeding.

Lecture II.

The varieties of wines produced at Jerez—mostos, añadas, finos, palos-cortados, amontillados, rayas, bastos, &c. Physical and chemical observations on the causes of these different results. Brandying, plastering, sulphuring, mixing, and counterfeiting of Jerez wines. Neglect of scientific guidance in vinification diminishes the certainty and success of otherwise highly-developed viticultural and commercial operations. Other Spanish vineyards and wines.

Lecture III.

Description of the vineyards of the Alto Douro, from personal observation of the lecturer. Contrast of geological position of these vineyards to those of Jerez. Varieties of vines cultivated; all medium-sized grapes; whereas the Jerez grapes are all large-sized. Indigenous vines, as studied by the lecturer in the province Entre Douro e Minho. Viticulture in the Alto Douro. The vintage and wine-making.

Lecture IV.

The varieties of wines produced in the Alto Douro; how treated at Oporto. Lodges. Brandy. Legend of elderberry. Unbrandied and dry natural Alto Douro wines. Neglect of scientific guidance here also, but processes more simple, and varieties of results not so great as at Jerez. Description of other Portuguese vineyards—the Beiras, Valley of the Tagus, Bucellas. Fable of the transplanted Rhenish grapes. Collares. Torres Vedras. General remarks on the nature and difficulties of Portuguese viticulture and vinification, all based upon personal observation of the lecturer.

Lecture V.

The wines of France compared to those of Spain and Portugal. The Gironde, its vineyards, wines, and varieties of wines. The Bourgogne and its productions. Belgian appreciation, and sweetness of Burgundy wine. The wine requires the procédé. The Champagne; peculiarities of viticulture. Chemical treatment of effervescent wine to ensure its soundness. Absurd notion of some writers on champagne; of the same on second wines and sugar-water wines; exposure of the sycophancy.

Lecture VI.

The wines of Germany; Riessling a type of bouquetted wines. Classification of the wines of the world, as determined by quality, quantity, value in the market of highest and lowest qualities. Active ingredients of wine. Use of chemical analysis. Use of wine to the healthy, whether old or young; wine, under which condition preferable to all other alcoholic liquids. Wine should be a beverage, not a dram. Use of wine to the delicate and sick. Selection and prices of wine. Proposed modification of the import duties, to adjust them to the climatic difficulties of Spain and Portugal.

INDIA COMMITTEE.

A Conference will be held this evening (Friday, 25th instant), at 8 o'clock, when a paper will be read by William Tayler, Esq., late Commissioner of Patna, on "The Rosary in India." Sir M. Digby Wyatt, F.S.A., will preside.

On Friday evening, 9th May, a Conference will be held, when a paper will be read by General Sir Arthur Cotton, R.E., on "The Harbours of India."

Members are entitled to attend these Conferences free, and to admit two friends to each of them.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...**SOCIETY OF ARTS, 8.** Cantor Lectures. Dr. Thudichum, "On Wines; their Production, Treatment, and Use."
London Institution, 2. Professor Bentley, "Elementary Botany."
Stationers' Company, 7¾. Technological Lectures. Rev. A. Rigg, "The Machinery used in Type Printing."
Royal Geographical, 8½. Capt. Sherard Osborne. "On the Probable Existence of Unknown Lands within the Arctic Circle"
Philosophical Club, 6. Annual Meeting.
Actuaries, 7. Mr. C. Y. Bunyon, "On the Origin and Nature of the Limited and Contingent Interests in Property, usually submitted to Actuaries for Valuation."
Medical, 8.

Tues. ...**SOCIETY OF ARTS, 8.** His Excellency Governor Pope Hennessy, "On the British Settlements in West Africa."
Civil Engineers, 8. Mr. William Pole, "Notes on the Rigi Railway."
Zoological, 1. Annual Meeting.
Royal Institute, 3. Mr. Dannreuther, "Music of the Drama."
Iron and Steel Institute, 2. (At Willis's Rooms.) Annual Meeting.

Wed. ...**SOCIETY OF ARTS, 8** Mr. L. P. Merriam, "On the Condensed Milk Manufacture."
Geological, 8. 1 Prof. Edward Hull, "On the Permian Breccias and Boulder-beds of Armagh." 2. Mr. G. W. Stow, "Geological Notes upon Griqualand West." 3. Prof. T. Rupert Jones, "On some Bivalve Entomostraca, chiefly Cypridinidæ, of the Carboniferous Formations."
Royal Society of Literature, 4½. Annual Meeting.
Iron and Steel Institute, 2. (At Willis's Rooms.)
London Institution, 12. Annual Meeting. 7. Ordinary Meeting.

Thurs...East India Association, 8. (At the House of the Society of Arts.) Mr. W. Tayler, "Publicity the Guarantee for Justice; or, 'The Silent Chamber' at Whitehall."
Royal, 8½.
Antiquaries, 8½.
Linnæan, 8. Mr. J. E. Howard, "On Cinchonas."
Chemical, 8. 1. Mr. J. B. Hannay, "On Zirconia." 2. Dr. Sprengel, "On a New Class of Explosives."
Royal Society Club, 6
Iron and Steel Institute, 11. (At Willis's Rooms.)
Royal Institution, 2. Annual Meeting.

Fri ......Royal Institution, 9. Professor Reynolds, "Alcohols from Flint."
Architectural Association, 7½. General Monthly Meeting.
Geologists' Association, 8.
Philological, 8¼.
Archæological Institute, 4.
Royal United Service Institution, 3. Lieut. Vincent, "The Austrian Army."

Sat......Royal Institution, 3. Professor Odling, "Ozone."

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* A meeting specially appointed, as His Excellency is leaving England.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,067. Vol. XXI.

FRIDAY, MAY 2, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

TECHNOLOGICAL EXAMINATIONS.

The Programme of Examinations in the Technology of some of the Arts and Manufactures of the country is now ready, and may be had on application to the Secretary.

The subjects selected for 1873 are Cotton, Paper, Silk, Steel, and Carriage-building. Those desiring to become Candidates, should apply for the programme without delay.

The following Scholarships are offered by Her Majesty's Commissioners for the Exhibition of 1851:—

To the three persons who shall most distinguish themselves in the Examinations of the present year, in the subjects of Steel, Silk, and Carriages respectively, Fifty Pounds each, upon the conditions stated in General Scott's letter, given below.

The following Prizes are offered by the Society of Arts in each of the five subjects mentioned above:—

To the best candidate in Honours, £10.

To the best candidate in the Advanced Grade, £7.

To the best candidate in the Elementary Grade, £5.

The following special additional Prizes are offered:—

By Wyndham S. Portal, Esq., to the Second and Third best Candidates in the Elementary Grade, Paper Manufacture:—

A Prize of	£3
A Prize of	2

By G. N. Hooper, Esq., to the Second and Third best Candidates in the Elementary Grade, Carriage Building:—

A Prize of	£3
A Prize of	2

By the Worshipful Company of Spectacle Makers, to the Second-best Candidate in Honours, in the Advanced Grade and in the Elementary Grade respectively, in the Manufacture of Steel:—

A Prize of	£5	5
A Prize of	3	3
A Prize of	2	2

The Council beg to announce the following contributions to the Prize Fund:—

The Worshipful Company of Fishmongers	£52	10	0
The Worshipful Company of Mercers	26	5	0
The Worshipful Company of Drapers	21	0	0
The Worshipful Company of Vintners	10	10	0
The Worshipful Company of Salters (annual)	10	10	0
The Worshipful Company of Clothworkers	10	10	0
The Worshipful Company of Coach and Coach Harness Makers	10	10	0
Dr. Crace Calvert, F.R.S. (annual)	5	5	0
Sir Daniel Cooper, Bart.	5	0	0
R. L. Chance, Esq.	5	5	0
Robert Nicol, Esq.	1	1	0

The following letter has been addressed to Major Donnelly, a member of the Council, by Her Majesty's Commissioners for the Exhibition of 1851:—

Upper Kensington-gore, London, W.,
10th April, 1873.

Sir,—I am directed by the Committee of Management of her Majesty's Commissioners for the Exhibition of 1851 to inform you that, with the view of encouraging persons to present themselves for the examinations in Technology, which have recently been established by the Society of Arts, they have resolved to recommend the Commissioners to offer to grant three studentships, of fifty pounds each, to be awarded to the persons who shall distinguish themselves the most in the subjects of Steel, Silk, and Carriages respectively at the examinations in the present year. These scholarships are to be awarded on condition that the recipients go for a year to some place of scientific instruction, such as the Royal School of Mines, the Royal College of Science in Dublin, Owens College, Manchester, or the English, Scotch, or Irish Universities, or other school approved by her Majesty's Commissioners, or travel abroad for the purpose of improving themselves in their trades.

If the persons who shall distinguish themselves the most in the several subjects shall decline to accept the scholarships on the foregoing conditions, then the Commissioners wish that the scholarships should be offered in succession to the candidates next in order, provided that they have shown sufficient merit to entitle themselves to such an award.

I have the honour to be, Sir,
Your obedient servant,
Henry Y. D. Scott,
Major-General, Secretary.

Major Donnelly, R.E., South Kensington Museum.

PROCEEDINGS OF THE SOCIETY.

DEPUTATION TO THE DUKE OF ARGYLL.

The Society's Deputation to the Secretary of State for India on the subject of facilitating our Communication through India with Central Asia, was received by the Duke of Argyll, who was attended by Sir Louis Mallet, C.B., Member of the Council of India, at one o'clock on Friday last, at the Indian Office. The Deputation consisted of Major-General Eardley-Wilmot, R.A., F.R.S., Chairman of the Council; Colonel Bourne, M.P.; Dr. Boycott; Andrew Cassels, Esq.; Dr. A. Campbell; J. Cheetham, Esq.; General Clarke; Hon. Wilbraham Egerton, M.P.; the Hon. D. E. Fortescue, M.P.; W. S. Fitzwilliam, Esq.; Colonel W. Gray, M.P.; Dr. Hooker, C.B., F.R.S.; B. H. Hodgson, Esq.; E. Levita, Esq.; Edwin Lawrence, Esq.; W. Maitland, Esq.; Vice-Admiral Erasmus Ommanney, C.B., F.R.S.; John Parsons, Esq.; Robert Rawlinson, Esq., C.B.; General Vaughan, C.B.; James Whatman, Esq., M.P.; with P. Le Neve Foster, Esq., Secretary of the Society; and Colonel E. A. Hardy, Secretary to the India Committee. Mr. Hyde Clarke, Chairman of the India Committee, was prevented from attending by another engagement.

General Eardley-Wilmot presented the memorial and introduced the deputation.

Mr. Cassels said that many circumstances had combined of late to attract attention to countries in Central Asia which hitherto had been little known, and it seemed to the Society of Arts that a favourable opportunity now presented itself for extending the trade of India and of England in that direction. Under his Grace's administration India had enjoyed peace and prosperity, and that distrust of the policy of our Government which at one time existed in the minds of the people of neighbouring native States had given place to a very different feeling. The friendship of England was therefore courted, and a more favourable opportunity for entering into desirable commercial relations with Eastern Turkistan could not be hoped for. Eastern Turkistan was stated, by recent travellers, to be a rich and fertile country, inhabited by an industrious race. It possessed gold mines which had been worked from very remote times, and produced silk of good quality, and wool of the finest description. It might also become an excellent market for our manufactures. Our railways already took us within 400 miles of Yarkand. The Society of Arts therefore asked his Grace to give his consideration to a subject so fraught with importance to the trading community. It was a mistake to suppose, as had been said at a recent meeting, that English merchants might not be enterprising enough to avail themselves of the chance of finding new markets in Central Asia. English merchants would go wherever there was an opening, but they must know beforehand what treatment they might expect to receive. This opening would be a very important one, for Eastern Turkistan might be called a commercial thoroughfare between the central countries of Eastern and Western Asia, and through that country it might be practicable to extend our trade into the western provinces of the Chinese Empire.

Mr. Brian Hodgson had long resided at Katmandoo, the capital of Nepaul, and though it was now more than thirty years ago, still there was no change whatever as to the policy of that state in their absolute exclusion of British subjects from their territory. They were perfectly free to pass into part of our dominions, but their frontier was absolutely sealed against us. As the objection on the part of the Chinese Government had been held up as a justification of this exclusion, and as he believed this to be a mere pretext, he thought it important that we should, at any rate, enlist the Chinese Government on our side, as, there was little doubt, could easily be done. There was an interesting and remarkable piece of information in the last "Edinburgh Review," which possibly his Grace might have seen, that a Russian exploring party had left Pekin early in 1872, with passports and recommendatory letters from the Chinese Government, for the purpose of travelling through Mangolia to Thibet, and thence across the Himalayas into British India.

Dr. Hooker was able to vouch for the readiness of the people, when he was in those parts, to buy tea, and he knew well how very much more our Indian tea trade would have been developed, to the great benefit of all parties, had it only been able to pass our frontier in that direction.

Dr. Campbell, as a long resident in Nepaul and at Darjeeling, could testify to the truth and urgency of the suggestions submitted for endeavouring to break through the policy of exclusion from Nepaul, and for making a railway to Darjeeling. We had done everything for Nepaul; the little that state had done for us at the time of the mutiny had been amply and handsomely rewarded by the grant of a large strip of territory, but still we were rigidly excluded from entering or traversing their dominion at any point. There existed fine tracts, suitable for tea plantations, and desirable spots for sanitaria, but the intervening line of the Nepaul frontier absolutely barred access thereto.

General Clarke entirely confirmed Dr. Campbell's statements, and ventured to hope that the present state of things would not be permitted to continue.

Mr. Maitland was chiefly interested in the finding a market for our tea, a matter of great and increasing importance to India. It appeared certain that our trade could and would be largely and beneficially developed by the adoption of some such measures as were suggested in the memorial which had been submitted to his Grace.

After a further brief conversation—

The Duke of Argyll said it appeared that the chief points to which the Society wished more particularly to direct his notice were the establishing commercial intercourse on the footing of the most favoured nation and people, with Eastern Turkistan, through its present ruler, the Atalik Ghazee, and the facilitating our means and right of passage through Nepaul and Thibet. As regards the first point, he was happy to say that he had received from Lord Northbrook a very satisfactory account of his reception of an embassy from the Atalik Ghazee, and of his intention to organise immediately a return mission to Turkistan. The mission would report on the best routes, and collect all necessary information on the subject; and this report on their return would, he hoped and believed, be followed by important and beneficial results. Apprehensions had been entertained as to the personal safety of the officers composing the mission, but Lord Northbrook had been satisfied by the embassy on this point; and it seemed the Atalik Ghazee had established his power so securely as to be able to ensure as much safety to travellers in his country as in our Indian territories. He thought, therefore, that on this point the deputation could hardly desire or expect anything more at present. As regarded the opening of communications through Nepaul, he could not give any satisfactory information, as he was not aware of any change as to our exclusion from the Nepaul territory, which, considering our long intimate relations, and all we had done for that State, he must say, he agreed in thinking, was a footing we could certainly not remain satisfied with. He would say he agreed, too, with the opinions in favour of the railway to Darjeeling, which, as Dr. Campbell, he believed, well knew, had not now for the first time been pressed on his notice. By the last official reports the Indian Government had approved of it, and it was likely soon to be taken in hand. He knew Lord Northbrook attached their full importance to both these questions, and had them under his immediate consideration; and for his own part, he could say that he would not fail to keep them in view.

General Eardley-Wilmot, on behalf of the deputation, thanked his Grace for the kind attention with which he had received the statements in support of the memorial, and the deputation withdrew.

Subjoined is the memorial and a portion of the supplementary papers which were laid before his Grace—

TO HIS GRACE THE DUKE OF ARGYLL, K.T., SECRETARY OF STATE FOR INDIA IN COUNCIL.

The Memorial of the Society for the Encouragement of Arts, Manufactures, and Commerce.

SHEWETH,—That the Council of this Society have, on several occasions, had under public discussion the expediency of extending the trade with Central Asia from the North-West Provinces of India to Turkistan, and from the Eastern Provinces of Bengal *viâ* Nepaul and Thibet. They beg to call the attention of your Grace to the following points, the present time appearing to be peculiarly favourable for taking action in connection therewith:—

1. The importance of procuring increased facilities for trade between India and Yarkund by the improvement of roads, bridges, and shelter places.
2. The importance of obtaining a commercial treaty, on the footing of the most favoured nation and people, with the present ruler of Kashgar, Atalik Ghazee Yakoob Beg.
3. That as an alternative to the at present difficult Ladak route, consideration be given to the route by the Chitral Valley, in the hope that the efforts of the Indian Government may secure it as a commercial route in safety and under protection.
4. That it is essential the Indian Government shall use every effort to obtain from Nepaul, free passage for merchants and goods to the Thibetan frontier, in return for the full and free access enjoyed by Nepaul to our territories.
5. That it is desirable to obtain better access on the Sikkim side to Thibet, where obstructions are raised on the plea that the Chinese authorities object to the trade.
6. That with the view to promote the traffic by the Sikkim route, the completion of the Calcutta and Darjeeling Railway, so long approved by the Government, should be carried into effect without delay.
7. That efforts be made to obtain the removal of all obstructions to trade with Thibet through Bootan from Eastern Bengal and Assam.
8. That a mart be established on the Sikkim frontier, after the example of Kiachta on the Russo-Chinese frontier.
9. That an application should be made by her Majesty's Envoy at Pekin to the Chinese Government, to remove all obstructions, and to grant full permission to trade along the frontier of Thibet.
10. That consular agencies be established with the Chinese authorities at Lhassa the capital of Thibet, and Digarchi, the next principal city, and generally wherever such agencies can be advantageously employed for the promotion of commerce.
11. Your memorialists therefore pray that your Grace will take the foregoing statements into your consideration, and be pleased to adopt such means as to your Grace may seem fit for attining the objects aforesaid.

And your memorialists will ever pray, &c.

Sealed with the seal of the said Society, this 24th day of April, 1873, in the presence of (L.S)

P. LE NEVE FOSTER, Secretary.

A.—MEMORANDUM OF MEASURES SUGGESTED FOR FACILITATING OUR TRADE WITH CENTRAL ASIA. BY B. H. HODGSON, ESQ., RESIDENT AT KATHMANDOO FROM 1831 TO 1843.

1. That the Secretary of State for India move her Majesty's Ministers to instruct the British Ambassador at Pekin to the effect that we have 1,500 miles of common frontier with the Empire of China along the Himalayas; that we desire to cultivate a friendly and commercial intercourse with Thibet along that line; that the interdict of the Emperor is pleaded by the little States on this side the Himalayas and by the Thibetan authorities in bar of such intercourse; that the Emperor be solicited to put an end to that plea, and to permit a free and unobstructed intercourse with Thibet through native agency, if European agency be objected to; that such an intercourse has long existed through Nepaul by means of Nepaulese and Cashmeery agency; and that we desire our subjects to participate in that trade without obstruction from the government of Nepaul, such as is now made more or less overtly under cover of the Emperor's disapproval; that what is urged against it in the address of the Lhassa authorities to the Emperor in the year 1868, is unfounded in reference to the religious scruples of the Lamas, who seem not to be aware that the British Government is distinguished for its protection of the works and monuments of that creed; and that the hostility alleged by the Lamas is the result of the monopoly they have got into their hands in conjunction with the Chinese at Lhassa, to the detriment of the people of Thibet, and to the discredit of the Emperor of China.

2. That the Secretary of State for India be solicited to request the Governor-General of India to call for all the records relative to the trade with Thibet, and to instruct his local functionaries adjacent to Thibet to report on those records, with reference to the present state of things in Nepaul, Sikkim, and Bhutan. That the Governor-General be further requested to instruct his Resident at Kathmandoo to point out to the government of Nepaul his wish and expectation that that government should meet in a friendly spirit his desire to promote an active trade with Thibet, such as all the circumstances of the present time seem to predicate the success of, in such manner as shall seem best to the Durbar and to the Resident, after friendly discussion of the matter; pointed reference being made by the Resident to the extent of the trade before the Goorka conquest.

3. That the Governor-General be also requested to call for the opinion of the Superintendent of Darjeeling, as to the advisableness of establishing a trading mart on the Thibet frontier, and with reference to the apparently assured success of such a mart, to expedite the contemplated railway and road; and that the carrying out of such frontier mart and such improved means of utilising it, should have the Governor-General's best support in co-operation with the merchants of Calcutta, in the manner and to the degree that may seem fit, facilitating to merchants, European or native, the first step of the undertaking, and this, as well directly in relation to Sikkim, as indirectly in relation to Nepaul, through the Resident there.

4. That the Secretary of State for India be pleased to suggest to the Governor-General of India the feasibility and propriety of opening a direct communication with the Dulai, or Teshoo Lama, or both; it being doubtful whether the real sentiments of the people ever have been, or now can be, truthfully known through Chinese or Nepaulese channels.

B.—MEMORANDUM, BY ROBERT B. SHAW, ESQ.

1. There is an immense population in the north of the Himalayas, whose requirements are precisely those which we can supply—piece goods of all kinds, chiefly cotton, but also woollen and mixed fabrics, and tea, which is a necessary of life with them, from our Indian plantations.

2. That Russia has already secured access for her subjects by a commercial treaty; although Russian fabrics will be burdened by 20 per cent. higher cost of transport than would English goods.

3. That a series of measures, resulting in the abolition of all transit duty by the Maharajah of Cashmere, in return for the remission by the government of India of Customs duties on all goods passing through India to Cashmere, and other advantages, the expenditure of considerable sums on the improvement of the roads through the British hill districts, and on bridging the rivers on the Ladak route, valuable and excellent measures will and must fail of the full effect for which they were

inaugurated—the opening to British trade of the market of Eastern Turkistan.

4. That the present moment is exceedingly favourable for the accomplishment of this purpose, the isolating Chinese dominion having come to an end in that region, and a strong and friendly kingdom being now established under the rule of the Atalik Ghazee Yakoob Beg, who has been recognised by the neighbouring Powers, and who is very favourable to commerce and industry, especially to trade with British India.

5. That a trade so mutually beneficial, and so politically advantageous, cannot be embarked upon with Central Asia without some security for immunity from vexatious interferences, for protection from excluding differential duties, and for fair-play.

6. That efforts should therefore be made as soon as possible, to secure for our industry this valuable market, by entering into arrangements with the Atalik Ghazee, whereby proper securities and facilities for British trade in his dominions may be obtained, provision for the due consideration of complaints and grievances be secured, and an engagement entered into that no duties beyond those imposed on the most favoured nation or creed be levied on British goods.

C.—Memorandum, by Colonel Gawler, Keeper of the Regalia, lately Commanding Sikkim Field Force; and by Dr. Archibald Campbell, late Superintendent of Darjeeling.

The State of Sikkim affords special facilities for opening commercial relations with Thibet, Central Asia, and Western China.

1. Because there has always existed among one section of the people a very friendly disposition towards the British Government; and among the remainder, or ruling portion, there exists towards us a real respect of a very wholesome nature, owing to the success of the expedition of 1861, and to the exemplary behaviour of the troops (as testified by the British Envoy), which left on their minds no feelings of apprehension, irritation, or resentment.

2. Because it is the shortest and most direct route to Lhassa from British territory, and there is already a road from Darjeeling to the Thibet frontier, practicable for pack animals, and a pass (the Chola) 14,900 feet high, open nearly all the year round, and free from snow for six months in the year; and by a branch extension of the East Indian Railway to the foot of the Darjeeling hills, the transport of English and Indian goods intended for Thibet, as well as our Darjeeling tea trade would be greatly facilitated.

3. Because the treaty of 1861 between the British Government and Sikkim establishes free trade between the subjects of the two Governments, free permission for the British Government to survey the country, and to make or improve roads in it, which the Sikkim Government are to keep in order if made.

4. Because of the intimate connections between Sikkim and Thibet, as follow:—

The head of the Sikkim religion (Budhism) is in Thibet; the Sikkim Rajah's mother is a Thibetean; many of the Sikkim officials are Thibeteans; the Sikkim Rajah receives a salary from Thibet; and, together with the Sikkim officials, spends most of his time in Thibet, at Choombi.

5. On account of the close proximity to the Sikkim frontier (about three hours) of the Thibetean town of Choombi, which is a large market town, with bazaars, and whence there is a good road to Lhassa.

With the advantages, physical and political, above enumerated, it is apprehended that there could be no great difficulty in establishing a consular agency at Choombi, to begin with, and eventually in sending an envoy to Lhassa, so soon as our treaty with China has been patiently and thoroughly made known and discussed, and when the people of Thibet have become better acquainted with us.

EXTRAORDINARY MEETING.

On Tuesday, April 29th, 1873, an extraordinary meeting of the Society was held. Sir Rowland Blennerhassett, M.P., in the chair.

The Paper read was:—

ON THE BRITISH SETTLEMENTS IN WESTERN AFRICA.

By His Excellency Governor Pope Hennessy, C.M.G.

The British Settlements in Western Africa are well deserving of public attention. Of her Majesty's tropical possessions they are the nearest to Europe. Of the gold-producing countries of the world they are also nearest to Europe. They afford remarkable facilities for the collection and speedy transit to England of raw materials essential to our manufactures, but which cannot be produced in this temperate climate.

Their total commercial movement is rapidly increasing. It now exceeds, in annual value, £2,500,000; that is, it is greater than the aggregate commercial movement of such flourishing colonies as Tasmania (£1,518,725), and Western Australia (£397,299), together with half-a-dozen of the smaller West Indian Islands. Furthermore, the West African settlements bring us into direct contact with one of the most numerous and interesting divisions of mankind, a race as capable of development, and with as great a future before it, as any race upon the face of the globe. And yet, with all this, there is no part of the Queen's Colonial Empire of which so little is known in England.

In their origin, and in some of the objects for which they have been maintained, they differ from all other British colonies. They were originally established to promote the slave trade. As the chief material means by which the negroes were captured and shipped across the Atlantic, they were certainly successful. When Parliament resolved to stop this, the settlements were still maintained to check and destroy the traffic in slaves. Some months ago I had the satisfaction of reporting to her Majesty's Government that the oceanic slave trade from West Africa was completely at an end. Thus these settlements have been alike successful in carrying out two different, and, indeed, contradictory objects.

Now that the oceanic slave trade from West Africa is gone, the British settlements are kept up avowedly for two reasons—to promote our commerce with Africa, and to assist in civilising the Africans.

A glance at the map of Africa, and a reference to the succinct and accurate geographical description of the four settlements which appears in Mr. William Robinson's Colonial Office List, will show how well situated they are for commercial purposes.

Sierra Leone is the most important of the British possessions on the West Coast of Africa. The colony consists of a peninsula terminating in Cape Sierra Leone, which is bounded on the north by a river of the same name. The Cape lies in 8° 30' N. lat., 13° 18' W. long. This colony is 18 miles in length by 12 in breadth, with an area of 300 square miles. Sierra Leone was ceded to Great Britain in 1787, by the native chiefs. Four years afterwards a charter was granted to a company, under the name of "The Sierra Leone Company." In 1800 a grant was made to the company, by letters patent, of the peninsula, and a court of directors of the company was empowered to appoint a governor and council, the former having power to enact laws; this state of things lasted seven years, when the colony was transferred back to the Crown.

In 1862 a country to the south, called Sherboro, was handed over by treaty to the colony.

The Isles de Los, which lie about 70 miles to the north of Sierra Leone, are also included in the Settlement. The Quia country, a considerable tract on the mainland, which was taken in 1861, has recently been ceded to the natives.

About 500 miles to the north of Sierra Leone, the River Gambia falls into the Atlantic Ocean by a large estuary, which measures in some parts nearly 27 miles across, but contracts to 10 miles between Bird Island and Cape St. Mary, and to little more than two between Barra Point and the town of Bathurst, on St. Mary's Island. The advantage of this large river for carrying on trade with the natives in the interior of Africa was well known to our merchants upwards of 230 years ago.

In 1588 a patent was granted by Queen Elizabeth to some merchants of Exeter to trade in this river, and in 1618 a company was formed in this country for the purpose of carrying on the trade; the company was not successful, and another, established two years later, experienced a like want of success.

In 1724, and subsequently till its abolition, it appears that the trade in slaves formed the staple traffic of the company; but the general commerce between Great Britain and the Gambia fell off after the abolition of the slave trade till 1816, in which year a new settlement was formed at the Island of St. Mary's. Mac Carthy's Island, about 150 miles up the river, has also been occupied as British territory. Near the mouth of the river a strip of land, one mile in width, called the Ceded Mile, and part of the district of Combo, adjoining Cape St. Mary, are also included in the settlement of the Gambia.

Where the coast of Africa to the south of Sierra Leone runs towards the east, it is usually divided into the Grain Coast, the Ivory Coast, and the Gold Coast. The latter is a name generally given to a portion of Upper Guinea, between 3° 30 W. long. and 1° E. long., stretching along the Gulf of Guinea from the River Assini, on the west to the River Volta on the east, between which points are the settlements of Apollonia, Axim, Dix Cove, Secondee, Chuma, Elmina, Cape Coast Castle, Anamaboe, Salt Pond, Apam, Accra, Christiansborg, Fredericksborg, Winnebah, Pram Pram, and Addah. In 1750, the African Company was instituted by Act of Parliament, with liberty to trade and to form establishments on the West Coast of Africa, between 20° N. and 20° S. lat. From the year 1750 to 1807 the parliamentary grant for the forts and settlements on this coast averaged £13,500 per annum, and was augmented in 1807 to £23,000 per annum. In 1821 the forts and settlements which had previously vested in the African Company were transferred to the Crown; and on the recommendation of Sir Charles McCarthy, at that time the Governor of Sierra Leone, four forts only were retained—viz., Cape Coast Castle, Anamaboe, Dix Cove, and Accra. In 1827, in consequence of the heavy expenses incurred by the Government in the Ashantee war, which broke out in 1824, and the decline of commerce, the public establishments were withdrawn from the coast. For several years the government was intrusted to Mr. Maclean and a committee of merchants. Mr. Maclean's conciliatory policy towards the natives, his recognition of native customs, and his scrupulous adherence to his engagements with the native chiefs, enabled him to avoid for fifteen years the petty wars that have since become so frequent. Owing to the recommendation of a committee of the House of Commons in 1842, the peaceful and prosperous administration of Mr. Maclean and the native chiefs was abandoned, and the Gold Coast was again placed under the direct control of the home government as a dependency of Sierra Leone. In 1850 it was made a separate government, but in 1866 was again placed under Sierra Leone.

Some years ago its territory was defined by a convention with the Dutch Government, which came into effect on the 1st January, 1868. By this arrangement the British Government received in exchange for Dix Cove, Apollonia, Secondee, and Commendah (which became Netherlands property or dependencies), Dutch Accra, Ber-raco, Apam, Cormantyne, and Moree. Her Majesty's government also relinquished to the Dutch the protectorate over Eastern and Western Wassaw, Apollonia, and Denkera, in the interior. A line drawn due north from the mouth of the Sweet River to the Ashantee frontier, with slight deviations, was the boundary line. A diminution in the population under British protection and its area followed. Probably 200,000 souls were then within the protected territory, and an average area of 4,500 square miles.

The interchange of territory in 1868 was not effected without some bloodshed, and, owing to this, it did not work well. The Dutch Government at length agreed to transfer to the British Crown the whole of their possessions on the coast of Guinea. By the Royal convention, signed at the Hague, in February, 1872, Her Majesty's Gold Coast Colony has been doubled in extent and population. The new territory, extending from the Sweet River to the west of Apollonia, includes the best landing-places and the richest gold districts in Guinea. It also contains the finest forts and castles. The castle of St. George d'Elmina was built by the first Portuguese governor, Diego D'Azambya, in the fifteenth century. It was captured by the Dutch, in 1637. Though it is a very recent addition to Her Majesty's colonial empire, yet, as it has been constantly occupied by Europeans since 1481, Elmina can now claim to be the oldest colony (excluding those in the Mediterranean) under the British Crown. During the 235 years of Dutch rule there were 104 Governors. The famous Admiral De Ruyter won several battles on this coast, and the actual transfer was effected when Governor Ferguson, the last representative of the King of Holland at Elmina, handed to me, on the 6th April, 1872, in the presence of the native chiefs and people, the ancient gold and ivory baton of De Ruyter, which was supposed to be the symbol of Dutch sovereignty in Guinea.

The native tribes, for three hundred miles along the coast, and from sixty to eighty miles inland, live in what is called the British Protectorate. The Ashantees occupy their northern frontier, and the kingdom of Dahomey their eastern frontier.

The actual British territory consists only of the forts we hold upon the coast. The Gold Coast Protectorate is an anomalous and somewhat unfortunate jurisdiction, the history of which was laid before Parliament, in 1865, by Governor Sir Henry Ord.

At the beginning of the last century the Ashantees, coming from the interior, attacked and subdued some of the more powerful of the tribes who now form the northern part of the Protectorate. Moving steadily onwards, about 1760 they had extended their conquests so far south as to excite some apprehension in the minds of the European settlers on the coast, and in 1800 had forcibly subdued the whole country, from the sea-board of the Assinee river, in the west, to the mouth of the Volta in the east, excepting only a small crescent, embracing the Fantees and a few other small tribes situated immediately in rear of the settlements.

In 1807 the Ashantees were masters of the whole country, and had even attacked and taken one of the European settlements. With the British they came once into collision, but were repulsed, and their further aggressions were averted by an engagement on the part of the authorities not to assist the Fantees. During the next few years, so bitter was the yoke imposed on the conquered nations, that several of them combined and revolted against it, but without success. The Ashantees not only maintained their hold over the country, but even threatened Cape Coast, the safety of which was only purchased by very sweeping concessions. This state of things lasted until 1817, when it was thought by the authorities at Cape Coast advisable to attempt to negotiate with the Ashantees, with the view of establishing peace on a secure footing, and promoting the prosecution of lawful trade.

The result of this mission was the conclusion of a treaty, by which the Fantees, who were now reduced to the position of tributaries of Ashantee, were placed under a sort of protectorate of the British, it being stipulated that the king should not engage in hostilities against them, even in case of their aggression, without previous reference to the Governor of Cape Coast. This treaty did not produce the benefit which had been anticipated. The slave trade progressed, to the injury of legitimate commerce, and induced a general lawlessness and a disregard of life and property throughout the country.

A fresh treaty was concluded with the Ashantees in 1819, which was disavowed by the local authorities; and in 1822 the imperial government, having once more assumed the control of the forts and settlements, placed them under the jurisdiction of Sierra Leone, and sent out Sir Charles MacCarthy as Governor-in-chief.

Mr. Brodie Cruickshank, who was for a long time a member of the Governor's Council at Cape Coast Castle, gives a minute account, in his "Eighteen Years on the Gold Coast," of our long and unsatisfactory negotiations with the Ashantees, which preceded the arrival of Sir Charles MacCarthy. He says:—

> "The perusal of these unvarnished details fills the mind with a feeling of great disappointment at the unworthy part which we appear to have acted throughout these events. The whole conduct of the King of Ashantee evinces a calm and temperate assertion of his just demands * * * more than all, his sacred regard for his engagements—which would not allow him to follow the natural impulse of his mind while he kept possession of the treaty—is a proof of an open, direct course of dealing, which forms a lofty contrast to the evasive conduct of the governor and people." Mr. Cruickshank asserts that we deliberately broke our treaty engagements, and, he adds, "It is humiliating to be compelled to make this admission, and to confess that a king of Ashantee had greater regard for his written engagements than an English governor."

Sir Charles MacCarthy, on his arrival, found our relations with the Ashantees in so unsatisfactory a state that he appears to have felt that it was necessary to declare war. The King of Ashantee made overtures of peace, through the Dutch Governor of Elmina, but they were rejected. Sir Charles MacCarthy avowed his intention of crushing the Ashantee power. He advanced with his troops and native allies towards the frontier, but was defeated and slain in the important battle of Essamacow, January, 1824. Cape Coast was then invested, and, but for a panic amongst the invaders, might have been captured. Late in the year, the whole power of the settlement, with aid from home, being brought to bear upon them, the Ashantees retired to their own country.

A general spirit of resistance to the Ashantees now spread in every tribe, from the Assinee to the Volta, but several years elapsed before the efforts of the British authorities succeeded in placing matters on a satisfactory footing. In 1831, however, says Sir Henry Ord:—

> "The exertions of the able, energetic, and resolute Mr. Maclean, then governor of the settlements, were rewarded with success. Convinced of the hopelessness of expecting that peace could be maintained so long as the Fantees and other tribes remained subject to the exactions and oppressions of their former rulers, and yet foreseeing at the same time the dangers which must result if so large a body of natives, composed of different tribes and having different interests and views, were left to carry on their affairs without the control or guidance of any superior power; believing, moreover, that the influence of such a superior and civilised power would help to work valuable reforms among the most turbulent and lawless of them, he conceived the idea of compelling from the King of Ashantee an acknowledgment of their independence, and by the influence over them which interference on their behalf had obtained for us, of inducing them to band themselves together under our guidance and control for protection against the common enemy. These important objects were at length secured by the signing of a treaty, on the 27th of April, 1831, between the Governor, the Ashantees, and the Fantee and other tribes, then in alliance with us; and during the next twelve years the results of this arrangement, under the administration of Governor Maclean, are detailed in the report of the Parliamentary Committee of 1842. There was exercised a very wholesome influence over a coast not much less than 150 miles in extent, and to a considerable distance inland, preventing within that range external slave trade, maintaining peace and security, and exercising a useful though irregular jurisdiction among the neighbouring tribes, and much mitigating and in some cases extinguishing some of the most atrocious practices which had prevailed among them unchecked before."

The inhabitants of the Protectorate are not British subjects. They are not called upon to take the oath of allegiance. In dealing with them the chief magistrate of the Gold Coast sits as Judicial

Assessor, an appointment which sprang out of an Act of Parliament of 1843, allowing the Crown the power of conferring foreign jurisdiction. He administers the law according to the native customs.

The circumstances under which we are bound to assist the natives in the Protectorate are not clearly defined. In fact, the obligations of the Protectorate are ill understood by both sides. Of late years one important body of natives, the Fantees, have formed a confederation, and have asked the British authorities either to govern the country like any other colony, or to give them a share in the administration of their own affairs. This reasonable alternative is under the consideration of Her Majesty's Government.

In 1861, Lagos, which lies still further to the east, in the Bight of Benin, was ceded to the British Government by King Docemo. The treaty of cession guarantees to him a pension of £1,000 a year, the right of deciding disputes between natives of Lagos with their consent, subject to appeal to British law, and the right of using the title of King, in its African signification. The settlement consists of the island of Lagos, with the towns of Badagry, Palma, and Leckie. As to the land interposed between the lagoon and the sea-beach, Sir Henry Ord reported, in 1865, that, to avoid any complicatious arising from the presence of domestic slavery, it had not been thought advisable to recognise it as British territory. Mr. Cardwell gave instructions to this effect in 1866, conceiving very properly, that for commercial purposes no further extension of territory was necessary, and that, indeed, any addition to the settlement would probably involve the local government in trouble. It is, therefore, evident that from the River Gambia to the Bight of Benin the British settlements practically command the commerce of one of the most productive regions of Africa. Whilst Lagos shares to some extent in the traffic of the mouth and the lower waters of the Niger, that great river can be traced northward and westward to its source in the hills of Futa, which are almost in sight of the colony of Sierra Leone. From the vast and fertile districts inclosed between the Niger and the sea, we get gold, ivory, cotton, palm oil, palm kernels, ground nuts, beni seed, Shea butter, pepper, ginger, gum.

For many of the specimens of these articles which are on the table I am indebted to Messrs. Banner Brothers. Their long-established and enterprising firm has done incalculable benefit to the trade of Lagos by the successful efforts they have made from time to time to develop the resources of the interior. On the Gold Coast Mr. Swanzy's House has also been indefatigable in introducing coffee and cotton, and stimulating the industry of the natives. I may here mention that Sir Arthur Kennedy's admirable plan of sending friendly missions to the interior was actively cooperated in by Mr. Swanzy, who at his own cost despatched Mr. Winwood Reade to Falaba—a mission which proved to be alike interesting to geographers and of practical utility to the trade of Sierra Leone.

I have made a summary of the trade returns of 1871, the last year for which they have been completed. It shows at a glance the value of the commerce of the British Settlements.

	Imports.	Exports.	Vessels Entered.	Vessels Cleared.	Tonnage Entered.	Tonnage Cleared.
	£	£				
Sierra Leone	305,849	467,755	411	409	110,646	110,919
Gold Coast	250,671	295,207	343	315	131,553	119,494
Gambia	102,064	153,100	229	211	51,853	47,997
Lagos	391,653	589,802	278	275	125,776	125,168
Totals	1,050,237	1,505,864	1,271	1,210	419,828	403,568

RECAPITULATION.

Imports	£1,050,237
Exports	1,505,864

Total commercial movement £2,556,101

Thus, over 1,200 vessels cleared and entered with cargoes exceeding two millions and a half in value.

These are the actual results of the year 1871. Since then two changes have been made, the effects of which are becoming already manifest—namely, the addition of the Dutch possessions in Guinea to the British Settlements, and the general revision of the tariffs, with a view of encouraging trade and shipping. Owing to these changes, I believe that the exports from her Majesty's West African Settlements will exceed £2,000,000 in 1873, and that the imports will reach £1,500,000, which would give a total commercial movement of £3,500,000.

The growth of the trade is seen by looking at the preceding table; for instance, in 1861 the total value of imports and exports was 1,258,280, just half what it became ten years later—that is, £2,556,101 in 1871.

We hear a good deal of the rapid improvement in Jamaica, yet there the total imports and exports in 1861 amounted to £2,304,096, and in the subsequent ten years they had only increased to £2,527,716.

To put it in another form—whilst the total commercial movements of Jamaica were, ten years ago, double that of the West African settlements, and they have both gone on increasing since then, the commerce of the latter has grown so rapidly that it now exceeds the commerce of Jamaica. At this rate, many years will not pass before it outstrips the commerce of the Mauritius, the Cape of Good Hope, and Ceylon. But between the commerce of West Africa and that of such colonies there is an important distinction. Jamaica and the other settlements I have mentioned are *producing* colonies, whereas the settlements on the West Coast of Africa are merely our *entrepots* of trade with the interior. They collect commerce, but produce nothing themselves; they hold, with respect to Africa, the same relation that the early settlements of the East India Company at Calcutta and Madras held, many years ago, to the then but little known interior of Hindostan.

Can we push the comparison further? Can we hope to see an African empire as rich and prosperous, and contributing as largely to the commercial wealth of England, as Her Majesty's empire in the East? From what I have seen of the negro race, I believe such a result is possible; but to accomplish it, great changes must be made in our system of dealing with the native chiefs and people.

It will be remembered that our settlements are but a little fringe on the great continent of Africa. The condition of the settlements themselves, with respect to Government legislation, fiscal arrangements, revenue, and education, must, however, be understood before considering the greater question of our influence in the interior.

The following tables exhibit the value of the imports and exports for the last fifteen years:—

VALUE OF IMPORTS AND EXPORTS.—SIERRA LEONE.

——	Imports.	Exports.
	£	£
1856	152,907	180,385
1857	172,315	288,728
1858	139,805	225,349
1860	172,726	304,394
1862	144,269	268,814
1863	209,106	295,853
1864	190,441	201.808
1865	368,545	237,240
1866	373.269	259,719
1867	284.766	296,718
1858	295.826	296,466
1869	289,779	404,862
1870	280,864	392,191
1871	305,849	467,755

VALUE OF IMPORTS AND EXPORTS.—GOLD COAST.

——	Imports.	Exports.
	£	£
1856	105,364	120,999
1857	118,270	124,394
1858	122.457	154,136
1860	112,454	110,457
1861	162.970	145,819
1862	145,100	102,086
1863	76,955	53,764
*1864	..	..
*1865	..	..
*1866	..	..
1867	206,920	160,291
1868	..	..
1869	213,491	281,913
1870	253,397	378.239
1871	250,671	205,207

* No returns completed.

VALUE OF IMPORTS AND EXPORTS.—GAMBIA.

——	Imports.	Exports.
	£	£
1856	108,852	176,577
1857	118,620	201,628
1858	118,693	227.460
1860	73,138	109,137
1861	109,581	136,837
1862	99,825	154,443
1863	172,965	141,673
1864	135,777	148,157
1865	128.808	138,693
1866	108,298	158,368
1867	193,420	214,389
1868	144,524	187,357
1869	94,027	109,312
1870	91,996	142,517
1871	102,064	153,100

VALUE OF IMPORTS AND EXPORTS.—LAGOS.

——	Imports.	Exports.
	£	£
1862 (half)....	77,933	61,932
1863	171,138	158.341
1864	120,796	166,903
1865	114,284	175.636
1866	220,766	262.699
1867	321,997	513,157
1868	340,815	517.253
1869	416,895	669,598
1870	400,558	515.365
1871	391,653	589,802

The Government of Sierra Leone consisted, until May, 1863, of a Governor and a Legislative Council, comprising the Bishop of Sierra Leone, the Chief Justice, the Colonial Secretary, the Collector of Customs, and one or two others appointed by the Crown.

By a new charter, issued at that date, an Executive Council was created, composed of four members nominated by the Crown; and the Legislative Council was made to consist of the members of the Executive Council, and such other person or persons as may be nominated by Royal Warrant.

In 1865, it was decided, on the recommendation of Sir Charles Adderley's Committee, that the Central Governments on the West Coast of Africa should be re-established in Sierra Leone. Gambia, the Gold Coast, and Lagos were accordingly placed under one general government.

The commission and instructions under which this change was effected were dated in February, 1866. They revoked and determined the former commission issued in respect of Sierra Leone, the Gambia, the Gold Coast, and Lagos, and constituted on the West Coast of Africa one Government-in-Chief, to be called the Government of the West Africa Settlements, and to comprise the four colonies aforesaid. Within each of the four said settlements a Legislative Council was established, to consist of the Governor and of such other persons, being not less than two in number, within each settlement, as should be named by instruction or warrant under the sign manual. In Sierra Leone it consists of nine members, five official and four unofficial, three of the latter being negro merchants. In Lagos, Gold Coast, and Gambia, the legislative body consists of four members, of which three are officials and only one an unofficial member. A larger representation of the mercantile element on the Council at Lagos and the other subordinate governments is much needed. To this serious want may perhaps be traced to some extent the stoppages of trade and other troubles that for many years past have so frequently occurred. Power was vested in these councils to establish, subject to the veto of the Governor-General, such ordinances as might be necessary for the good government of the settlements.

Within the settlement of Sierra Leone, an Executive Council was established for the purpose of advising and assisting the Governor-General.

It was provided that the Governor should reside in Sierra Leone, except when the interest of the service might render his presence desirable in any other of the said settlements.

Provision is also made in the commission, that in case of the death or absence of the Governor, the Government of Sierra Leone shall be administered by the Lieutenant-General, or if there should be no such person, by the Senior Military Officer in command of the troops. In Lagos, Gambia, and the Gold Coast, similar powers are, in the absence of the Administrators, vested in the Collectors of Customs there.

Until the appointment of the late Mr. Alston, as Queen's Advocate of Sierra Leone and legal adviser of the Governor-in-Chief, but little had been done since 1865 to reform the statute books of the settlements. During his brief tenure of office, however, some valuable changes were made, especially by the following new ordinances :—

The Naturalisation Ordinance.
The Coroner's Ordinance.
The Lunacy Regulation Ordinance.
The Gaol Ordinance.
The Waterworks Ordinance.
The Harbour-works Ordinance.

The recent legislation, however, of most importance is that respecting taxation and customs revenue. The laws passed on these subjects are as follows :—

Road Tax Repeal Ordinance, Sierra Leone, No. 10, of 1872.
House and Land-tax Repeal Ordinance, Sierra Leone, No. 12, of 1872.
An Ordinance to Amend the Duties of Customs, Sierra Leone, No. 13, of 1872.
Harbour Dues Ordinance and Abolition of Wharfage Dues, Sierra Leone, No. 14, of 1872.
Market Dues Repeal Ordinance, Sierra Leone, No. 16, of 1872.
Customs Revision Ordinance, Gold Coast, No. 3, of 1872.
Customs Revision Ordinance, Lagos, No. 3, of 1872.
Fishing-tax Abolition Ordinance, Lagos, No. 5, of 1872.

The general result of this legislation is already seen. The population of Sierra Leone, which for ten years past had been diminishing year by year, is now being recruited by families that had gone to the Bullion Shore and the neighbouring districts, to avoid the penalties of the road tax and the house tax.

The road tax was not a good impost. Under its provisions a system of forced labour on the roads was maintained, which was only another form of negro slavery. I found the police-office filled day after day with batches of from forty to fifty poor people, who, from inability to pay the tax, and omitting to work upon the road, were sent to hard labour in the chain-gang. Destitute widows, men on the invalid list, young women, all were forced to work on the roads or were sent to prison if they could not pay the tax. The house and land tax was also oppressive to the poor. These laws, as Mr. M'Arthur truly pointed out in the House of Commons in 1871, had caused "sullen discontent" amongst the natives under British rule. Her Majesty's Government, however, readily consented to repeal them.

To make up for the loss of four or five thousand pounds of revenue, derived from such imposts, a new tariff was framed, based on the principle that Richard Cobden long since recommended for adoption in her Majesty's colonies.

This new tariff abolished the general *ad valorem* duties, and repealed the long list of specific duties established at Sierra Leone twenty years ago. It makes the following articles free in future :—

Bread
Bacon
Beef
Biscuits
Bricks
Candles
Clocks
Cheese
Fish
Horses
Flour
Iron (raw)
Iron (manufactured)
Preserved meats
Pitch and tar
Sugar
Tea
Timber
Masts and spars
Shingles
Staves
Shooks
Lard

The total abolition of the wharfage dues and the reduction of tonnage dues from 1s. 6d. to 6d. a ton, are parts of the tariff that have directly benefited the shipping interest.

On the other hand, the increase of the duties on spirits (from 1s. 6d. to 2s. a gallon), tobacco (from 1½d. to 4d. a lb.), and gunpowder (from 9d. to 2s. per barrel), has not apparently diminished the import or consumption of these articles. The consequence is that, after meeting the large remissions of direct taxation, and providing for the reforms made in the other parts of the tariff, the additional increase from the duties on spirits, tobacco, and gunpowder has left a considerable surplus.

After deducting all liabilities, the balance that was found in the treasury chest of Sierra Leone on the 31st of December, 1872, was larger than any balance hitherto obtained there on closing the transactions of the year.

The new Gold Coast tariff has raised the spirit duty from 6d. to 1s. a gallon, and abolished all the *ad valorem* duties on food, clothing, building materials, hardware, cutlery, stationery, cotton, silks, &c. This tariff has also provided a large balance in the treasury chest at the end of 1872, and has enabled the estimates of 1873 to leave a surplus of over £11,000.

The Gold Coast revenue for 1872 was estimated at £24,561. Since the transfer and the new tariff, it is estimated for 1873 at £46,486.

Owing to the interruption of trade that had taken place at Lagos, no change was made in the tariff beyond a slight increase in the spirit and tobacco duties. When the general trade revives, the spirit duty, now only 6d. a gallon, may be doubled with safety.

The new fiscal system in Sierra Leone and the Gold Coast has shifted the incidence of taxation from the settlements to the consumers in the interior. Nearly all the revenue now collected in Sierra Leone is paid by tribes remote from the settlements, who consume the spirits and tobacco imported into Freetown, and which are exchanged for native produce.

The increased price of spirits and tobacco from the new duty is hardly felt by the great mass of the consumers, owing to the fact that the price increases beyond all proportion to the original cost of the articles as they are carried into the interior of the country.

On the whole the taxation along the coast is extremely light.

Since Sir Charles Adderley's Parliamentary Committee on the West African Settlements, which led to the formation of a Government-in-chief and to other administrative reforms, the revenue of the whole colony has considerably increased.

The total sum collected in 1871 was £172,197, as against £116,281 in 1866.

The ratio of increase has been steady and satisfactory. In 1867 the revenue rose to £128,320; in 1868, to £130,660; in 1869, to £149,884; in 1870, to £159,830; and the revenue for 1871 exceeds that of 1870 by £12,367.

In the year 1873, when the revenue from the late Dutch possessions will be taken into account, and when the new tariffs will be in full operation, I believe the total income of the settlements will exceed £200,000.

The rapid increase of revenue from 1866 to 1871 contrasts favourably with the corresponding period of ten years before. The following table, however, does not include Lagos, as that settlement did not come under the colonial office until 1865.

Total Revenue of H.M. West African Settlements.

1856	£65,893
1857	56,810
1858	58,633
1859	54,918
1860	55,835
1861	61,958

The revenue of each separate settlement, from 1866 to 1871, was as follows:—

Revenue.

	1866.	1867.	1868.	1869.	1870.	1871.
	£	£	£	£	£	£
Sierra Leone.........	62,263	64,871	59,272	69,617	67,135	80,486
Gold Coast	11,053	10,839	15,404	24,127	30,851	28,609
Gambia	19,079	22,415	22,088	15,518	18,969	17,490
Lagos	23,823	30,195	33,896	40,622	42,875	45,612
Total revenue of H.M. West African Settlements	116,218	128,320	130,660	149,884	159,830	272,197

The expenditure has generally been kept well within the revenue, as may be seen from the following figures:—

Expenditure.

	1866.	1867.	1868.	1869.	1870.	1871.
	£	£	£	£	£	£
Sierra Leone.........	60,532	70,984	55,694	70,465	68,033	76,130
Gold Coast	11,589	10,993	11,651	18,836	35,609	29,094
Gambia	17,681	18,664	17,082	20,236	21,937	16,662
Lagos	23,602	30,195	33,711	39,431	42,379	45,611
Total	113,411	130,836	118,138	148,968	167,958	167,497

Sir Henry Ord pointed out to the Committee of 1865 that the military expenditure, which then amounted to a charge of £127,897 on the Imperial Exchequer, could be considerably reduced, and when the Government-in-Chief of the four settlements was concentrated at Sierra Leone, and local forces substituted for some of the West Indian detachments. This policy has been steadily pursued, and with such success that, though the trade with the United Kingdom has considerably increased, the military expenditure chargeable to the United Kingdom has fallen to one-fourth of what it was in 1865. In 1871 it amounted only to £29,331. This sum is divided between Sierra Leone and the Gold Coast.

The other two settlements—Lagos and the Gambia—provide for their own defence. In 1863 Governor Freeman purchased 400 stand of arms for a force he was raising from a widely-spread Mahommedan tribe, the Houssas. In July, 1864, he reported that he could maintain 100 armed Houssas at an annual cost of £1,269. Before his death, which occurred soon after, he anticipated the substitution of his Houssas for Imperial troops, and this was accomplished under Sir Arthur Kennedy's instructions, in 1869. An armed police force has also been substituted for the Imperial troops at the Gambia.

The experiment was tried in May last, of moving 100 Houssas from Lagos to the Gold Coast. They have been doing garrison work at Elmina, and are found to be, for the sort of duty required in the Protectorate, more useful than the West Indian troops.

The only buildings of any strength and magnitude in the West African settlements are of old date, having been constructed either by the Portuguese or the Dutch. However, immediately before his departure, Sir Arthur Kennedy laid the foundation stone of a new wharf in Freetown Harbour, on which £13,700 was spent in 1872, and a further sum of £25,000 appropriated for its construction in the present year (1873).

On the coast of Guinea the Government Works Department obtained some fine forts and castles by the transfer of the Dutch settlements. One part of the extensive and well-preserved fortress of St. George D'Elmina has already been utilised as a government bonded warehouse. Another part is occupied as a barrack for the Houssas. The Palaver-hall is used as a court of justice, and the wing of the castle overlooking the sea contains a good suite of rooms, suitable for the Governor-in-Chief when he visits the Gold Coast.

Immediately after the transfer, the Colonial Surveyor was instructed to begin two public works, one being a road from Elmina to Cape Coast, a distance of eight miles, the other the extension of a sea-wall, which will facilitate the shipping of cargo at Elmina. The new road is now made, and when the bridge across the Sweet River is finished it will be available for general traffic.

At Lagos a good deal of money was spent for the last few years in cutting the Offin Canal, but, owing to causes not foreseen when the works were undertaken, it has turned out to be useless. The roads and streets are admirably laid out, though, on account of the sandy soil, they are much broken up in the rainy season. The merchants' houses—especially those belonging to foreigners—are substantially built. There is not, however, a good government building in the settlement, except the barrack, now used as the hospital. The gaol looks like a collection of native huts surrounded by a mud wall. The public offices and the court-house are mere temporary makeshifts.

When the revenues of Lagos admit of it, a public work may perhaps be undertaken, which would be of immense benefit to the commerce of West Africa; that is, a breakwater, on the principle of that constructed at Natal, for rendering the bar deeper. Such a work, if successful, would make Lagos the Liverpool of the West Coast. The buildings of the Gambia are far superior to those of the Cape Coast or at Lagos.

It can now be truly said that one of the great objects for which the British Settlements were maintained has been accomplished—the oceanic slave trade is entirely gone. But though the slave trade across the Atlantic is extinct, African slavery, as a home trade, exists; and it must be admitted that to slave labour we owe our flourishing commerce with Africa. The whole of the produce shipped from Lagos is the result of slave labour. The same must be said of the Gold Coast and of the Gambia. With the exception of a little free labour employed in curing hides in Freetown, and one or two other trifling pursuits, the labour of domestic slaves produces all the exports of Sierra Leone.

Of the produce, valued at £1,050,237, shipped from the British Settlements in Africa in 1871, not more, perhaps, than one thousand pounds worth is the result of exclusively free labour. Of the 17,882 ounces of gold dust sent to England, probably not one ounce was obtained by free labour.

The European produce is carried from the coast into the interior by slaves. In 1871 the value of the produce so conveyed into Africa by slave labour must have exceeded £1,250,000.

It is not unlikely that for some time to come the growth of our commerce with Africa will strengthen domestic slavery, instead of diminishing it, just as the material progress of Russia under Peter the Great intensified the serfdom of Eastern Europe in the beginning of the eighteenth century. In one of his despatches to Lord Clarendon, written in 1866, Dr. Livingstone says:—

> "There is a sort of charm in the prospect of gradual amelioration of the state of slavery by the steady advance of trade and civilisation; yet all experience proves the prospect to be delusive. It is in the patriarchal state alone that slavery is endurable. So long as that state continues there is little disparity between master and man. Each enjoys the general indolence; but, let society advance, artificial wants increase, and luxuries become necessaries, the distance between owner and slave becomes proportionably widened. In fact, just as the love of gain is developed in the master, the lot of the slave becomes compulsory, and for the sole profit of the master; the interests of owner and slave diverge, and this divergence increases with every advance in trade, civilisation, and luxury."

In the British settlements domestic slaves, of course, are free; but in the neighbouring protectorates they are to be found in every house. Thousands of domestic slaves are to be seen every day in Lagos, coming and going on their owners' business. It very rarely happens that any of them sent to Lagos with produce elect to remain there against their masters' wishes.

The fact, however, that runaways often leave British territory, and ask their masters to take them again into servitude, is some proof that there is a wide difference between domestic slavery and the oceanic slave trade.

EDUCATION.

In addition to the stopping of the oceanic slave trade, our West African settlements were established in their present form with the avowed object, not of territorial aggrandisement, but of training the natives so as to render them capable of self-government. The views put forward in the *Times*, on the 14th December, 1872, as to the hopelessness of forming a colonial empire with European officials in this climate are in accordance with my observations, and with the experience of the most intelligent persons I have met in my visits to the settlements.

Every year that has elapsed since 1865 has served but still further to confirm the resolution of the Select Committee of the House of Commons, in saying—

> "The object of our policy should be to encourage in the natives the exercise of those qualities which may render it possible for us more and more to transfer to them the administration of all the governments, with a view to our ultimate withdrawal from all, except probably Sierra Leone."

But, though time has only shown the increased necessity of this policy, very little has been done in the last seven years to establish that on which alone a safe foundation of African home government can be built, that is, a comprehensive system of public instruction.

Sir Arthur Kennedy, in his despatch, No. 1, of the 11th January, 1869, written at Sierra Leone, said—

> "Education, as elsewhere on the coast, has been, and is, most inadequately provided for."

In his official report for 1870, Mr. Popplestone, the late Director of Public Instruction, thus summed up his description of the state of education in Sierra Leone:—

> "As may be inferred from this description of the state of education, and from the want of duly capacitated persons to train, moral duties are not inculcated during the school lessons. Apart from this decided want of instruction in practical morality, there is, it may safely be asserted, in the habits of listlessness and inanimation conspicuous among the younger section of the scholars, an indirect incentive to the formation of a thoughtless, idle, and indolent character."

Mr. Popplestone's statements to me in 1872, my own inspection of some of the schools, and the experience I gained by conducting a competitive examination for clerkships in Sierra Leone, in which I examined young men of various denominations and ranks of life, together with the constant opportunities which the head of the executive in a colony possesses of estimating the intellectual training of the community, all convince me that no real progress has been made, and that the system still continues to be "an incentive to the formation of a thoughtless, idle, and indolent character."

Acting-Administrator Salmon informed me that, however defective he had observed the system of public instruction at Sierra Leone to be, he found it still worse at Cape Coast; and the late acting-administrator of Lagos, Mr. Fowler, gave me a similar account of that setttlement. Last year the colonial chaplain of the Gambia thus described, in an official report, the state of education as he finds it in the government schools in that settlement:—

> "The Government school has 100 pupils on the roll. Some attend only two days, some one day, out of the five days of the week. Others show up once in three weeks, or once a month. The parents or guardians generally employ the children in selling goods in the market.
>
> "Thus we have the mortification to see, in several cases, the fruit of our labours nipped in the bud in this department.
>
> "The children pass from our hands before any permanent good is effected. Nothing, to my mind, will answer here but the compulsory system.

"The Sunday school is attended by nearly all the school children, with a few others. The number averages 60.

"I have also commenced a separate school for the poor heathen children. They are quite naked and destitute, and belong to the tribe called Sërërës.

"The average number of attendance is from eight to twelve."

It was, however, by the chiefs at Lagos and at Cape Coast that my attention was first drawn to the cause of this widespread educational failure.

On my second visit to Lagos, King Docemo told me that his chiefs and principal people wished to get their children educated, but they were debarred from doing so. Some years ago he had asked the administrator to aid him in getting his son taught English, and the boy was accordingly sent to school. But in a short time he had to withdraw the boy from school. King Docemo is not a Christian, and it appears that, in accordance with a custom of his religion, it was his practice, on the anniversary of the death of some relative, to proceed with his family to the house where this relative had been interred, and there go through certain prayers or ceremonies. His son, who had been sent to the English school, was warned by his teachers that this was all very sinful, and that he should assist in rooting out the heathen customs of his father. But neither the boy nor King Docemo would agree to this; and as the teachers said their mission was to enlighten the natives in such matters especially, no agreement as to the education of the boy could be arrived at.

All the chiefs and captains of companies at Cape Coast came to me with similar stories. They said they would give anything for a good education. They grieved to see their children brought up within a few yards of the English forts without learning to read or write English, or even to speak it. But in every English school their religion and customs were specially discouraged. They said that a few low caste natives, tempted by the emoluments of government clerkships and of catechists, would continue going to such schools, but they pointed to the flagrant hypocrisy and idleness that was thus created.

Subsequently I had an interview, in the neighbourhood of Sierra Leone, with the kings and chiefs in treaty with the settlement. Bey Mauro, King of North Bullom, being deputed to address me by the others, said that it had reached their ears that I had written to the Queen's government suggesting a scheme of education where Mohammedans and others not Christians could be educated. That this news had spread far and wide, and caused intense satisfaction. They were all most anxious that their children should learn English, but what could they do? Of all the kings and chiefs then present not one could sign his name in English to the treaties they made with the Queen, though in their fathers and grandfathers' time there were the same schools at Sierra Leone as now. But their fathers would not send them to change their religion, and they could not send their sons to the English schools for the same reason. Bey Inca, King of the Small Scarcies, said he had to send his son to Bisan, in the Portuguese settlements, to learn Arabic and Portuguese, and from thence he was about sending him to Senegal, to learn French and complete his Arabic.

The native kings who thus spoke to me were as intelligent persons as any Europeans I had seen on the coast. Bey Inca apologised for having to speak through an interpreter, explaining that it was no fault of his; and he added his regret that his son, whose book learning would be greater than his own, would be unable to read or write any European language except Portuguese and French, though the district he would be called upon to govern was in such close proximity to Sierra Leone.

These statements account for the fact that whilst the British Settlements exercise a certain political and commercial influence some hundreds of miles in the interior of Western Africa, their educational influence in the interior is absolutely "nil." And yet it is from the interior that the governing class must be drawn. The liberated Africans of Sierra Leone, though not bad people, are in character, intelligence, and bearing, very inferior to the genuine specimens of the negro race beyond the settlement.

It was only in the interior that I saw a population exhibiting any real love for learning. At Kambia, a fine town, at the head of the navigable part of the Great Scarcies, I found native schools, where negro boys and negro girls were taught to read and write Arabic by negro teachers.

I have here one of their timber school-books or boards. This one (A) I got from a boy on the 11th of January last, at Kambia, who was seated, with a dozen others, on the ground around a fire, about half-past seven in the evening. They all had similar boards, with written lessons, which the native teacher was explaining. Two other circular groups of scholars were seated not far off. The fire was kept up with small bundles of wood, to enable the writing to be seen. The following evening, in the courtyard of another house, I got this board I have marked (B.) It is the first lesson-book they use. It was given to me by a little boy, between three and four years of age, who was then learning his alphabet. The letters on this board are large; they only form one word "Bismillah"—"In the name of God."

The two boards marked (C) I got from little girls who were learning Arabic at six o'clock in the morning. The large board marked (D) was given to me in another school. It contains a neatly-written biography of Mohammed. I believe I was the first European the negro children ever saw. Their negro teachers had no acquaintance with any Europeans. All the children of that district—numbering some thousands—attended these morning and evening schools with great regularity. The school fees supported the teachers.

The lower part of this ornamental writing that I produce was over the inner doorway of a native house. It was thus translated for me by the interpreter:—

> "The Almighty, there is no God but He—the living, the self-subsisting. Neither slumber seizeth Him, nor sleep. To Him belongs whatever is in the heavens, and whatever is on the earth. None can intercede with Him except by His permission. He knoweth all the past and all the future, and nought of His knowledge can man grasp, except what He pleaseth. His throne extendeth over the heavens and the earth, and the holding of them doth not burden Him. He is the Exalted—the Mighty."

Such were the words I saw written over a doorway in the house of a negro, in a purely negro town of Africa, remote from all the so-called benefits of our civilisation and enlightenment. On returning home, I find that very different sentiments are being inscribed on the portals of European philosophy; but of the two, perhaps, the simplicity and faith of the negro is to be preferred to the proud intellect that is so busy and dogmatic with us.

In the town of Billeh, not far from Kambia, one of those teachers showed me his private library, containing more works on philosophy, jurisprudence, and history than I fear would be found in the private libraries of all the schoolmasters in Sierra Leone put together.

In that district I received, for the first time in Africa, a work composed by a negro teacher, Essays by Sheik Omar Al Hadji, of Dingawari (in Futa Jalou), a town between Kambia and the Niger. In the same place I obtained a manuscript, written in Arabic by a negro, containing his own observations of the various places of the moon and stars at different times of the year.

One of these learned negroes did me the great honour of composing a poem in my praise, which he handed to me as I was leaving Kambia. It is an acrostic, as will be seen by inspecting it; the caligraphy of the pure negroes is characteristic and clear. The author's name is Ahlusani, the son of Fodé Tarawalli.

As an illustration of the fact that this love of learning is not altogether confined to the interior, I may mention an interview I had at Sierra Leone with a negro born in the settlement, but who, being a Mohammedan, had to go to Futa, about 250 miles off, for the greater part of his education.

Though a young man of slender means, he was in the habit of purchasing expensive books from Trübner and Co., of London. He showed me his copy of De Sacy's "Les Séances de Hariri," the Paris edition, in Arabic, with Professor Chenery's translation, printed in London; Dr. Pfander's "Mizan ul Hagg," with Rahmat Allah's reply; the "Izhar el Hakk," or "Demonstration of the Truth." He also showed me Dr. Freytag's "Libri Arabici seu Fructus Imperatorum;" Dr. Ferdinand Wüstenfield's "Life of Mohammed," and other costly books that he had ordered from Europe. He possessed many works printed at Boulac and at Tunis, as well as numerous manuscripts composed by his countrymen in the chief towns in the northern valley of the Niger.

Though he had a more cultivated mind than I had observed in any of the young men trained in the Government school or the missionary schools, he had no acquaintance with Europeans. He had received no aid or countenance from the educational system of Sierra Leone.

The total absence of anything like industrial education in the settlements has often been deplored by my predecessors.

The indisposition of the Sierra Leone young men to take to agriculture, or any sort of manufactures for earning their bread, has been noticed by Sir Arthur Kennedy. That this is not owing to any inherent fault in the negro race, is shown by a visit to the interior. The whole of the country surrounding Kambia is well tilled by a hard-working population, who may be seen leaving the town at daybreak every morning for the adjacent farms.

MANUFACTURES.

In Kambia itself I saw, for the first time in Africa, some attempt at manufactures. From the cotton shrub that grows near every house the women pluck the raw material, from which they spin a coarse, strong thread. This is transferred to a native loom, made of hard wood and of leather prepared by themselves.

In the verandahs of the native houses the country cloth, from which they make tobes and other articles of wearing apparel, may be seen in process of manufacture within a few feet of the plant, still laden with the opening seeds from which the material of the thread is plucked whenever it is required.

In the circular gate-houses leading to the courtyards of the better classes I have seen the blacksmiths making hinges, nails, and other common articles from native iron. The same sort of iron ore that is to be found at Sierra Leone is also to be found in the interior. But, though it is neglected on the coast, it is smelted in rude furnaces at Kambia, and is the material from which the blacksmiths make all the iron required in that district.

The negroes of the interior may also be seen tanning leather, colouring it with native dyes, and making sandals, shoes, and saddles.

In every valley they are busy manufacturing oil for their own consumption and for the European markets. The value of the oil so manufactured and exported last year to Europe exceeded £400,000. This manufacturing industry is altogether carried on by the negroes beyond our settlements.

At Elmina there are a considerable number of natives who have been trained by the Dutch as masons, carpenters, nad blacksmiths. The native houses are strongly built of stone. At Cape Coast, eight miles off, the native houses are built of mud, and there is very little attempt at industry to be seen.

The German missionaries at Akropong give technical instruction in their schools. They are zealous, and live in a healthy district, but as yet they have made no impression beyond a very limited area.

At Lagos, the liberated Africans, who have emigrated from Brazil, are disposed to be industrious. In this respect they are a contrast to the liberated Africans of Sierra Leone. When I saw them they numbered about 6,000, and they are rapidly increasing.

POPULATION.

The total population of the West African Settlements, as returned according to the census of 1871, amounts to 513,370. Of this number in the year 1871, 328 were Europeans, divided as follows:—Sierra Leone, 107; Lagos, 94; Gold Coast, 70; and the Gambia, 57.

Of the total number of 513,370, less than 35,000 are returned as professing Christians by the various Missionary Societies, but of these very few are practical Christians. Though it has been the invariable practice to enrol as members of the Church of England all the liberated Africans and their children brought for many years past to Sierra Leone, the actual number of Church members here now is far less than the number of liberated Africans and their descendants.

The native Christians are almost exclusively confined to the coast towns. They comprise the following denominations:—Church of England, Wesleyans, Roman Catholics, Baptists, Old Connection, Lady Huntingdon's Connection, United Methodist Free Church, Baptist New Connection, German Evangelical, and Presbyterians.

The Christian population enjoy the services of two bishops and about one hundred clergymen of different denominations. The missionary societies in Europe contribute most generously to the conversion of the natives in West Africa. The latest return I can find of adult baptisms in Sierra Leone, Bullom, Quia, and Mendi Missions, is that given in the "Proceedings of the Church Missionary Society" for 1869, page x, where the total number of such baptisms in the year is returned at 16. The number of clergymen, directly or indirectly connected with this society in the districts in question, including the Lord Bishop of Sierra Leone, is 26.

The Mohammedan clergy, who are gradually approaching the coast from the interior, are more successful. In one year they make more converts than the clergy of all the Christian denominations in West Africa make in ten years.

The European missionaries, no matter how largely supported with funds from home, cannot in this climate compete with the Mohammedans. One or two are eminent for activity and zeal, but as a general rule they are feeble and ineffective.

In the appendix to the Primary Charge (October, 1871) of Dr. Cheetham, the present Bishop of Sierra Leone, an abstract is given of an interesting paper by a native pastor, the Rev. James Johnson, on "Our Mohammedan and Heathen Population, the duty of the Church in relation thereto." The author thus sums up the effect produced by the Christians of Sierra Leone upon their foreign brethren outside the boundary of the settlement :—

> "The result, after allowing for the persons arriving more than once, gives about 40,240 arriving yearly, a number almost equal to the total population of the colony; and, added to the 5,000 actually resident, gives 45,240, a number greater by about 9,000 than that of professing Christians.
>
> "The foreigners represent different African nations, some intelligent, and enjoying a very good degree of mental culture, having a literature of their own in Central Africa, as well as a portion of the works of Aristotle and Plato.
>
> "What influence have we exerted over them, or they over us?
>
> "We have not influenced our foreign brethren, though for a period of forty years we have been coming in contact with them. Central Africa might long since have been under Christian influence if we had been faithful.
>
> "But they have influenced us.
>
> "Neither the Mohammedan Alufa (priest), or Babbalaivo (priest), have been inactive. We see the result in backsliding Christians. It is said that three-fourths of the Mohammedans in the town were not always so; that is the instrumentality of a small band of faithful Fulah Moslems that has made them such. Christian parents willingly give up their children for marriage; many baptised persons live in guilty intercourse with heathens and Mohammedans. Christians, in their hour of need, consult heathen oracles and Mohammedan priests."—*Pimary Charge of the Bishop of Sierra Leone*, page 63; printed 1872.

In the discussion that ensued as to this lamentable result of forty years' labour, Mr. Johnson suggested, amongst other practical remedies, that the missionaries should pursue "a more diligent and systematic study of the Arabic and native languages." As to this suggestion, however, the late Director of Public Instruction, Mr. Popplestone, "doubted the advantage of teaching children Arabic, and thought variety of creeds, and want of concord between Christian ministers, the stumbling-block."

The native schools beyond the settlement, where I have seen the Mahommedans zealously teaching Arabic, are evidences of the wisdom of what Mr. Johnson recommends. There are other causes, however, for the failure.

Sir Henry Ord, in his evidence before the Parliamentary Committee of 1865, dwelt upon one of those causes, seven years ago. He was asked, Question 2,043 :—

> "Take the missionaries, for example. Is it possible that you can spread Christianity in Africa except through the blacks?"

He answered :—

> "I think that the only way to spread Christianity in Africa is by the agency of black ministers."

The following is Dr. Livingstone's evidence on the same subject :—

> "Have you formed any opinion with regard to the degree in which Christian teaching has affected the African character?"
>
> "Yes. I know a very great number of converts in the middle of the country, not on the West Coast; and I have had opportunities of knowing them intimately. I have travelled with them, and I think the progress they have made in knowledge is very satisfactory, and that their conduct is very good indeed."
>
> "Which are the people you speak of? I speak of the Bechuanas."

In answer to another question, speaking of Angola, he said :—

> "The people there have retained the teaching that was communicated to them some 150 years ago, and now, wherever you find a village, you find people who can both read and write, and they teach each other."

Referring to a missionary he met at Ambanka, Dr. Livingstone says :—

> "He was a very respectable man, and I found out that he was a very good man, and that he bore a very high character among the people around him. He was perfectly black, yet he was a canon of the Church."

In his "Missionary Travels in Africa," p. 117, Dr. Livingstone asks the question :—

> "Can our wise men tell us why the former mission stations—primitive monasteries—were self-supporting, rich, and flourishing as pioneers of civilisation and agriculture, from which we even now reap benefits, and modern mission stations are mere pauper establishments, without that permanence or ability to be self-supporting which they possessed?"

The statements I have quoted from the appendix of the Bishop of Sierra Leone's Primary Charge show that, whilst the European clergy have failed to influence the Mohammedan and heathen population, the native priests of the Mohammedan religion are perverting Christians, even in Freetown itself. The reverend gentleman who made that statement is corroborated by the most recent returns prepared in the Liberated African department.

The liberated Africans, on arriving at Sierra Leone, have invariably been handed over to the clergy of one of the societies. They are ready-made converts, as it were, by the action of the government, and their children are not only baptised, but placed under the special guardianship of the clergy. Even at the present moment the governor signs warrants every month for paying money to the bishop for the education of such children.

The present population of Sierra Leone is 38,936. In his Primary Charge (1871) the bishop claims 14,528.

This is, however, said to be excessive, and in the "Church Missionary Proceedings" for 1869 the total number of "native Christians" was only given at 1,741; but, according to the returns of the Liberated African Department, now before me, dated 24th December, 1872, the liberated Africans and their descendants number 35,864 out of the 38,936 persons constituting the population of Sierra Leone. Many liberated Africans emigrated again. The total number registered up to this date is 95,261.

From these figures it is clear that the Mohammedan, or other agency, has actually changed the religion of the majority of the Christians within the settlement, who had been placed for years past by the State in the custody of European clergy.

The Mohammedans who are doing all this are pure negroes. They achieve success by native agency alone. To face them a similar agency is required.

The more I have seen of missionary operations in Africa the more I am convinced that Sir Harry Ord and Dr. Livingstone are right in their estimate of the native pastors. The contrast between the native pastors and their European brethren is very striking.

The native pastors mix with the people, speak their languages, and understand their habits and customs; but unfortunately they are all placed in an inferior position to the European, both as respects emolument and authority. The white colonial chaplain gets £500 a-year; the black assistant chaplain, £150. The white clergyman at Pademba Road gets £250 a-year; the black clergyman, a well-educated and accomplished gentleman, £82. And yet everyone sees that the hard work is left to the native. During the recent sickly season, which was so fatal along the whole coast, the white colonial chaplain was absent for the benefit of his health, receiving pay all the time, in England. Other European ecclesiastics were also prevented, by the state of their health, from remaining during the sickly season.

Again, in the streets of Freetown, where small carriages are drawn by human beings, the Mohammedan proselytisers can point to European missionaries dragged about by pairs of negro boys in lieu of horses, as the latter cannot now live in Sierra Leone. Some of the native pastors have remonstrated against this slave-like exhibition, but the European clergymen who keep those carriages have the excuse that they cannot walk about in such a climate as Sierra Leone, and that for the preservation of their health they are compelled to use the blacks in this way.

The cure for this is obvious. Native pastors only, as Sir Henry Ord says, can do the work.

Meanwhile, however, the fact remains that, beyond the settlement, no educational or religious influence is exercised by us; and, even in the settlement itself, the majority of the people who are made Christians by the act of the State do not continue Christians for two generations.

In addition to such facts as these, the climate of West Africa indicates from time to time the absolute necessity of employing native agency instead of European, not only in the great work of Christianising Africa, but in commercial pursuits and in the Government service. Many years ago, Sierra Leone was called "the white man's grave." The climate is generally bad, but every seven years there comes a sort of epidemic which is extremely fatal.

The last mail brought us the lamentable news of the death, from African fever, of my successor in the Government-in-Chief, Mr. Keate. His health was impaired by long services in the Sechelles, Trinidad, Granada, and Natal, before he came to Africa. When he arrived he was unable to walk from the steamer to Government-house. He told me an insurance office in England had asked thirty-five per cent. extra premium for the risk of insuring his life. He had, therefore, been compelled to forefeit his insurance. The climate so affected him that he had to do his arduous official work stretched on a sofa, and propped up with pillows. He died in a month after his arrival. There was not a better public servant in the colonial service. I have every hope that her Majesty the Queen will not forget Mr. Keate's widow and children.

The year 1872 was a most unhealthy year for the European population along the whole coast. Out of a European population of thirty at the Gambia the colonial surgeon reports that ten died on shore, and five more after being conveyed on board the steamer.

I sent the present administrator, Mr. Callaghan, to Europe in the month of April, as the doctors said they could not get him free from fever, and that he could not outlive the rainy season. His predecessor, Colonel Anton, died of fever on the voyage from the Gambia to England. Mr. Callaghan's *locum tenens*, Mr. W. H. Simpson, died of fever when put on board the steamer for Sierra Leone.

As an illustration of the rapidity with which Coast fever sometimes produces its effect, I may mention that the despatches that reached me from the Gambia, on the 8th of October, were in the handwriting of Mr. Capper, the acting first writer, and were signed by Mr. Simpson, the acting administrator; but the captain of the steamer sent me a note reporting that they had both died after the mails had been made up.

During my stay on the Gold Coast, the Rev. Mr. Waite and his two children died. Out of the small group of Europeans at Cape Coast his loss will be severely felt. He was the son-in-law and the ablest assistant of the eminent head of the Wesleyan body in West Africa, the Rev. Benjamin Tregaskis.

At Elmina, owing perhaps to the ample supply of good water, the people enjoy better health than at Cape Coast. In an interview with the chiefs of Cape Coast in May, 1872, a municipal council for sanitary purposes was decided on.

One moiety of this council is to be composed of chiefs elected by themselves; and, instead of imposing a sanitary rate, it is proposed to allow them to devote to sanitary objects from £1,000 to £1,500 a year out of the proceeds of the additional duty on spirits.

A recent despatch from Lagos states that the fever is also of a bad type there. The Commodore states that H.M.S. "Coquette" having entered the lagoon for a few days, had to proceed quickly to sea, as thirty-seven, out of fifty-seven of her crew, were soon down with fever.

The sanitary requirements of Sierra Leone were so pressing that the Acting-Governor-in-Chief in 1872 took the responsibility of adding a separate department to the establishment there, to be called the Department of Public Health.

In the ordinary annual estimates the Colonial Surgeon appeared as Sanitary Inspector, with an addition to his salary, for that duty, of £120 a year, with a clerk, at a salary of £22 17*s*. 6*d*., and one labourer at £18 6*s*. That is, £161 a year was specially voted for sanitary purposes; a sum quite inadequate to deal with the public health of a place like Freetown.

In the estimates for 1873, however, votes are inserted for sanitary purposes to the amount of £1,600 a year.

The services of the late sanitary officer and surveyor of Dartmouth have been secured for this post.

Under the supervision of the inspector a sum of £1,200 a year will be laid out in future on the sanitary improvement of Freetown.

During my experience of Sierra Leone (that is from February 1872 to February 1873) 24 Europeans died out of a population of 98. The extraordinary sickness and mortality was, however, confined to Freetown. The mountain district, according to the Registrar-General's returns, appears to be as healthy as any part of England, or indeed as Madeira, the climate of which it closely resembles.

It is, therefore, worth consideration whether the seat of government might not properly be removed to the mountain villages of Leicester or Regent, which are only three or four miles from Freetown; or, at least, whether a vote might not be sanctioned for building a few substantial bungalows for government officials in the healthy districts lying above the vapours that rise from Freetown River, and above the range of the more active malarial influences.

Though in future no expense will be spared to keep the town clean, the government must not be too sanguine as to the result. With the exception of the Mohammedans, the habits of the people, and of some of the European residents, as the medical officers point out in their reports, are very bad. One of the main duties urged upon the sanitary inspector and his staff is that of teaching the inhabitants the dry-earth system, but it will take considerable time before it can be expected to be generally adopted.

There is another reason why we must not expect too much from Government action in this matter. Over and over again my predecessors tried experiments to improve the health of Freetown. As a result of many years' observation, it is alleged that sickness sometimes breaks out in the cleanest parts of the town, whilst apparently dirty localities escape.

For my own part, having narrowly watched the phenomena affecting public health there, I venture to express the opinion that, owing to its situation, Freetown is radically unhealthy. It is near the mouth of a broad river, laden with vegetable decomposition, which is partially driven back to the town twice every day by the tide, and at its rear it is hemmed in by a range of hills, which tend to keep the products of evaporation suspended over the streets. During my morning walks up Leicester Hill, I frequently observed the river vapours lying motionless over the houses of Freetown.

The general conclusion at which I have arrived respecting the state of the public health in these settlements, is that they are unsuited for European residents.

I venture here to repeat what I said in a despatch to Her Majesty's Government last October—

> "Whenever it can possibly be done, I would strongly recommend dispensing with the service of Europeans on this coast."

Fortunately this can be done, and to a much greater extent than is generally imagined. Some of the ablest members of the Legislative Council of Sierra Leone are pure negroes. The best scholar on the coast, a man who knows Hebrew, Greek, Latin, French, German, Italian, and Arabic, and is well read in the literature of these languages, is Mr. Blyden, a pure negro. The most intelligent clergy of the Church of England, in the various settlements, are the native pastors. Among the most trustworthy men in the public service are the native officials.

However, to give the natives a fair chance, it is, as I have pointed out in the remarks on education, essential that something should be done to alter the present system of education.

I hold in my hand some letters addressed to me by a Protestant clergyman—a pure negro—on this subject, and I read the following extracts from them with the double object of showing you how admirably a negro can write and argue, and of explaining to you, in better language than I could use, the necessity for some such institution as a West African university.

"Freetown, December 6, 1872.

"Sir,—In the interview I had the honour to have with your Excellency the other day, you expressed an opinion that a great effort should be made not only to spread the rudiments of technical and secular knowledge among the mass of the population on the coast and in the adjacent interior, but also to establish a sort of Educational Department of State for the purpose of securing to intelligent and studious natives the advantage of instruction in the higher branches of learning.

"The more I reflect upon the subject, the more I am convinced that we can have no thorough and permanent reform—no proper development and growth—without the means being afforded of a liberal education to the youth.

"If in the Government of these Settlements, native agency is to be welcomed and encouraged and not despised and excluded; if the people are ever to become fit to be entrusted with the functions of self-government; if they are ever to become ripe for free and progressive institutions, it must be by a system of education adapted to the exigencies of the country and race; such a system as shall prepare the intelligent youth for the responsibilities which must devolve upon them; and, without interfering with their native instincts, and throwing them altogether out of harmony and sympathy with their own countrymen, shall qualify them to be the efficient guides and counsellors and rulers of their people.

"The system, unfortunately, or want of system, to which the natives of this country have been subjected in consequence of the conflicting dogmatic creeds introduced among them from abroad, has unduly biassed their development and hampered their progress.

* * * * * *

"Europeans, sent hither to instruct us, too often labour under feeble health, and, owing to physical causes, are destitute of that energy and enthusiasm which alone can inspire and stimulate the young. Their work is a laborious task to them; and many a distinguished teacher from abroad, fully competent to fulfil the highest functions of an instructor, has laboured in a net-work of encumbrances and limitations, until, as our graveyards attest, he has been compelled to yield up his life, joining 'the noble army of martyrs' in the cause of Africa's redemption, and adding another to the 'cloud of witnesses' who, we are told, testify that Sierra Leone is the 'White Man's Grave.'

"The establishment of an Institution here, such as the Hon. William Grant suggested, to be conducted by earnest and well-cultivated negro instructors, would secure for the community the presence of qualified men who would not only, so far as health is concerned, be able to perform continuous and uninterrupted labour in the schools, but who would also exert a wholesome influence upon the masses and guide public opinion aright; or, rather, develope and organise a public opinion, which, perhaps, does not yet exist. You may depend upon it, Sir, unless some changes are brought about in the system of educating our youth, fifty years hence will find us just where we are now—performing the arduous but resultless treadmill operation of which Lord Macaulay speaks—'always beginning again; much exertion, and no progress.'"

Such an institution as this intelligent writer indicates would be of great benefit, not only to the Government, but to the mercantile community. Why should London merchants, who have establishments in Calcutta and Bombay, be able to rely, as they so often do, on high-class native agency, when the Liverpool and London houses who trade with Africa have often to send out European clerks to do their business in the worst climate in the world? The spread of education among the native traders would insure to the mercantile interest a fairer share in the administration of the settlements than, unfortunately, they now possess. It is lamentable to see such purely commercial colonies handed over so much to the management of military and naval officers.

Furthermore, the great work of influencing the interior of Africa can only be secured by such an institution. The many millions of negroes in the interior constitute a race which, as Dr. Livingstone truly says, is indestructible. He describes their many good qualities. From my own experience of the negroes in the interior, I can testify that they possess natural ability, a love of knowledge, a capacity for culture, a taste for music and poetry, a generous and hospitable disposition, patience and even cheerfulness under long-suffering, gratitude, truthfulness, honesty in their dealings, and a strong domestic love. In two respects they differ from some of the leading people in Europe—they are very ignorant of the art of war, and they have a child-like capacity for religious faith. These are simple qualities, but who will say they do not contain some elements of future greatness—elements that may yet be developed into a vast, peaceful, prosperous, and independant African Empire.

DISCUSSION.

Mr. Hale said there seemed the same difficulty in Africa that there was in England with reference to education, viz., that arising from religious prejudices. It appeared a most excellent suggestion that native Africans should be employed in the public service and otherwise, and he thought it would be well if some of the population were brought to England and educated, so that they might go back and influence their countrymen, without offending their prejudices.

Mr. Hyde Clarke said the Society was indebted to Mr. Pope Hennessy for one of the most valuable papers which had been read in that room for a long time, and one which certainly bore very strongly on the objects they had in view — the promotion of Art, Manufactures, and Commerce. He had already distinguished himself in the colony of Labuan, where he had succeeded in restoring an important branch of industry, and he had also rendered great services to the colony over which he had lately presided. Many years ago he (Mr. Hyde Clarke) remembered being concerned in an effort which extended the commerce of those districts by refining palm-oil, so as to enable a larger quantity to be carried, but since then, through the extension of steam communication, parts which at that period were inaccessible, were now brought within as easy a distance as the most civilised parts of the world. He could not but be struck, not only with the progress that had taken place, but with the evidence of future prosperity which must be developed if properly treated in that great empire which was scarcely inferior to British India. He felt much indebted to his Excellency for the manner in which he had treated his subject, giving the results of his own practical experience, and not occupying time with details which could be found in ordinary writers. He would therefore propose a cordial vote of thanks to Mr. Pope Hennessy, with sincere wishes for his welfare in whatever part of the world he exercised his administrative talents in future. He would observe, in comment on what had been said with regard to the Ashantees, that they consituted a race of very great interest indeed, and it was much to be regretted that these nations, from being looked upon as barbarous, had not sufficiently attracted the attention of men of science. Indian subjects were frequently discussed there, and he believed that if those acquainted with India would turn their attention to the races of West Africa, they would find in many cases that the people belonged to the same race, and that, in many cases, their language could be traced to the same stock, as some of the Indian races. In fact, it was one of the most favourable circumstances they had heard that evening, with reference to the prospect of these nations' advancement, that they belonged to a race which occupied a very high position in civilisation—the Dravidian—and that their language was closely allied to the Tamil. Wherever you found a language of culture, there you had a powerful instrument of culture, and as it appeared that the imported Arabic language had exercised a great influence in their education, so would their own tongue, if properly understood and cultivated.

Mr. P. L. Simmonds had much pleasure in seconding the vote of thanks, particularly as he had some knowledge of West Africa, having a son and a brother engaged in business operations there. It appeared to him, however, that his Excellency had hardly done justice to the importance of the whole trade with West Africa, by confining his notice to that with the English colonies, omitting the large trade which was done with the foreign settlements on the western coast. He found, taking the total figures from the Board of Trade returns for 1871, that they would almost double those which had been given, whether in regard to palm-oil or other matters. At so late an hour it was impossible to go into details; but he would cite one or two figures, to show the importance of the West African trade to England, especially since the establishment of a weekly or fortnightly communication by steam. It was very strange that Lagos never appeared at all in the Board of Trade returns, though it was a colony of some importance, and a great deal of business was done there. Leaving out this port, however, the aggregate exports from Western Africa were nearly £2,000,000 in value, including foreign and British possessions, whilst the exports from England to West Africa were about £1,750,000, making a total of £3,750,000 as the aggregate trade. Of palm oil alone the value of the imports in 1871 was nearly a million and a half.

The Chairman, in putting the motion to the meeting, said he had listened to the paper with the greatest possible interest. No one could doubt that great educational difficulties existed in England, and he could not altogether approve of the suggestion of Mr. Hale, that young persons should be brought over from Africa, to add to them. He was quite of opinion that if anything was to be done to elevate the mind of any nation it could not be simply by influences external to it. Therefore, if anything were to be done for the benefit of the races on the West Coast of Africa it could only be done, according to the whole experience of history, through those races themselves.

The vote of thanks was carried unanimously.

TWENTIETH ORDINARY MEETING.

Wednesday, April 30th, 1873, G. C. T. BARTLEY, Esq., Member of Council, in the chair.

The following Candidates were proposed for election as Members of the Society:—

Barclay, John, Seedley Printing Works, Manchester.
Beck, W. H., 139, Cannon-street, E.C.
Bleckly, W. H., Ashfield, near Warrington.
Buckley, John Charles, Carr-hill, Mossley, near Manchester.
Cassels, Walter Richard, 54, Queen's-gate, S.W.
Dunn, William, Messrs. William Dunn and Co., 6, Lime-street-square, E.C.
Muir, John, James Finlay and Co., Glasgow.
Robertson, Archibald David, 53, Queen's-gate, S.W.
Sandall, Frederick, 114, St. George's-road, Southwark, E.C.
Shaw, Robert B., Waterloo Hotel, Jermyn-street, S.W.
Turney, John, Trent Bridge Leather Works, Nottingham.
Tyser, George Walter, Parkside, Reigate, and Lloyd's, E.C.
Young, William, 33, Blandford-square, N.W.

The following Candidates were balloted for and duly elected Members of the Society:—

Bleckly, H., Latchford-grange, Warrington.
Bodmer, J. J., 23, The Grove, Hammersmith, W.
Brockelbank, George, Tower-house, St. Katherine's-wharf, E.
Cochrane, Henry, the Longlands, Middlesboro'-on-Tees.
Coles, Edward (Alderman), High-street, Rochester, Kent.
Hampton, Thomas, Phœnix Bessemer Steel Works, the Ickles, near Sheffield.
Harvey, John, 13, Upper Thames-street, E.C.
Henfrey, Charles, jun., 75, Victoria-street, S.W.
Hennessy, His Excellency J. Pope, C.M.G., Governor of the Bahamas.
Jenkins, John J., The Grange, Swansea.
Lemare, William, Mus. Doc., 382, Brixton-road, S.W.
Nichol, Rev. John George Scrymsour, King James's Grammar-school, Knaresborough.
Rew, Charles H., 5 Victoria-street, Westminster, S.W.
Sullivan, Sir Edward R., Bart., 13, Grosvenor-place, S.W.
Tattersall, Charles, Burbage-house, Buxton.
Walker, Frederick James, Claxton-hall, York.
Williams, James, 223, High-street, Shadwell, E.

The paper read was—

ON THE CONDENSED MILK MANUFACTURE.

By L. P. Merriam.

Milk, as an article of food, has been so largely discussed during the past twenty years, and its value so fully recognised by all eminent authorities on food, that it is not necessary for me at this time to enlarge upon it.

I would like, however, this evening, before speaking of condensed milk, to call your attention to the milk usually sold in large towns, not only in England but in other countries. According to Professor Wanklyn, pure milk should have an average specific gravity of 1030, and should consist of the following proportions:—

Water	87·19
Solids	12·81
	100·00

The solids consisting of—

Butter	3·53
Casein	3·74
Sugar of milk	4·75
Ash	0·79
	12·81

MM. Henrie and Chevalier give the following as the constituents of cows' milk in the normal state:—

Butter	3·13
Casein	4·48
Sugar of milk	4·77
Ash	0·60
Water	87·02
	100·00

Slight differences may be allowed on account of the variations in the breed of the cows, the pasturage, the food, the climate, and the seasons of the year; but there is a sufficient agreement amongst analysts of milk to allow me to take Professor Wanklyn's analysis as a standard, and especially in England, where are to be found the best pasturages, the finest breed of cows, and where the cows are less subject to violent changes of temperature.

THE MILK OF TOWNS.

The ordinary milk supplied to large towns, and even to many small country villages, is, however, a very different article from that which I have mentioned.

For many years it has been a matter of public notoriety that milk has been almost universally impoverished, until it has come to be accepted as a condition of life in towns that good and pure milk cannot be procured at any price, excepting under great difficulty.

To such an extent has the impoverishment been carried, that it is estimated it amounts to an average of at least 25 per cent., and in some cases it reaches as high as 50 per cent.

Most of the impoverishment is done either by adding water or by skimming off the cream, and sometimes both are done to the same milk.

Watered milk is acknowledged as a regular article of trade by the milkman, under the name of "Simpson." Milk that has been simply watered, or skimmed, is described by scientific men as "sophisticated" milk; and "skilfully sophisticated" milk is that which is both watered and skimmed, and afterwards treated to restore its original appearance.

Different substances are often added for colouring, or for changing the flavour, in order to give a fictitious appearance and a taste of richness.

Lest it may be said that the foregoing statements are unfounded, and a slander on the milk-dealers, I shall refer to independent, unimpeachable, and scientific testimony. In 1851, Dr. Hassall, under the direction of the *Lancet*, made very careful investigations as to the quality of the milk sold in London at that time. He obtained samples from the dealers under such precautions that it could be proved from whom they were procured; these samples were analysed, and the results published in the *Lancet*. It was shown that while some pure milk was sold, a large proportion was impoverished by skimming or watering, and in some cases both were done to the same milk. The names of the parties from whom the samples were obtained were published, with the analyses of the samples.

Within the past two years, Professor Wanklyn has carried out a similar but more extensive investigation for the *Milk Journal*, taking thousands of samples, and publishing names and addresses of the parties from whom the samples came, with the particulars as to the quality of each sample. Out of 256 names published in one year in the *Milk Journal*, only 26 were given as those furnishing genuine milk, 230 being recorded as selling deteriorated milk, the *Journal* saying:—"The names of large numbers of milk-dealers we are compelled to suppress, inasmuch as, although they are without exception dealers in deteriorated milk, we have not the requisite evidence of it against them."

The fact that there has been no action for slander against these journals by the dealers whose names were published as selling deteriorated milk, proves that the statements were correct.

In November, 1867, the *British Medical Journal* published an article on the same subject, and its report of examinations of milk from dealers in different parts of London showed that little, if any, pure milk could be obtained, and that some of the West-end shops sold a very poor article at a high price.

Other evidence as to the poor quality of milk usually sold might be given from towns in England, in France, in Germany, and in the United States; and wherever the matter has been taken up and investigated by scientific men, the result has been the same.

Mr. Rowsell, Superintendent of Contracts to the Admiralty, last year made a report on the supply of provisions to the workhouses of the Metropolis, to the President of the Poor-Law Board, which report was published by order of the House of Commons.

Mr. Rowsell made investigations of the quality of milk, amongst other articles of food, assisted by Dr. Letheby and Professor Wanklyn, one sample being furnished to Dr. Letheby, and a duplicate to Professor Wanklyn, for analysis; and the report says, "There is an agreeing difference, usual in delicate scientific examinations."

The results of the examinations show that these institutions are, if possible, more badly treated than the general public; showing, in several instances, that skim milk was furnished, diluted with twenty, thirty, thirty-five, and forty per cent. of water; and no less than seven samples of "milk" consisted of milk and water, half-and-half.

The report justly says, "that dilution or adulteration with water has been carried to such an extent as seriously to compromise the character of the milk, and make it utterly unreliable as food for infants and aged persons."

The contracts called for pure and unadulterated milk, but evidently no attention was paid by the officers of these institutions to see that the quality of the articles furnished was that contracted for, they, apparently, only considering the price and promises made by the contractors. There is reason to believe that many of the hospitals are quite as badly served.

It is clear, therefore, that pure, genuine milk, almost the only article of food which alone will sustain life for an indefinite period, is rarely sold to consumers. While the public have for a long time believed this to be so, it is only within the past 25 years that it has been scientifically demonstrated on a large scale.

It was hoped that the new Adulteration Act would remedy the evil, at least partially; and several meetings of milk-dealers were held, at which it was admitted that the price of milk must be advanced, if the Act was enforced against them, and they should be obliged to furnish genuine milk, but as they have not advanced prices, it is fair to presume they do not now fear its enforcement.

From the evil of adulterated milk there seemed no escape, until condensed milk made its appearance.

Let us now see what condensed milk is, and whether it does furnish the way of escape.

CONDENSED MILK.

Condensed milk, as it is now known, was introduced to the British public in 1867—say six years ago. Previous to that it had been prepared here in small quantities for shipping, but it was not used to any extent for domestic purposes. At first it naturally had a very limited sale, as it was not only unknown, but the price was very high, about double at retail what it is now. In America, however, it has been in general use for over ten years, and the business there has for a long time been of considerable magnitude.

It is a disputed point who discovered the process. The Americans certainly made some important improvements, facilitating the working of the large quantities which are necessary to supply a general consumption.

Preserved milk in the form of a powder has been prepared in England and on the Continent for many years, for ships' use, and for export.

This is known as "desiccated" milk, but the manufacture of it has now almost entirely ceased, as, apart from its high price, it is of inferior quality, and was put aside almost as soon as the condensed milk came into competition with it.

The process of preparing the desiccated milk breaks the butter globules, and seriously changes the character of the milk. It can only be dissolved in warm water, while the condensed milk dissolves readily in cold or warm water.

Condensed milk is somewhat explained by its name, as it is pure milk as drawn from the cow, with three-fourths of its bulk taken away by condensation. The portion removed consists of water only. The remaining part retains all the nutritive elements originally contained in the greater bulk, and in an unchanged condition. The evidence of this will be given later. The condensed milk may be made with the addition of sugar, or without.

If it is desired to keep it a long time, sugar must be added; that without sugar will only keep in good condition for a few days. The condensed milk with sugar is that best known in England, and is what is usually sold by the grocers and chemists; but in America the unsweetened is largely used. The process of condensing milk has been fully described in the public journals within the past three years, and there is not much for me to add that will be new in this respect. I will, however, go over the more important points relative to the collecting of the milk, and the process after receiving it at the works, omitting some of the particulars of treatment in which the public are not specially interested. The method I speak of is that practised at Aylesbury, Buckinghamshire, and Middlewich, Cheshire, by the English Condensed Milk Company, with which I am connected, and is substantially the same as adopted by the principal Swiss Company and the best American establishments.

The starting point is with the farmers who furnish the crude milk to the company. The farmers contract that the cows shall be fed with nothing that will impart an injurious quality or unpleasant flavour to the milk; that no milk from a diseased cow shall be sent in; that the milk shall be cooled immediately after milking, and kept cool; that everything connected with the milking and the utensils used, shall be perfectly clean; that the milk shall be pure as drawn from the cow; that it shall be delivered at the company's works in a perfectly good condition within a limited number of hours after the milking. These conditions are not simply rules to be broken, but are rigidly enforced.

It is well-known that milk is very likely to be tainted by the odour from objectionable substances, when it is left near them, and men are employed to examine each can of milk as it comes in from the farmers, who look at, smell, and taste the milk, so that if there is any peculiarity of colour, odour, or flavour, it is immediately detected, and it is rejected if there is any question as to its condition or quality. By this daily examination the men become experts in judging of the quality and condition of the milk, as tea-tasters do in judging of the quality and flavour of tea. Cream tests are daily and carefully made, and frequent analyses are also made, which demonstrate exactly the constituent parts of the milk.

As regards diseased cows, precautions are taken so that the company will know if any farmer attempts to send in milk from such cows.

The milk is delivered at the works early in the morning, by the farmers' carts, and comes only a comparatively short distance. As soon as it arrives, the milk of each can is carefully examined, as described before, a small portion being set aside for more critical tests than can be made at the time. The milk is now passed through fine strainers into a large tank, of which there are several, one of them holding 1500 gallons. The cans the farmers send the milk in, before being returned to them, are thoroughly cleansed at the works; first, by washing in hot water; each can is then subjected to a powerful jet of steam, which enters every crack and crevice in the can, and afterwards it is rinsed in cold water, so that it goes back cleaner than the farmer could possibly make it.

No time is now lost. That the cream may not rise, or any change take place in the milk, it is heated as soon as possible preparatory to being sent into the vacuum pan, which is done when the heat reaches a certain point. The milk is kept in the vacuum pan at a low temperature; the vapour from it is condensed and taken away, until the milk is brought to the proper consistency, and the necessary quantity of sugar having been previously added, the process is complete. The time occupied in condensing varies according to the quantity of milk, and ranges from two hours and a half to five hours.

The condensed vapour comes away as colourless as water, showing that none of the nutritive qualities are removed.

After the process of condensation is complete, the milk is drawn off and poured into the small tins, which are immediately soldered up. These small tins are packed in cases, holding 48 tins each, and are then ready for the market. Once sealed up, there is no chance of their contents being tampered with; and as the tins are labelled with the Company's labels, a consumer may depend upon receiving the milk exactly as sent out by the Company; and if the milk from the farmers was in good condition, and the treatment of it correct, no change will afterwards take place, excepting a gradual thickening up with age.

The process which I have described sounds simple enough, but in practice it is a very difficult one, and the utmost care and nicety must be observed, from the beginning to the end, that the results may be successful.

The exact details of the process I do not propose to enter upon, as they are fairly the property of the proprietors.

Our works at Aylesbury have been visited at different times by a number of scientific and experienced men, who have witnessed the entire process, and their testimony has been unanimous as to the care taken to get good milk from the farmers, and to treat it properly, the cleanliness of everything connected with the establishment being especially noted, one gentleman saying, "The first and last thing which strikes the visitor is the excessive and almost amusing cleanliness which pervades the whole establishment."

Competition forces the large producers of condensed milk to send out the best possible article, and it must be good to keep well, and find a ready sale. There have been, since the starting of the business, a number of attempts to prepare condensed milk by private parties and public companies, who lacked the experience and knowledge necessary for dealing with so delicate an article as milk; and although they had good material to work with, their efforts have resulted in failure and serious loss.

The condensed milk without sugar is treated in the same manner as that prepared with sugar; it is largely used in the principal American cities, but possesses no advantage over the sweetened milk excepting where sugar is not wanted.

It has, however, the same advantage of careful and accurate attention, and of being prepared in the neighbourhood of the farmers who produce the crude milk, and at some future period will undoubtedly be offered to the public.

The Quality of Condensed Milk.

We have seen what the standard of pure cows' milk is, and we now propose to see what the quality of condensed milk is, and how it bears comparison with the original milk.

In 1867, Baron von Liebig gave the following analysis of condensed milk :—

Water	22·44
Solids	77·56
	100·00

He said of it :—"It consists of nothing but cow's milk and the best refined sugar, and possesses all the properties and qualities of a perfectly pure milk." *The British Medical Journal* of the same year, and *The Lancet*, in 1868, both testified of its purity and excellence. Again, *The Lancet*, in 1871, gave the following analysis of it :—

Moisture	25·10
Butter	11·73
Caseine	15·17
Milk sugar	16·24

Cane sugar	29·46
Ash	2·30
	100·00

saying it "was perfectly sweet, sound, and free from lactic acid." In September, 1872, one of the editors of the *Lancet* visited the works at Aylesbury and examined the whole process, and spoke in the highest terms of the enterprise, giving a new analysis, corroborative of the previous one. the *British Medical Journal* also, in September, 1872, gave an analysis of condensed milk, which was substantially the same as that of Liebig and the *Lancet*.

In October, 1872, Dr. Hassall, in an article published in "Food, Water, and Air," gave his opinion of condensed milk. He made very careful investigations into the matter, and saw the process, from the receiving of the milk from the farmers, until it was soldered up in the small tins. He said, "the milk used was whole milk, of the best and richest description;" and, referring to examinations of condensed milk, made by him at different times, he says, "we have always found it to be both genuine and in a perfect state of preservation."

The foregoing analyses and testimonies have been confirmed in every case where a fair examination has been made.

Taking the condensed milk as having been reduced to about one-fourth of the bulk of the crude milk, it will be seen that it contains, as nearly as possible, the original elements of the original milk, *minus* the water, condensed, and *plus* the sugar, added to preserve it. It can be procured at any time, in any grocer's shop, for testing.

As regards its price, as against the milkman's milk, it is not easy to fix an exact comparison, as it would be unfair to place it on a level with what is ordinarily sold as milk, but the fact that the public have quickly adopted it to a very large extent, and that there is a steady demand for it, is the best possible evidence of the satisfactory price at which it is sold. The demand is not principally for use at sea, as many suppose, but the milk is largely used in families, and as food for infants, for which it is especially adapted.

The trade has grown to such an extent during the past six years that it is estimated that from eight to ten thousand gallons of crude milk are daily required to work into condensed milk for consumption in England.

The company with which I am connected have intentionally put the price of their products very low, in order to induce a demand, and look to a large business with a minimum profit, instead of a smaller business with a large profit. The sale is proportionally quite as large in the poorer districts as in the wealthier, and it certainly offers to the poor as well as the rich the advantage of a really pure article at a moderate price. This is not possible with ordinary milk. The fact is, the company starts with an important advantage over the milkman in the quality of milk each obtains. Admitting that the farmer in both cases sends the milk as drawn from the cow—and in our case, as we deal only with the best class of farmers, I am happy to say we have very little cause to complain—the milkman cannot receive it in so good condition as we do. The milk for towns the farmer has to take to the station, to which he may be obliged to hurry to catch the train; it is then subjected to a railway journey of greater or less extent, and afterwards it is jolted over the pavements in the milkman's carts.

The motion it receives on these several journeys amounts to a partial churning, and, added to the exposure of the hot sun or the rain, to which it is often subjected, seriously affects its charater. Besides, the milkman who distributes the milk to families is not brought into direct contact with the farmer, and the question as to the responsibility of quality or condition of the milk is not easily settled.

The milkman who brings the milk to your door says the milk is as he receives it from the wholesale dealer. The wholesale dealer tells you the milk is as he received it from the farmer. The farmer affirms he sends nothing but genuine milk, and where "the cow with the iron tail" comes in it is not easy to decide.

With condensed milk the quality and condition of the crude milk, as received from the farmer, is of vital importance, as the success of the process depends largely upon the materials started with, and any defect at the beginning would be financially fatal, as good condensed milk cannot be produced from poor materials.

The companies, with their larger organisation, can and do have more careful and scientific tests and examinations of the crude milk than the milkman does or can.

Simple tests of condensed milk can be made by dissolving it in water, adding three or four parts of water, and setting it in shallow dishes to stand ten or twelve hours, when the cream will rise. Also, by mixing with water, and churning it at a temperature of 70 deg. Fahrenheit, and butter will be produced, showing clearly that the butter globules are retained and unbroken. Milk in the condensed form will not convey contagious diseases, as crude milk does. It has been clearly shown, and especially by Dr. Ballard, of Islington, that scarlet and other fevers have been disseminated by crude milk, which has been left to stand in the houses of dealers where disease prevailed. With condensed milk this is not possible, as neither at the farmers nor at the works is it brought in contact with disease, and after it leaves the works, nothing can come in contact with it in the tins.

For infants it is the most natural and uniform food, excepting mother's milk, and it is even preferable to that, if the mother is not in good health. Care must be taken, however, that it is not given too rich,—that is, it should be diluted with seven or eight parts of water.

The summing up of the disadvantages of the ordinary milk as supplied to consumers, and the advantages of the condensed milk as sold in the shops, are shown, I think, to be as follows:—

The disadvantages of ordinary milk are—

1st. It is of a very uncertain quality, and is usually impoverished to a great extent.

2nd. It is materially injured on the journey from the farmer to the consumer.

3rd. If delivered sweet, it remains in that condibut a limited period, as it is well known milk changes from hour to hour.

4th. For infants' and invalids' food it is not a uniform or regular diet, on account of the rapid changes which take place in it.

5th. Little care is taken by the milkmen to get milk in prime condition, and from healthy cows; and a great deal of milk is sold from cows kept in unhealthy sheds in towns.

6th. It is not so convenient to use, as every family must wait for the milkman for their breakfast.

The advantages of condensed milk are—

1st. That it is pure—what it pretends to be—and of uniform quality.

2nd. It is condensed in the country, near the place where it is produced, and receives no injury in transportation.

3rd. It does not change, but keeps sweet any length of time, even if the tins are opened.

4th. For infants' and invalids' food, and for domestic purposes, it is regular and uniform, always to be depended upon from one day to another, or from one week to another, as possessing the same qualities.

5th. Great care is used to obtain from the farmers the milk not only of good quality but in good condition. After it is sent out by the company, it cannot be tampered with, as the tins are hermetically sealed.

6th. It is convenient, always at hand at any hour of day or night, and available for all domestic purposes.

In connection with condensed milk, a combination may also be prepared of cocoa and milk, and of coffee and milk, both of which are ready for immediate use, and need only boiling water to make a cup of either.

[Further information as to the process of preparing condensed Swiss milk will be found in the evidence given by Mr. Merriam before the Food Committee of the Society. See *Journal*, vol. xvi., p. 76.—Ed. *J. S. A.*]

DISCUSSION.

Mr. A. Eames said this was a very important question to him, as he had the conduct and management of a very large public institution (Royal Naval School, at Newcross), with about 300 inmates. It struck him that a little more information with regard to liquid milk would be serviceable—for instance, as to how it could be obtained. He had endeavoured to secure such an unadulterated article, but had always found a difficulty in applying a test. He had used a lactometer, but it was by no means an infallible test. He had also tried the condensed milk, and found it exceedingly useful when ordinary milk could not be obtained. He should like to be informed, however, what quantity of condensed milk represented a given quantity of liquid milk, and the relative expense of the two.

Mr. Botley said he was somewhat surprised to find fully one-third of the paper taken up with strictures on the quality of ordinary milk. He did not think adulteration was carried to so great an extent as was stated. With respect to the trade done in condensed milk, it was now from 8,000 to 10,000 gallons. That did not seem a very large quantity.

Mr. Merriam—8,000 to 10,000 gallons daily.

Mr. Botley said it was not a large quantity, even daily. With regard to cleanliness, dairies, both at Aylesbury and elsewhere, were always remarkable for cleanliness. He could not agree with the paragraph in the paper which stated that condensed milk was the most natural and uniform food for children.

Mr. Smartt thought it might be possible to supply this concentrated milk at a less price than ordinary milk of equal quality, since it could be brought from districts where rent was much lower than in the vicinity of large towns. The process of evaporation had not been fully explained. He asked whether it would not be possible to prepare it in large quantities, and place it in large receptacles, so that dealers might obtain it in that way, and reduce it to the shape of ordinary milk, and then supply it retail.

Mr. Duncan inquired at what temperature the milk was condensed, and what was the quantity of cane sugar introduced? If the temperature were raised above a certain point, the albumen of the milk would be coagulated, the sugar of milk would be changed, and a great disturbance would take place in the quality of the milk. Cane sugar was very objectionable in milk, as some persons could not digest it, and he would suggest that glucose might be advantageously substituted for it.

Mr. Wentworth Scott said, as he had acted as analyst to a large manufactory of condensed milk, he felt some interest in the subject, and should have been glad if Mr. Merriam had given some further information with regard to the modes of testing the milk as received from the farmers. This he might fairly have done without trenching upon any of those trade secrets to which he had referred. He himself was tolerably well acquainted with the practical difficulties attending this portion of the subject, and it would be very useful if a general list of the methods or tests which the milk had to undergo before it was passed by the company's officers, was given. One very simple test, in the hands of educated workmen, which he had introduced, was the examination of the milk with a compound lens of no very great power. If the animal from which it was derived were unhealthy, the globules, more especially their edges, would present an abnormal serrated appearance, which a tolerably practised eye readily perceived. He had also been much struck with the large portion of cane sugar added to the milk, and he was anxious to learn whether any precautions were taken to prevent the undue excess of that substance. He had found, in some samples which he had analysed, no less than 37 per cent. of cane sugar. which was of a higher proportion than that mentioned in the paper. He doubted if the odour of milk, when cold, was any test of its genuineness, or of the health of the animal; though, if the milk were warmed, with a small portion of alkali, and then compared with genuine milk, the test might be regarded as reliable. The suggestion made that retailers of milk should be allowed to sell this milk in a diluted form, at their own discretion, would be nothing more nor less than the legitimation of adulteration on a very large scale. There was no sufficient means of establishing a standard of strength or quality of condensed milk, on the one hand, or pure milk on the other. The suggestion that glucose should be substituted for cane sugar did not meet with his approval, because he had occasionally found traces of glucose, and sometimes more than traces, in condensed milk, which was not of good quality when prepared, or which had undergone some detrimental change in the preparation. He had thus a means of testing the condensed milk, and, especially in his professional capacity as a country analyst. He should be very sorry if any means such as this of testing the quality of the milk were taken from them, by glucose being generally introduced, especially as, in the case of milk, there were very few reliable tests of its quality.

Mr. Dipnall said there was no doubt that adulteration of ordinary milk was a very prevalent practice, and though he might doubt whether the best way of of introducing a lecture on condensed milk was to give such a lengthy criticism on the milk generally supplied, still he was much pleased with the account which had been given. He hoped the company, therefore, would proceed in its course; and if, as was stated, the milk was properly selected, they were doing a good service by supplying a wholesome article of food.

Mr. Newman said he found that the system was first introduced by Mr. House, in 1857, though he did not bring it prominently forward until 1859, when he went to America, where improvements on the process were made by Mr. Borden, and that gentleman became the great manufacturer there. In America, prisons and hospitals used the condensed milk, which was delivered daily, and it appeared to him there was much less waste labour there than under the English system, where the milk was delivered twice a day. If the hospitals in London could, in like manner, be supplied with unsweetened milk, he thought they would find an advantage in it. He knew of several cases of illness in which condensed milk had been used with success.

Mr. Cowper thought a very hard-working and industrious class of persons (the milkmen) had been somewhat harshly dealt with, and that they were not so bad as had been represented. The milk was doubtless useful as a substitute for the fresh article, but it had an unpleasant taste. As in the case of tinned meat, he thought the article was spoilt by the process of preservation. He did not consider the condensed milk any cheaper than the ordinary milk, even supposing the latter had some water added to it.

Mr. Merriam, in reply, said the tests employed by the company to secure good quality in the milk were all that were known. In the first place, tasting,—and although an ordinary person would not detect any difference in different kinds of milk, those who were constantly employed became so expert that he was sure they could detect blindfolded the difference between the milk of different farmers, or from different soils. The milk arrived in large tins, or churns, and on taking off the cover any objectionable quality could be detected by the odour. Then, again, they set a small quantity and raised the cream, which was a very good test of the quality, and if any doubts were entertained, a portion was analysed. On several occasions farmers who had not sent good milk had been dismissed, so that there was no doubt of the tests being rigidly carried out. The microscope was also used, though not so largely as Mr. Scott had suggested. The lactometer was also used, and, though it was not a perfect test, it answered very well when the milk had simply been reduced by the addition of water. Analysis, of course, did not show the condition of the milk, but it was decisive as to its quality. The statements he had repeated, with regard to the adulteration of milk, were not his own—they were all taken from other and higher authority, and he had never heard them disputed. It had been said that all dairies were clean, and so they were, to a certain extent; but the process of condensation required absolute and perfect cleanliness, and it was, therefore, always insisted on. Then, again, if the fluid milk came clean from the dairy, it very often became contaminated with dust and smoke in transit on the railways, so much so that a large dealer informed him he was sometimes ashamed to send it out. With regard to the estimated quantity of 10,000 gallons per day, supplied by the various companies, he thought it was very satisfactory in so short a time, considering the difficulty there always was in introducing any new article. A remark had been made as to the original cost of milk being low in the country, but practically it was regulated by the price of butter and cheese, into which it was converted if there was not a good market for it in the crude state. The milk was evaporated *in vacuo* at a temperature never exceeding 140° Fahr., so that there was no opportunity for a film to form upon it, nor did he think any change was effected in the constituents by the temperature. With regard to the quantity of sugar introduced, there was no uncertainty about that; the milk was measured or weighed as it came in in the morning, and the sugar added in an exact proportion accordingly—in fact, it was not to the interest of the company to increase the quantity of sugar, for practically the product was sold by the bulk, and the addition of sugar only added 6 per cent. to the bulk, whilst it raised the expense by 25 per cent. They would prefer to reduce the sugar, if it could be done with safety. The *Lancet* and Dr. Hassall gave the proportion of cane sugar at 29 or 30 per cent., which was not quite so much as stated by Mr. Scott; but he understood from analysts that there was a great difficulty in separating sugar of milk from the cane sugar which was added, and possibly slight variations might be accounted for in that way. As to the proportion of water, there was quite sufficient competition to make all the companies supply a good article, or they would immediately lose their connection. If the milk were set for the cream to rise, it would be so changed in character that it would not keep when condensed.

Mr. Cowper said he wished to know if condensed milk at the present price was cheaper than ordinary milk with say 25 per cent. of water added.

Mr. Merriam thought it would be, but the only way would be to get a tin and try it. Taking ordinary milk at 4d. a quart, and condensed milk at 8½d. a tin, he thought the latter would be the cheaper. It appeared so by the constantly increasing sale, even in the poor districts. He considered a tin represented about two quarts of ordinary London milk. There was no doubt that the process of condensation did impart a slight taste to it, though he believed it was not perceptible in coffee or in cooking. In tea, however, some found it objectionable, though others did not. One gentleman said he preferred pure milk, and so would most people, but the difficulty was to find where it could be got.

The Chairman, in proposing a vote of thanks to Mr. Merriam, said he was glad that gentleman had acknowledged there was one failing in the condensed milk, because he was always suspicious of any article which was described as faultless. He should have liked to have heard more of the details of the process, and not quite so much of the panegyric, as it was the more general custom in the Society for members to form their own opinion on the merits of what was brought before them after hearing a full explanation of its properties. All these matters, to a great extent, depended on price, and if a tin cost 8½d., and two quarts of milk could be bought for 8d., he saw no advantage in it. He lived near a dairy, and bought perfectly pure milk at 4d. a quart; and he was able to speak with some authority, having kept cows himself. It was a pity to advocate anything to an extreme, and he regretted that it had been stated that condensed milk was superior to human milk for infants, which was absurd, though, no doubt, if it could be produced at a cheap rate abroad, where pasture land was abundant and cattle plentiful, it would be of great service in aiding the supply of milk to the metropolis.

The motion having been carried,

Mr. Merriam, in acknowledging the compliment, said he had not represented the condensed milk as better than natural milk, but as superior to that ordinarily procurable in towns. The chairman might be unusually fortunate, but he could only repeat that the statements he had made as to the prevalence of adulteration were not his own, but those of men whose testimony was unimpeachable.

Reports from Bordeaux state that the recent severe frosts have so injured the vines that all hopes of a vintage is this year at an end.

The *Scientific American* says that maple sugar, as an article of merchandise, is in a fair way of extinction, the trees are being cut down and converted into broom handles. At the present rate of destruction both maple broom handles and sugar will soon become unknown in trade.

ANNUAL INTERNATIONAL EXHIBITIONS.

The number of visitors admitted to the Exhibition for the week ending Saturday, April 26, was as follows:—Season tickets, 1753; on payment of 2s. 6d., 1351; on payment of 1s., 18,461; total, 21,565.

The number of visitors admitted on Thursday last was, season tickets, 236; on payment of 1s., 3,722; total 3,958; on Friday, season tickets, 294; on payment of 1s., 3,448; total, 3,742; on Saturday, season tickets, 406; on payment of 1s., 4,932; total, 5,338. The number admitted on Saturday, after 6 p.m., was, season tickets, 13; on payment of 6d., 220; total, 233. On Monday, season tickets, 269; on payment of 1s., 2,828; total, 3,097; after 6, p.m., season tickets, 15; on payment of 6d., 211; total, 226. On Tuesday, season tickets, 248; on payment of 1s., 3,247; total, 3,495. The number on Wednesday was, season tickets, 351; on payment, of 2s. 6d., 1,354; total, 1,705.

The 10th meeting of the Committee for Silk and Velvet was held on the 29th April. There were present Sir D. Cooper, Bart., in the chair, Dr. Campbell, Mr. Cassels, Mr. Cobb, Mr. Lewis, Mr. Lintilhac, and Dr. Mann. The following resolutions were passed:—1. That it is desirable for this Committee to cause to be published brief notes, to be transmitted to the seats of manufacture, specifying what has been accomplished for the Exhibition; and that the several members of the Committee be requested to send, as soon as possible, a few notes on the particular points to which they consider the attention of the respective branches of the silk trade should be called 2. That invitations be sent to the Mayors and Chambers of Commerce of the towns interested in silk manufacture, to find out the most intelligent workmen, who should have every facility given them to examine the products.

Among the *fêtes* proposed to be offered to the Shah of Persia on his visit to this country, it is in contemplation to give one in the Royal Albert Hall, on a grand scale, to which only season ticket-holders and seat-holders will have the privilege of admission.

The late exhibits at the London Tavern, for the benefit of the "Northfleet Relief Fund," are all to be removed to the International Exhibition.

THE SCHOOL OF POPULAR COOKERY.

Now that the success of this school is established, it may be confessed that the scheme was a hazardous one. It was so easy to laugh at the idea of teaching cooking seriously by lectures, that any mishap would have been fatal, and the whole thing might have collapsed under a mass of ridicule. The execution of the idea must of necessity have been either very bad or very good, for unless it had been very good it could never have carried sufficient weight to have overpowered objections. As it is, the popularity of the thing is secured—everybody has a good word for the school, and fault-finders are silenced.

In real truth, there is no reason why the art of cooking should not be placed on a higher level than it now occupies. The work in itself is no more menial or degrading than are most of the occupations of women—not so much so as half of them, insomuch as they have a tangible and useful result, which is more than can be said for the most popular female occupations of our time. By good cooking the health of the people can be improved to an extent little thought of by those who have not considered the subject. Supplies of food now wasted can be utilised, new sources of food can be made available, and the food now used be made to do double its work in supporting and nourishing the frames of its consumers. The proper preparation of food may add not a little to a people's comfort and happiness; and when the method of such preparation can be simply and easily taught, is not such teaching a worthy and a useful object? Such are the intentions of those who started the School of Popular Cookery, and it must be a matter of no small congratulation to them that their intentions are so fully appreciated by the general public who come to the Exhibition.

The method of operation has been several times described, but we may perhaps just mention that every day, at certain hours, a lecture is given describing with minute detail the preparation of some dish. While the lecturer describes, assistants illustrate the description by carrying out the various processes one after another as they are mentioned. Visitors have thus the opportunity of seeing the actual manner in which the dish is prepared, and at the same time having the *rationale* of the process explained. There are, of course, pauses in the lecture, while the actual cooking is going on, but these are filled up by various general remarks upon the ingredients of the dish under treatment, or by practical suggestions originating from the method pursued. This is a simple programme enough, but so well is it carried out that the attention of the crowded room never seems to flag, and the entire audience appears to follow with the greatest care the remarks of the lecturer and the manipulation of his satellites.

The process most recently under explanation has been the cooking of omelettes, and the preparation of maccaroni in different ways. Some useful information was also given as to the method of cooking used in the Prussian army. Two Prussian soldiers illustrated the plan by actual cooking, carried on in a bit of waste ground adjoining the school. The vessel is merely a tin case, and the operation is performed over a fire of sticks, but the results are excellent. It was suggested that, by a similar device, many a workman who now has to make his dinner off a bit of bread and a lump of cold bacon, might be provided with a warm and tolerably comfortable meal. Next week we understand that methods will be described of cooking Australian and other preserved meat. It would be difficult to select a more suitable subject. The introduction of preserved meats has been so recent, that very few persons have any idea how to prepare them for the table. In consequence of this the public generally are not in a position to avail themselves of this most important source of food supply. Badly cooked, there is no doubt that preserved meats are far from palatable, but by proper treatment they may be made as pleasant and savoury as meat recently killed. We anticipate for the lectures on Australian meat a popularity even greater than that attained by those already delivered.

Arrangements are also being made for the giving of personal instruction in cooking to any who wish for it. A room, near the school, is being prepared, so that those who wish for more practical knowledge than they can obtain by merely listening to lectures, may be able to obtain it. The success of this experiment makes us wish that by some means more lasting provision might be made for giving similar instruction. The result of these lectures will certainly be no mere increase in luxury, but improvement in the health, the comfort, and general happiness of the people. That comparatively little good can be done by a short course of lectures, such as these, is but too certain, but if they can be made the foundation of a regular and lasting institution, the good they will effect cannot be measured by the influence exerted on the few—out of our millions of population—who have the opportunity of profiting by them.

The Channel Tunnel scheme is again under notice, Lord R. Grosvenor having had an audience with the French Minister of Works with regard to a concession being made.

EXHIBITIONS.

VIENNA EXHIBITION.

The published arrangements for the opening were as follows:—"The International Exhibition at Vienna will be opened by the Emperor Francis Joseph in person on Thursday next at noon. The Empress will be present, and the entire Court will be in attendance, in addition to the Royal visitors by that time already the Emperor's guests. Among them are the Prince of Wales and Prince Arthur, and the German Crown Prince and Princess. Invitations have been issued to the most distinguished official men. The commissioners will attend *ex officio*, exhibitors on special application, and the public only on payment of 50s. each person. Every one possessing a uniform is required to wear it, and such as have orders or decorations are requested to display them. Other male spectators must be in evening dress. The doors will open at nine and close at eleven. The Court and Royal guests will assemble in the Emperor's pavilion at 11·30, where the Emperor and Empress will join them shortly before twelve. The Imperial company will cross the grounds to the south portal of the Exhibition Palace on foot, while military bands play the National Anthem and troops stationed in the grounds fire a royal salute. Up to the outside of the portal the chief master of ceremonies conducts the august company. Here he relinquishes his charge to the Minister of Commerce, Herr von Bahnans, who, in his turn, resigns it on the threshold to Archduke Rainer, the "protector" of the Exhibition, and his staff of commissioners. The Archduke will conduct the Emperor and his party to raised seats under the dome, the company present rising, and the Exhibition orchestra, under Herr Strauss, reinforced by the Opera orchestra, playing the National Anthem. After a brief address from the Archduke Rainer, accompanied by the presentation of a memorial and catalogue, his Majesty will declare the Exhibition open, while a second royal salute will convey the tidings to the outward world. Brief addresses from the Prime Minister and the Mayor of Vienna will follow; thereupon the foreign commissioners are expected to take their places in front of their departments, while the opera *personnel*, under Herr Dessoff, performs Handel's festival chorus. Their Majesties and the Court will then make the round of the Industry Palace, conducted by Archduke Rainer, and in their departments by the foreign commissioners. The promenade will extend through all the transepts. Having concluded this, their Majesties will return to the rotunda, and by the south portal to the Emperor's pavilion, taking their departure while a third royal salute is fired. The Exhibition will then remain open to the privileged company assembled till six o'clock."

According to all received accounts preparations for opening the Exhibition were proceeding vigorously, and the city was rapidly becoming full of visitors. Previous to opening, reports stated that the British department in the Palace of Industry was decidedly more advanced than any other, not excepting even the Russian, so that it was in a position to make a very comprehensive and splendid show yesterday.

The Prince of Wales and Prince Arthur reached Vienna on Tuesday, and visited the Exhibition on Wednesday.

A telegram from the Special Correspondent of the *Daily News* at Vienna announces that the Prince of Wales paid a visit to the Exhibition on Wednesday afternoon, in his capacity as Chief Commissioner of the British Department. The Prince first examined the houses where the workmen in that department are lodged, and then inspected the machinery. He afterwards visited the Agricultural department, and expressed his satisfaction that the arrangements were so nearly completed. After transacting some formal business in the Pavilion of the British Commission, his Royal Highness went the round of the British department in the main building, and paid special attention to the display of porcelain and the Indian collection. The Correspondent adds that the arrangements for the opening ceremoney are well advanced. Ten thousand men are employed by day and four thousand by night to hasten on the work.

The official catalogue of the British section, published in London, was despatched in time for the opening ceremony, and it must have been the only catalogue that was actually on sale in the Exhibition building yesterday; since it was, so far as we have been able to discover, the only one in a sufficiently forward state for such early publication. This is a fact which reflects no little credit on the executive of the British Commission, and it is decidedly satisfactory that in this, as in other respects, we should be so far advanced of the other nations represented at the Exhibition. In itself the catalogue is a most comprehensive and carefully compiled work, and one which reflects no small credit on all engaged in its preparation. It is not indeed complete, for the collections from India have not arrived in time to be catalogued, nor are the consecutive numbers to be attached to each exhibitor's case yet published, so that we must wait for a future edition for their omission to be supplied; but so far as the arrangements concern merely the British section, they are complete, and all the *lacunæ* have to be supplied by the central authority at Vienna.

A brief sketch of the contents may be useful. First comes an account of the general regulations for admission to the Exhibition. Then follows the official list of commissioners, committee, and executive. After this is a list of owners of objects of fine art. Next is a description of the medals. Then comes an account of the space allotted to each country in the industrial, machinery, and agricultural halls. Next is a scheme of the general Austrian classification; this is arranged in parallel columns, one giving the preliminary classification of the exhibited objects, and the other the classification as finally drawn up for the examination by the juries. We now come to the catalogue proper. This includes an alphabetical list of exhibitors, a list of exhibitors arranged in groups, and also a "dictionary of objects exhibited." This is a new idea, and a very excellent one. By means of this "dictionary" we get a complete subject-matter index to all the exhibits in the British section, so that all exhibitors of any particular object, or class of objects, are shown at once. After this comes a classified list of colonial exhibitors, and there will be besides, in future editions, a similar list of exhibits from India.

Such are the contents, but the illustrations deserve notice also. There is a plan of the entire Exhibition, showing in colours the spaces allotted to each country; a similar map of the British space; and one of the fine art portion, also coloured. There is also a large map of Vienna itself, a plan of the Rotunda and surrounding space; a perpendicular section of the Rotunda, and a perspective view of the same. It will be seen that the book is very decidedly superior to the ordinary run of exhibition catalogues, and contains an amount of information seldom to be found in them.

In addition to the Catalogue, H. M. Commissioners have published a translation of the Austrian tariff of import duties, for the use of exhibitors. The Exhibition itself is, so to speak, "in bond," but it is an important matter that exhibitors should know what duty will have to be paid, either upon their exhibited goods, if sold, or upon other goods hereinafter imported. Various other items of useful information for the exhibitors, such as patent laws, protection of designs, &c., are also provided.

Among the British exhibits is a portable cooking apparatus, the invention of Mr. Adams, and is intended principally for street use. The idea of thus providing a properly-cooked meal in the streets, or wherever a body of workmen may be congregated, is an excellent one, and one which deserves to be properly carried out. We hear that the apparatus is attracting considerable notice at Vienna, and that for practical convenience, portability, and economy of fuel, it has few if any equals.

Amongst the Scotch exhibitors at the Vienna Exhibition, Mr. J. D. Dougall, of Glasgow, who took the grand gold medal at Moscow, has arranged to show some of the recent improvements in breech-loading rifles and fowling-pieces and other weapons. His case will contain a sample of the various breech-loading weapons manufactured in Glasgow by him for all the varieties of game. The first is a large-bore spherical-ball double rifle, for dangerous animals, such as tigers and elephants. This rifle is supplied with the "Dougall shell," which, from its extreme deadliness, makes the whole weapon the most destructive that man has yet produced for individual use. The second is a small-bore double-barrelled express rifle, ·450 bore. The bullet weighs about half an ounce, but, from being hollow in the point, it opens up after entering the skin of the animal, and creates a wound of a fearful nature, which is certain to be fatal. This is a sample of a class of weapons to be used against deer, antelope, &c. The third specimen is an eight-bore gun, barrels three feet long, and almost 13lbs. in weight, the maximum weight for weapons of this character. This kind of weapon is used by American sportsmen for use against swan, geese, and duck. The fourth is a twelve-bore fowling-piece, such as is in general use. All the preceding examples are on the patent lock-fast system. The fifth is also a twelve-bore gun, its peculiarity being that it is lock-fast, and partially self-closing. The next is a sample of a gun that is entirely self-closing, and which is considered the strongest of the class of weapon which depends on a spring for its fastening. The case will also contain other minor articles, and it is expected that it will be unsurpassed in its class. The list value of the battery complete is a little over £400.

A train of 132 waggons has left Warsaw for Vienna, conveying Russian contributions to the Exhibition. The second train is to consist of 30 waggons.

A correspondent of *Iron* sends in the following details, dated April 21, as to machinery in the Exhibition :—

"Entering the machinery hall, at the west end, the first section to traverse belongs to America. With the exception of a solitary fire engine this section is quite empty, as is also the American gallery in the main building.

"Next to the American, in the machinery-hall, comes the English section. In no part of the building is more rapid progress being made with the setting up the machines than in this section. Many exhibitors have already quite completed their preparations, and in the agricultural hall there remains but little to do. The boilers are all fixed (one by Cater, Walker, and Co.; one Howard's patent safety tubular; two Daniel Adamson and Co.; two Galloway and Sons). Complaints are made of the slowness with which the goods arrive, and although the English have made great progress, in comparison with other nations, it is not certain whether all the machines will be in working order by the 1st of May.

"In the French section, which comes next to the British, affairs are in a lamentable state; not a single machine is even ready, and only one is in its place. Very few French machines have arrived as yet, and their pace in the machinery hall is almost altogether vacant. The French boiler-house is yet quite empty.

"Next to the French comes the Swiss. Here rapid progress has been made during the last fortnight, and the preparations are in an equal state of forwardness with those in the English section. The little boiler-house, with its single boiler, has been ready for some time.

In the adjacent Belgian section there is, comparatively, little done or doing; but many things were unloaded last week. The boiler-house is still empty.

"In the German section, which comes next, a great deal of work is being done; but the preparations are far from being so far advanced as they should be. An immense amount of work remains to be done before this section will be completed. The German section of the machinery hall, as well as the Austrian, is provided with a pair of overhead travelling cranes, capable of raising 5,200 kilos. The German boilers are nearly ready.

"The next and last section is reserved to Austria and Hungary, and, with the exception of the French and American sections, is the least advanced in the whole building, a large portion of the farther end being quite empty and desolate. But few machines have arrived, and even the preliminary work of getting out the foundations, &c., is going on very slowly. The boiler-house, however, is finished, and the boilers set.

We have received, says the *Architect*, from a gentleman who is a member of the French Commission, and well acquainted with exhibitions of other countries, excellent accounts of the prospects of the coming exhibition of Vienna.

All those, he says, who remember the condition of the Paris Exhibition of 1867, agree that the works at Vienna a fortnight before the opening of the Exhibition were decidedly more advanced than were those in the Champ de Mars at Paris at a similar period. There is therefore, no doubt whatever about the opening of May 1, and if certain galleries should not receive their last touch and finish until a little later, the first visitors will find quite sufficient to cause surprise and admiration.

The impression made on everybody on first passing the outer barrier which encloses the palace and the other buildings of the exhibition, is the immensity of the enterprise, and the enormous efforts which have been made for its realisation.

Around the principal building, crowned by its dome, or rather lantern, near the palace of the Beaux Arts, the pavilion of the amateurs, or loan collection, the machine gallery, which is as long as the principal building itself, a prodigious number of buildings in every style, and of all kinds of materials, built by Austrians and foreign commissions, rise all over the immense park in all directions. Prominent among these are the pavilion of the Emperor Francis-Joseph, that of the jury, one belonging to the directors of the most important journal in Austria—the *New Free Press*—model-houses of various kinds, and restaurants almost without number, where the tourist may recruit his powers during his travels through the great transformed park of the Prater. The area covered by the Vienna Exhibition is, in fact, several times larger than the Champ de Mars of Paris, and it may be seen at a glance that the account of the dimensions are in no way exaggerated.

The works in the Prater present the most animated and picturesque appearance; amidst the shrieking of the locomotives, which are dragging loads of machinery and merchandise to the very doors of the Exhibition buildings, in the midst of the unloading of cases, the sharp sound of saws, and the dull noise of hammers we hear the voices of all nations. The workmen and workwomen employed by the Austrian commission itself include four or more nationalities, amid which the Italians, Croats, and Germans are prominent. The women take more part here in manual labour than they do in Paris, and still more than in London; and it is rather startling to see a number of women mounted on the scaffolding, mixing mortar and otherwise aiding in the work of the masons.

Over the centre of the principal building rises the grand dome, whose daring construction equals in point of interest the wonders it covers. From the top of the lantern which surmounts the whole, the panoramic view is very fine. At present the ascent is a work of considerable labour, but a lift will shortly be ready for the visitors. It will give some idea of the enormous dimensions of the central rotunda to state that on the occasion of the opening ceremony of the 1st of May, the carriages of the Emperor and of the entire official procession, will make the tour of the inside of this grand central building, which is large enough to allow of this, although containing a vast mass of splendid trophies, and with space for an immense concourse of visitors.

It may be a question whether the number of visitors will reach the total hoped for by the Imperial Austrian Commission, but this is certain, that the Exhibition itself will deserve the most signal success.

Exhibition of Leather.—Steps are being taken to have an exhibition of leather at Northampton, the principal place where the boot and shoe trade of this country is carried on. Already the applications for space have been so numerous and important that the committee find that the Town-hall will not be large enough for the exhibition, and it is proposed to erect a separate exhibition building. American machinery is already on its way to this country for the purposes of this exhibition, and a large number of the leading inventors and manufacturers have already secured spaces for their exhibits.

VENTILATION OF CATTLE TRANSPORTS.

Our neighbours have for some time occupied themselves with this important subject, and we have before us the report of M. Morin, on experiments carried out at Cherbourg, the results of which must be taken as below an average, as the experiments were conducted without the benefit of sea-breezes and steam-boilers in full work. The inferences from these trials are as follows:—

1. That with arrangements effected in the case of the cattle transport *Calvados*, a natural ventilation may be obtained, without any artificial heat being called into play, which is highly favourable to the sanitary condition of the interior of wooden vessels, and that with a fresh breeze it amounts to a supply of 16,000 cubic metres of air per hour. 2. That with the aid of a moderate fire beneath the boilers, very much smaller than that required for the working of engines, a supply of 41,000 cubic metres of air per hour was obtained, corresponding with 183 cubic metres per stall and per hour. 3. That the auxiliary fires, intended to produce ventilation in harbour, in sailing, and also in exceptionally unfavourable cases occurring in tropical regions, when under steam, would assure a removal of the air in the hold at the rate of 35,000 to 40,000 cubic metres per hour, with a consumption of not more than 30 to 40 kilogrammes of coal. The powerful action of the boiler chimneys would probably, in nearly all cases, prevent the necessity of recurring to the use of auxiliary fires, and, consequently, of any additional expenditure of fuel for ventilation, the healthy condition of the hold of steamers may then be considered to be obtained without cost.

In commenting upon the experiments in question, made by M. Bertin, the reporter says:—"The happy application by M. Bertin of the known principles and arrangements of ventilation by simple action (*appel*), and the remarkable results which his observations have brought to light under conditions eminently less favourable than they would be on board a vessel at sea, prove once again that it is scarcely ever necessary to have recourse to mechanical means, always more complicated and more troublesome than the simple and rational system of ventilation. The introduction of the use of fresh, dried, and preserved vegetables has caused scurvy to disappear almost entirely. The rendering wholesome the interior of vessels will complete the work of benevolence, towards the accomplishment of which every friend of the sailor and soldier ought to lend all the aid in his power."

The above would doubtless be more satisfactory were the arrangements made on board the *Calvados* fully explained, but the officially-reported results themselves have an actual value.

GENERAL NOTES.

Technical Education.—The judges appointed by the Company of Coachmakers and Coachharness Makers to examine the drawings of carriages and parts of carriages sent in for competition for the prizes offered by the company report that the drawings sent in were far more numerous than last year, there being 27 competitors and 62 drawings. Most of the competitors, the judges say, seem to have fairly understood what was required, and it is hoped that by taking advantage of the means of exhibiting the best drawings at the carriage exhibition, held this year at South Kensington, the prizes offered annually by the company will become better known and more keenly competed for, and each year show a higher average of skill in drawing. There seems to be a very general want of knowledge in freehand drawing, as a preliminary training before special carriage drawing; the consequence is a poorness of design, that better training would prevent. There is also an evident want of general knowledge of carriage construction, as a whole, among the competitors. Each competitor seemed to have a fair knowledge of his own department, but when he tried to combine the work of other departments with his own the result in many cases was unsatisfactory. A good training in the technology of carriage building, as proposed by the Society of Arts, will tend greatly to strengthen future competitors in the means of producing satisfactory results. The judges have not considered the work of any competitor of sufficient merit to justify them in recommending the court to confer the freedom of the company this year. They, however, recommend that, considering the great increase of competitors, the company should increase the number of medals and money prizes to be awarded in future years by the judges, and continue to offer the freedom to such candidate as shows a high degree of merit, especially as the freedom seems to be considered a distinction eagerly sought after.

Water Gas.—The *Scientific American* disposes of the question of obtaining gas from water as follows:—"This water burning business has become a nuisance that can only be abated by the dissemination of correct scientific principles. Pumping water into a reservoir by a costly engine in order that it may drive a small wheel at the bottom, is fully as economical as any of the contrivances for burning water with which we are acquainted."

NOTICES.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

THE LIBRARY.

The following works have been presented to the Library:—

The Bible Educator. Part I. Edited by the Rev. E. H. Plumptre, M.A. Presented by Messrs. Cassell, Petter, and Galpin.

Annals of the Queen's College, Birmingham. Vols. 1 and 2. Edited by Wm. Sands Cox, F.R.S. Presented by the Editor.

Report of the Charter, Warneford Trust Deeds, and the Act of Parliament of the Queen's College, Birmingham. By Wm. Sands Cox, F.R.S. Presented by the Author.

Proceedings of the Royal Society of Edinburgh. Presented by the Society.

The Agricultural Economist. Vol. 3, 1872. Presented by the Editor.

Official Catalogue of the British Section of the Vienna Universal Exhibition, 1873. Presented by the British Royal Commission.

Vienna Universal Exhibition, 1873. Austrian Tariff of Import Duties upon the Principal Articles of British Produce and Manufactures. Prepared by Her Majesty's Commissioners for the Guidance of British Exhibitors. Presented by the British Royal Commission.

Theory and Practice of Linear Perspective. By P. Pellegrin. Presented by the Publishers.

Report of the Metropolitan Board of Works for 1872.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. The following meetings have been arranged:—

May 7.—"On Improvemements in the Manufacture of Gun-cotton." By S. J. Mackie, Esq., C.E.

May 14.—"Improvements in Rifles." By Capt. O'Hea.

May 21.—"On Recent Processes for the Production of Gas for Illuminating Purposes." By Thomas Wills, Esq.

CANTOR LECTURES.

The Third Course of Cantor Lectures for the present session is "On Wines; their Production, Treatment, and Use," by J. L. W. Thudichum, Esq., M.D. The Course consists of six lectures, the third of which will be given on Monday evening, the 5th of May, the remaining three on the Monday evenings succeeding.

Lecture III.

Description of the vineyards of the Alto Douro, from personal observation of the lecturer. Contrast of geological position of these vineyards to those of Jerez. Varieties of vines cultivated; all medium-sized grapes; whereas the Jerez grapes are all large-sized. Indigenous vines, as studied by the lecturer in the province Entre Douro e Minho. Viticulture in the Alto Douro. The vintage and wine-making.

Lecture IV.

The varieties of wines produced in the Alto Douro; how treated at Oporto. Lodges. Brandy. Legend of elderberry. Unbrandied and dry natural Alto Douro wines. Neglect of scientific guidance here also, but processes more simple, and varieties of results not so great as at Jerez. Description of other Portuguese vineyards—the Beiras, Valley of the Tagus, Bucellas. Fable of the transplanted Rhenish grapes. Collares. Torres Vedras. General remarks on the nature and difficulties of Portuguese viticulture and vinification, all based upon personal observation of the lecturer.

Lecture V.

The wines of France compared to those of Spain and Portugal. The Gironde, its vineyards, wines, and varieties of wines. The Bourgogne and its productions. Belgian appreciation, and sweetness of Burgundy wine. The wine requires the procédé. The Champagne; peculiarities of viticulture. Chemical treatment of effervescent wine to ensure its soundness. Absurd notion of some writers on champagne; of the same on second wines and sugar-water wines; exposure of the sycophancy.

Lecture VI.

The wines of Germany; Riessling a type of bouquetted wines. Classification of the wines of the world, as determined by quality, quantity, value in the market of highest and lowest qualities. Active ingredients of wine. Use of chemical analysis. Use of wine to the healthy, whether old or young; wine, under which condition preferable to all other alcoholic liquids. Wine should be a beverage, not a dram. Use of wine to the delicate and sick. Selection and prices of wine. Proposed modification of the import duties, to adjust them to the climatic difficulties of Spain and Portugal.

INDIA COMMITTEE.

A Conference will be held on Friday evening, 9th instant, at 8 o'clock, when a paper will be read by Lieut.-General Sir Arthur Cotton, R.E., on "The Harbours of India." Lord William Hay, F.R.G.S., will preside.

The report of Mr. Tayler's paper on "The Rosary in India," is postponed till next week.

Members are entitled to attend these Conferences free, and to admit two friends to each of them.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...**SOCIETY OF ARTS**, 8. Cantor Lectures. Dr. Thudichum, "On Wines; their Production, Treatment, and Use"
Social Science Association, 8. Commander Dawson, R.N., "The Legal Securities to Life at Sea."
Society of Engineers, 7½. Mr. John Somerville, "Charging and Drawing Gas Retorts by Machinery."
Farmers' Club, 5½. Mr. J. Bailey Denton, "The Storage of Water."
Victoria Institute, 8. Mr. W. D. Michell, "The so-called Flint Implements of the Drift."
Stationers' Company, 7¾. Technological Lectures. Mr. E. A. Davidson, "Wood Engraving, its History and Practice."
Royal United Service Institution, 8½. Capt. C. E. Luard, R.E., "Field Railways; and the General Application of Railways in War."
Institute of Surveyors, 8. 1. Mr. Hope, "Sewage Farming." 2. Discussion on Mr. Menzies' Paper, "Arterial Drainage Works, Water Supply, and Sewage Drainage Works, executed at Windsor, between the years 1867 and 1873."
Entomological, 7.
British Architects, 8. Annual Meeting.
Medical, 8.
Asiatic, 3.
London Institution, 4.

Tues. ...Civil Engineers, 8.
Pathological, 8.
Anthropological Institute, 8.
Biblical Archæology, 8. 1. Mr. Cull, "On the Signification and Etymology of the Hebrew Noun Tirshatha." 2. Mr. W. R. A. Boyle, "On the Chronology of the Olympiads in connection with the Golden Age of Greece." 3. Mr. A. M. Cameron, "On the Sites of Ophir and Taprobane, from Greek and Hindu Authorities." 4. Mr. P. Le Page Renouf, "On the Character of the Preposition in the Egyptian Language." 5. Mr. C. W. Goodwin, "Translation of an Egptian Hymn to Ammon."
Zoological, 8½.
Royal Institution, 3.

Wed. ...**SOCIETY OF ARTS**, 8. Mr. S. J. Mackie, "Improvements in the Manufacture of Gun-cotton."
Microscopical, 8.
Obstetrical, 8. Mr. W. K. Parker, "On the Development of the Sturgeon's Facial Arches."

Thurs...Royal, 8½.
Antiquaries, 8½.
Royal Society Club, 6.
Mathematical, 8.
Royal Institution, 3.

Fri ......Royal Institution, 9.
Quekett Club, 8.

Sat......Royal Botanic, 3¾.
Royal Institution, 3.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,068. VOL. XXI.

FRIDAY, MAY 9, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

INDIAN COMMITTEE.

A conference was held on Friday evening, April 25th, Sir M. DIGBY WYATT, F.S.A., in the chair.

The Paper read was :—

THE ROSARY IN INDIA.

By William Tayler, Esq., late Commissioner of Patna.

I feel that it is almost incumbent upon me to apologise for venturing to introduce a subject which, as far as the general character of this Society is concerned, is foreign to its purpose, and which, even in respect to the special department of "Indian Conferences," can claim little sympathy on the grounds which are usually accepted as the basis of public addresses; for the question which I am about to present to your notice has no connection with art or science, nor any relationship to the civil, political, or material interests of India.

The break of guage in the Imperial Railway does not enter my programme. Taxes, opium, education, have neither part nor lot in the matter. There is not the most distant allusion to Central Asia, the "neutral zone," Russian ambition, or Anglo-Indian diplomacy.

It is a question simply of a certain number of beads hung upon a string for the purpose of being passed, devotionally or mechanically, as the case may be, through the fingers of a worshipper—a question which (save as regards one Christian body, whose use of the Rosary is devoid of all mystery or exaggerated effect), has no concern with an energetic European race of the 19th century, and certainly no immediate bearing—at least, that can be perceived by ordinary eyes—on the affairs of modern Englishmen.

If, therefore, I were asked, how is it that I presume to bring before an English audience, in 1873, a subject so apparently alien to all national and individual interests, I should be driven to answer, as our poet Cowper answered his imaginary critic, who asked what was the world to him, and why he troubled himself with the affairs of other men ?—

> "What's the world to me?"

the poet says—

> "Much. I was born of woman;
> I think, articulate, I laugh and weep,
> And exercise all functions of a man.
> How, then, should I and any man that lives,
> Be strangers to each other?"

But, irrespective of such general appeal to the unlimited sphere of human sympathy, this subject, trivial and eccentric as it may appear, has other claims to the passing attention of the modern cosmopolite, whether artist, savant, or socialist. For, in the first place, it bears with it certain not uninteresting phases and incidents ; secondly, it is a subject on which, speaking generally, there is the most profound ignorance; and thirdly, it is connected with one transcendant truth, to which, though in a strange and wayward way, it testifies—viz., the universal belief, in all parts of the world, of the existence of a God, the dependence of man upon His power and providence, the reality of a future existence, and the efficacy as well as the duty of present worship.

With such apologies for my subject, I trust I may be pardoned if I am on this occasion deviating from the usual routine of artistic, practical, and scientific discussion.

If any lady or gentleman here present were to open a work of established authority—the "Imperial Dictionary" or "Encyclopædia Britannica," for instance—and turn to the word "Rosary," they would find it described as a "chaplet of beads, used during worship by the Roman Catholics." This, with perhaps a few details in regard to its use, and number of beads, is almost the entire information vouchsafed to the inquirer; and it is very much as if the word "hat" were to be described as a "species of head-dress worn by cabmen in Piccadilly."

And this is, in all probability, the general idea of the Rosary—at least, among those who have not cared to carry their inquiries further. And those who entertain this restricted conception of the Rosary may possibly be under some apprehension that in discussing its origin and use, I shall transgress the rules and regulations of this Society by entering on the religious phase of the subject connected with the ceremonial worship of that body of our fellow-Christians who, according to the dictionaries, are the sole monopolists of the Rosary as an accompaniment and aid to devotion.

It may, therefore, be well, at the commencement of the subject, to relieve the minds of any who entertain such apprehensions by stating that the Rosary, instead of being confined to Roman Catholic Christians, is to be found in the hands of I really don't know how many millions of mortal men — Hindoos, Mahommedans, and Buddhists, constituting, with the Roman Catholic Christians, about three-fourths of the entire human race. In the few observations, therefore, which I propose to make upon its origin, object, and use, I shall have something to say without in any way entering upon any question likely to excite the *odium theologicum* of Protestant or Catholic, Hindoo, Mahommedan, or Buddhist, high, low, or broad Church.

True devotion consists, I need hardly say, not in active and articulated prayer only, but in the communion of the soul with God—a communion beautifully described by one of our sacred poets as "the soul's sincere desire, uttered or unexprest." Every man, I apprehend, feels, or has felt, the extreme difficulty of reaching such a state of mental abstraction from the realities of actual life as to admit of such communion for any length of time. Words, as George Eliot beautifully says in the "Gypsy," "are but as broken light upon the depths of the unspoken." Words may or may not assist the struggling mind in the contemplation of the Deity; but, among occupied and energetic men, who feel that "to labour is to pray," and who recognise in honest and active occupation the best discharge, even of religious duty, there is little desire to devote too much of their time to spiritual contemplation, and thus it happens that actual prayer, at stated periods, and for a given time, is the only devotional exercise in which they can indulge.

Such men, as it appears to me, do not require artificial aid to their devotion, and it is not among such people that we should naturally look for the first adoption of the Rosary, which, in whatever way it is used, is an accompaniment and aid to devotional worship, not in its active or aggressive phase (if I may use such an expression), but in that of calm and solemn contemplation.

It is accordingly among those religionists who, above and beyond all others, are distinguished for the calm and contemplative character of their religion, that the Rosary was most appreciated, although its invention may be claimed by others; and this brings me to a subject which would in its fulness occupy fifty lectures, but upon which I have time only to say but a very few words. I wish I could conscientiously believe that sufficient interest was taken in the ancient history of India to make it superfluous to say that some 500, some say 1,000, years before the Christian era there was a real living being called Goutama Buddha, and that this man, being of Royal race, and born in the purple, did actually leave his regal palace and his father's dominions, of his own free will, exchanging the luxury and magnificence of a court for the privation and hardships of a wilderness, and that subsequently issuing from his retirement, he did, unaided, and by the force of his own exertions and example, entirely subvert the national religion of the Brahmins, and establish in its place a new system of religion and morality utterly opposed to that which he displaced.

Now, whatever difference of opinion may exist among the learned as to the exact character, extent, and origin of the Buddhist religion, one characteristic of that religion is admitted by all, and that characteristic is what may be termed "quietism."

It seems to be a matter of dispute whether the Buddhist believes in the existence of God or not; but he certainly ignores providential interference. He believes he may win everlasting happiness by his own efforts, and those efforts exerted not in active occupation, benevolent enterprise, or polemical agonisation, but in the cultivation of holy calm, gentleness of demeanour, tenderness of life, extending even to the bug and the flea, holy and continuous contemplation, a religion in which "all thoughts, all passions, all delights, whatever stirs the mortal frame," are accounted violators of the peace. Buddha himself is ever at rest, the highest merit attainable in this world is abstraction and quiescence, the highest final beatitude "nirvana" or absorption in the Deity.

Now, in following out such a system of devotion as this, we can perceive that artificial aid is not to be despised. The man, especially in a warm climate, who conceives it to be his first duty to sit quiescent and unmoved upon his hams for hours together, in solemn contemplation of an unseen Deity, with the vague prospect of eventual absorption, after thousands of years and frequent transmigrations, and who believes that this abstraction from the things of this life is, in itself, the merit by which the highest beatitude can be attained, such a man, if he partakes of human infirmity, would, I imagine, be rather disposed, in spite of himself, to fall asleep, unless in some way or other he aided his devotional exercise by some material adjunct, which, while it helped to keep him awake, would not disturb the calm and quiet character of his worship. Precisely such an adjunct would be found in the rosary—rendered still more agreeable, as some people say, by the additional charm of *coolness* in the beads as they pass through the hands on a hot and oppressive day.

And it is worthy of remark that the Bhuddist's rosary is almost always made of smooth material—stones, coral, amber, or seeds, the most common being the seed of the Toolsee plant (the *Ocymum basilicum*), the well-known shrub into which the fair maid Toolsee was metamorphosed by Vishnu's wife, who thought that her husband admired the young woman more than she approved.

That the rosary was in use among the Hindoos long before the introduction of the Buddhist religion is obvious, for the most ancient images and pictures of the gods are frequently represented with chaplets of beads in their hands; but it is equally obvious that it was cordially welcomed by the reformers, who subsequently carried the system of artificial or rather vicarious prayers to an extent which, though doubtless affording considerable relief to an indifferent or exhausted worshipper, is sublimely absurd.

This is seen in the adoption of the whirligig, or prayer-wheel (which I shall show you presently).

Dr. Hooker, in his excellent work, the "Himalayan Journal," thus mentions this amusing machine:—"Here, too, I first saw a praying machine turned by water; it was enclosed in a little wooden house, and consisted of an upright cylinder, containing a prayer, and with the words 'Om muni Pudmi om' (Hail to him of the Lotus and the Jewel) painted on the circumference. It was placed over a stream, and made to rotate on its axis by a spindle, which passed through the floor of the building into the water, and was terminated by a wheel."

Messrs. Huc and Gabet, the celebrated French missionaries, give a longer description of the custom, with an amusing anecdote, which I will here quote—"The Buddhists have another mode of simplifying pilgrimages and devotional rites. In all the great Lamaseries you find, at short intervals, figures in the form of barrels, and turning upon an axle. The material of these figures is a thick board, composed of infinite sheets of paper pasted together, and upon which are written, in Thibetan characters, the prayers most reputed throughout the country. Those who have not the taste, or the zeal, or the strength to carry huge boards of books on their shoulders, or to prostrate themselves step by step in the dust or mire, or to walk round the Lamasery in winter's cold or summer's heat, have recourse to the simple and expeditious medium of the prayer-barrel. All they have to do is to set it in motion, it then turns of itself for a long time, the devotees drinking, eating, or sleeping, whilst the complacent mechanism is turning prayers for them. One day, on approaching a prayer-barrel, we found two Lamas quarrelling furiously, and just on the point of coming to blows, the occasion being the fervour of each for prayer. One of these having set the prayer-automaton in motion, and quietly returned to his cell, as he was entering turned his head—doubtless to enjoy the spectacle of the fine prayer he had set to work for himself—but, to his infinite disgust, he saw a colleague stopping his prayers, and about to turn on the barrel on his own account. Indignant at this pious fraud, he ran back and stopped his competitor's prayer. Thus it went on for some time, the one turning on, the other stopping the barrel, without a word said on either side. At last, however, their patience exhausted, they came to high words; from high words they proceeded to menaces, and it would, doubtless, have come to a fight had not an old Lama, attracted by the uproar, interposed words of peace, and himself put the automaton in motion for the joint benefit of *both* parties."

Ludicrous as is this picture, it shows the belief of the contending devotees in the reality of prayer, even when mechanically conducted by a senseless barrel.

And here it may be as well to give a little further information as to Buddhist ceremonial, especially as I have been enabled, by the kindness of Dr. Campbell, the former superintendent of Darjeeling, to show you—as I shall at the close of this lecture*—a Buddhist Lama in his priestly dress, with the altar and all the paraphernalia of Buddhist worship.

To this end I will quote a few further passages from Dr. Hooker's interesting journal:—

"We were awakened at daylight by the discordant orisons of the Lama; these commenced by the boys beating the great tambourine, then blowing the conch shells, and, finally, the trumpets and thigh-bone.

"Shortly the Lama entered, clad in scarlet, shorn and bare-footed, wearing a small red silk mitre, a loose gown girt round the middle, and an under-garment of questionable colour, possibly once purple. He walked along, slowly muttering his prayers, to the end of the apartment, whence he took a brass bell and dorge,† and sitting down cross-legged commenced matins, counting his beads, or ringing the bells, and uttering most dismal prayers. After various disposal of the cups a larger bell was violently rung for some minutes, himself snapping his fingers and uttering most unearthly sounds. Finally, incense was brought, of charcoal with juniper sprigs; it was swung about, and concluded the morning service, to our great relief, for the noises were quite intolerable. Fervid as the devotions appeared, to judge by their intonations, I fear the Lama felt more curious about us than was proper under the circumstances; and when I tried to sketch him, his excitement knew no bounds; he fairly turned round on his settee, and continuing his prayers and bell accompaniments, appeared to be exorcising me or some spirit within me."

Here is another description of the Lama worship, vol. i., p. 312:—

"This being a festival day, when the natives were bringing offerings to the altar, we also visited the old temple, a small wooden building. Besides more substantial offerings there were little cones of rice with a round wafer of butter at the top, ranged on the altar in order. Six Lamas were at prayers, psalms, and contemplations, sitting cross-legged on two small benches that ran down the building; one was reading, with his hand and forefinger elevated, whilst the others listened; anon they all sang hymns, repeated sacred or silly precepts to the bystanders, or joined in a chorus with boys, who struck brass cymbals, and blew straight copper trumpets six feet long, and conch-shells mounted with broad silver wings, elegantly carved with dragons. There were besides munis, or praying cylinders, drums, gongs, books, and trumpets made of human thigh-bones, plain or mounted in silver.

Before leaving the Buddhist and his devotional auxiliaries, it may perhaps interest you to see a Lama as he appears at his prayers, which the kindness of Dr. Hooker has placed at my disposal.

At the close of my paper I shall have the pleasure of showing you, in greater perfection, what is now concealed by this curtain, viz., the Lama in his actual dress, with the altar, bell, rosary, and other articles of ceremonial worship.

We must now pass from the Buddhists to the Hindoos, and see in what light they regard the Rosary. Of the earliest days we have little information, none, indeed, except the mere fact of its being in use. It is clear that the Buddhists received it from the Brahmins, and that the Brahmins resumed it when they expelled the Buddhists.

The Shastras tell us that the advantages gained by counting beads are four, viz.:—

1st. Arth (riches).
2nd. Dhurm (piety).
3rd. Kam (sensual enjoyment).
4th. Mosh (salvation.)

So that all the beatitudes, temporal and eternal, are attainable by this simple exercise.

Moore, the Oriental scholar (no mean authority), says, "The thousand names of Vishnu and Shiva are strung together in verse, and are repeated on certain occasions by Brahmins, as a sort of litany, accompanied sometimes by the rosary. As each name is mentally recited, with the attention abstractedly fixed on the attribute or character that each name excites the idea of, a bead is dropped through the finger and thumb. Such operation is supposed to assist and promote abstraction, an attainment that enthusiastic Hindoos think exceedingly efficacious."

One of the most important ceremonies in which the Hindoo rosary played a part, was in what was called the "Nama-kirt-han."

The formula of this devotional exercise was somewhat monotonous, as it consisted in nothing but the repetition (at least in Bengal) of the names of Krishna, as follows:—"Huri Krishna, Huri Krishna; Krishna, Krishna, Krishna, Huri. Huri, Huri, Ram; Huri Ram, Ram. Huri, Huri!"

This is a specimen of those vain repetitions which our Saviour reprobated among the Jews (probably alluding to the "Mea Heracoth"), but which, strange to say, have always apparently found special favour among human beings in all parts of the world, as if reiteration of words alone, or the physical fact of lingual ejaculation, were devotionally valuable.

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* By an unfortunate accident this dress, &c., did not arrive in time to be shown.

† "Dorge," a supposed model, in metal, of a thunderbolt.

The variety in the size of the rosary and the number of the beads among the Hindoos constitutes a difference between their beads and those of the Buddhists.

Moore says he once saw a rosary of one hundred thousand beads! although the true rosary, as finally accepted, consists, like that of the Buddhists, of one hundred and eight beads only; the piety of a Vaishnava (he continues) is generally estimated by the number of times the rosary is gone round. No real Vaishnava, under whatever circumstances, drinks water or tastes food without making one revolution of the sacred mala, the name by which the rosary is designated. It is an object of adoration, and is generally enclosed in an envelope of silk, neatly and tastefully made. In every village of Bengal the Vaishnavas are seen after the morning ablutions and at nights duly counting their rosaries while walking in the streets; their fingers are seen rolling over the Toulasi beads, and their lips in motion. The Námá Kirt'tan, however, is performed in silence; no audible voice is heard; the fingers and the lips are only observed to be in the utmost activity; experienced Vaishnavas, veterans of the Námá Kirt'tan, can manage very often to serve God and Mammon at the same time. They may be seen listening to a conversation and taking their part in it, and at the same time engaged in counting their beads.

Marvellous efficacy is ascribed to the Sádhana; it is the only thing necessary, in this age of sin and vice, for the attainment of future felicity. The neglect of the rest of the Sádhanas can amply be atoned for by a diligent performance of Hari Námá. This is pre-eminently the duty of the Kali-Yuga, or iron age.

From these descriptions it will be perceived that there is a considerable difference in the practice of the Hindoo and the Buddhist. The Hindoos, as I have shown, consider that all happiness here and hereafter is to be attained by the constant use of the Rosary. With them the Rosary is not only used for the purpose of assisting abstraction (though this is sometimes the object) but as an exercise constantly repeated on various occasions of active employment, as well as in the energetic celebration of established ceremonies; and it is worthy of remark, that the Buddhist rosary is, as I have before observed, always *smooth*. The most favourite materials of the Hindoo rosary is the *Roodrach*, an extremely *rough* and rugged seed, quite unsuited to the quiet manipulation of the contemplative Buddhist.

I have myself an idea that the rosary or prayer bead owes its earliest origin among the Hindoos to the sacred necklace or mála, for that is the word, to this day, indiscriminately used both for necklace and Rosary.

The origin of the necklace is involved in some obscurity, but that necklaces are among the most ancient of ornaments there is little doubt, as they are frequently mentioned in Scripture.

The most ancient, probably, now in existence is the necklace of Menes, the first of the Egyptian kings (now, I understand, in Dr. Abbott's cabinet at Cairo), and it is said to resemble the Indian necklaces as represented in the most ancient cave temples.

It will be found, perhaps, that the first conception of the necklace was a string for suspending charms and amulets in a collar, itself vested with Talismanic powers. Necklaces and collars, in the form of serpents, were thus worn by the Greeks and Romans as charms against the evil eye. Roots and herbs also were thus appropriated as antidotes for sickness, and for their pleasant perfume and sweet scent, as in the "Winter's Tale" Autolycus offers—

> "Necklace amber,
> Perfume for a lady's chamber."

It is easily conceivable that such necklaces, almost all of which, as far as male wearers are concerned (for the female love of ornamentation is an entirely different matter, being simply the ambition of personal beauty, common alike to ancient barbarian and modern belle), are connected with some religious idea, should gradually assume the more direct religious character which appertained to the Rosary, and thus eventually a sacred or devotional necklace, or chaplet, should be originated.

The chief necklace wearer among the Hindoo Gods was Shiva, or Muhadeo (the destroyer). His necklace was not a pleasant one, being composed of human skulls, which he invariably wore, even when in company with his amiable consort, Parbutee. Indeed his wife kept him company, and she wore at times a string of smaller skulls.

We now come to the Mahommedans, and here, curiously enough, we find the same value and importance given by them as by Buddhists and Brahmins to the repetition of prayers, benedictions, and sacred names, as a meritorious act, conducive to salvation or spiritual benefit, which is, indeed, one of the most prominent doctrines of the Koran.

"The Mussulman," says Gibbon, "is encouraged to hope that prayer will carry him half-way to God, fasting will bring him to the door of his palace, and alms will give him admittance."

Mahommed, in his personal experience with the Deity, was commanded to impose on his disciples the daily obligation of 50 prayers, though these were afterwards reduced to five. With the conviction of the value of repetitions, and with the example of the Jewish "Mea Heracoth" (or hundred benedictions) before them, the adoption of the Rosary was a natural expedient of the Mussulman. The mode of using it is described by Lane in his notes on the "Arabian Nights:"—"When the Moslem has finished the prayers ordained by the Koran, if he would acquit himself of supererogatory acts, he remains sitting (but then may sit more at ease), and recites in succession sundry passages from the Koran, repeating each 33 times."

I must here, however, observe that Mahommedans generally say that Mahommed never used the Koran himself, but counted his prayers on his fingers; and it is certain that the Wahabees, those unpleasant fanatics who have for years past plotted and still are plotting against the British Government, totally abjure the use of the Rosary, and regard it as an abomination.

The full Mahommedan Rosary, called by them *Tusbeeh*, consists of ninety-nine beads, with one chief bead which they call the Imam, the whole number corresponding with the hundred names of God. It is divided into three equal portions, each consisting of thirty-three beads. The divisions are marked, sometimes with a stone or bead of different shape, sometimes by one or more tassels, called "shumsehs," which, made of gold thread and silk of divers colours, have a brilliant and pleasing effect.

The Rosary, among Mahommedans, is used by women as well as men; and Tom Moore was not drawing on his imagination when he writes—

> "Her little garden mosque to see,
> And once again at evening hour
> To tell her ruby rosary
> In her own sweet acacia bower."

Mount-Stuart Elphinstone, in his "History of Cabul," says:—"Many people have always a rosary hanging round their wrist, and begin to tell them whenever there is a pause in the conversation. They are supposed to repeat the name of God whenever they drop a bead, but they often go on while they are listening attentively to what is said, and even while they are speaking themselves."

The unhappy Eloisa pathetically represents this divided attention—

> "Thy voice I seem in every hymn to hear;
> With every bead I drop too soft a tear."

Among the Hindoos and Buddhists, we see the Rosary confined to a few simple substances, chiefly seeds, grains, coral, and other natural products, and seldom, at least among the ordinary worshippers, assuming an ornamental appearance.

Among the Mahommedans the case is different: all the Rosaries they use are made of elegant and ornamental materials, such as I here show you—agate, cornelian, onyx, even emeralds.

Here is one of onyx, which deserves some special notice. The onyx is called by the Mahommedans "Soleymani puthur," or "Solomon's Stone," for what exact reason I cannot ascertain; but there is a curious anecdote connected with King Solomon and the onyx which may throw some light upon it. The Mahommedans have a tradition that before the Queen of Sheba went to the length of visiting King Solomon in person, she endeavoured to test his reputed wisdom by sending him a bevy of young girls cunningly dressed as boys, a pearl not pierced, and an onyx bead with a crooked passage drilled through it. King Solomon was equal to the occasion. He at a glance penetrated the disguise of the boys, ordered a worm to bore the pearl, and another to pass a thread through the onyx.

The onyx—which, in passing, I may observe derives its name from the Greek word for nail (the white patch in it being considered like the human nail)—is frequently mentioned in Scripture as highly precious, and is held in great estimation among the Mahommedans.

It was her anxiety to recover the onyx necklace which brought Ayesha, the favourite wife of Mahommed, into that awkward scrape, from which she was only rescued by a "special revelation." She had stayed behind her husband on a journey, and the prophet suspected her of desiring a stolen interview with an admirer. The revelation absolved her, and she recovered her necklace and her character at the same time.

What this material is (*showing one of the specimens of rosaries*) I do not know, and have not been able to discover. I have consulted all the savans of Calcutta, and made enquiries from many natives, without effect.

The names given to it are two, and are remarkable. The one in Arabic is, "Uqueeq oolbuhr," or "Cornelian of the Sea." The other (in Oordoo) is "Moonga-ka-jur," or "Root of Coral." It is apparently of a resinous nature, as will be seen by holding it to the light; and a curious circumstance is, that a small bead of red coral is always inserted, it being the universal belief that without this the beads would crack.

It is worth noticing, in regard to this rosary and its name, "Root of Coral," that Chaucer, in his "Canterbury Tales," mentions a coral as apparently in use for prayer beads. He describes the fair nun's dress thus:—

> "Full fetire was her cloak, as I was ware.
> Of small corall about here she bare
> A pair of bedes, gauded all with greene."

In this note on the passage there is the following explanation of the word "gauded":—"Having the gaudies greene;" and then in Latin—"Tria paria precularicum, cum le gaudoys argenti deaurata,"—*i.e.*, three pairs of prayer-beads, and then Gower is quoted:—

> "A pair of bedes, black as sable,
> He took and hung my neck about."

And this "pair of bedes," thus specially mentioned, is again referred to by Beaumont and Fletcher—

> "Go, get a pair of bedes, and learn
> To pray, sir, with your wife for a month."

But I have not exhausted the noticeable Mahommedan rosaries.

Here is one of peculiar sanctity, called the "Khak-i-shafa," or earth of healing, being made of the sacred earth of Kurbala, where the martyr Hossein was slain.

It is difficult to exaggerate the sacredness of this earth, or the veneration shown even at the present day to the memory of Hossein, the younger son of Ali, and grandson of the prophet Mahommed. The story of this young hero's death, as related by Gibbon, is so interesting that I shall be pardoned if I here read it. The tale may perhaps be new to some present.

Hosein's Story.

"With an equal measure of piety, Hosein, the younger brother of Hassan, inherited a remnant of his father's spirit, and served with honour against the Christians in the seige of Constantinople. The primogeniture of the line of Hashem, and the holy character of grandson of the apostle, had centred in his person, and he was at liberty to prosecute his claim against Yezid, the tyrant of Damascus, whose vices he despised, and whose title he scarcely deigned to acknowledge. A list was secretly transmitted to Medina, of one hundred and forty thousand Moslems, who professed their attachment to his cause, and who were eager to draw their swords so soon as he should appear on the banks of the Euphrates. Against the advice of his wisest friends, he resolved to trust his person and family in the hands of a perfidious race. He traversed the deserts of Arabia with a timorous retinue of women and children, but as he approached the confines of Irak, he was alarmed by the solitary or hostile face of the country, and suspected either the defection or ruin of his party. His fears were just. Obeidollah, the governor of Cufa, had extinguished the first sparks of insurrection; and Hosein, in the plain of Kerbela, was encompassed by a body of five thousand horse, who intercepted his communication with the city and the river. He might still have escaped to a fortress in the desert, that had defied the power of Cæsar and Chosroes, and confided in the fidelity of the tribe of Tai, which would have armed ten thousand warriors in his defence. In a conference with the chief of the enemy he proposed the option of three honourable conditions—that he should be allowed to return to Medina, be stationed in a frontier garrison against the Turks, or safely conducted to the presence of Yezid. But the commands of the caliph, or his lieutenant, were stern and absolute, and Hosein was informed that he must either submit, as a captive and a criminal, to the commander of the faithful, or expect the consequences of his rebellion. 'Do you think,' replied he, 'to terrify me with death?" And, during the short respite of a night, he prepared with calm and solemn resignation to encounter his fate. He checked the lamentations of his sister Fatima, who deplored the impending ruin of his house. 'Our trust,' said Hosein, 'is in God alone; all, though both in heaven and earth, must perish, and return to their creator. My brother, my father, my mother were better than me, and every Mussulman has an example in the 'Prophet.' He pressed his friends to consult their safety by a timely flight. They unanimously refused to desert or survive their beloved master, and their courage was fortified by a fervent prayer, and the assurance of Paradise. On the morning of the fatal day he mounted on horseback, with his sword in one hand and the Koran in the other. His generous band of martyrs consisted only of thirty-two horse and forty foot; but their flanks and rear were secured by tent-ropes, and by a deep trench which they had filled with lighted faggots, according to the practice of the Arabs. The enemy advanced with reluctance; and one of their chiefs deserted with thirty followers, to claim the partnership of inevitable death. In every close onset or single combat the despair of the Fatimites was invincible; but the surrounding multitudes galled them from a distance with a cloud of arrows, and the horses and men were successively slain; a truce was allowed on both sides for the hour of prayer, and the battle at length expired by the death of the last of the companions of Hosein. Alone, weary, and wounded, he seated himself at the door of his tent. As he tasted a drop of water he was pierced in the mouth with a dart, and his son and his nephew, two beautiful youths, were killed in his arms. He lifted his hands to heaven; they were full of blood, and he uttered a funeral prayer for the living and the dead. In a transport of despair his sister issued from the tent, and adjured the general of the Cufians that he would not suffer Hosein to be murdered before his eyes; a tear trickled down his venerable beard; and the boldest of his soldiers fell back on every side as the dying hero threw himself among them. The remorseless Shamer, a name detested by the faithful, reproached their cowardice, and the grandson of Mahomet was slain with three and thirty strokes of lances and swords. After they had trampled upon his body they carried his head to the castle of Cufa, and the inhuman Obeidollah struck him on the mouth with a cane. "Alas!" exclaimed an aged Mussulman, "on those lips have I seen the lips of the Apostle of God!" In a distant age and climate the tragic scene of the death of Hosein will awaken the sympathy of the coldest reader. On the annual festival of his martyrdom, in the devout pilgrimage to his sepulchre, his Persian votaries abandon their souls to the religious frenzy of sorrow and indignation."

It is not a matter of surprise that the memory of Hosein should receive the enthusiastic veneration which it does to this day. It is in memory of him and his brother Hassan that the great festival of the Mohurrum is yearly celebrated in all parts of India, when thousands of fanatical devotees smite their breasts in frensied enthusiasm, and the air resounds with the cry of "Hai Hassain! Hai Hosein!"

The following memorandum was written by myself in India, after showing this rosary to several Mahommedans:—

"I have been much amused at the account given me of this holy earth by those around me. The Sherishtadar of my office, 'Farzund Ali,' says that the Soonnees do not carry the Rosary, nor use the 'Sijdeh-gah,' because they do not hold the earth in much estimation. On the contrary, 'Moolvee Imdad Ali' (Sudder Ameen), a Soofi, and a professedly enthusiastic devotee of the Soonnee faith, gives quite a different reason. His version is that the earth is to the Soonnees an object of such intense and overpowering sanctity that they dare scarcely touch it! The mere sight, he says, overwhelms the faithful and religious Moslem with such awe and pious horror that he is fain to withdraw his unworthy eyes from the contemplation. In telling me this 'Imdad Ali' pointed to an imaginary piece of earth, and assumed the appearance and aspect of a condemned criminal, with one foot on the scaffold.

"My old Kansamann (butler) tops this account by affirming that the genuine Khak-i-Shufa *turns red* during the Mohurrum (when the death of Hosein is celebrated) in sympathy with the hero's martyrdom.

"Synd Azeem Ood-deen, the deputy collector, on the contrary, who gave me the Rosary, a man of singular intelligence, himself a Sheah, treats the matter with a decorous though scarce concealed indifference, perhaps contempt.

"Last, though not least, the principal Sudder Ameen, Mahomed Rookenood-deen, the pillar of piety (supposed to be a Wahabee), openly scorns the whole affair and all its sanctities, as utterly absurd."

Having now given you some faint idea of the Rosary in the East, I must say a few words as to its use and incidents in our own country.

I need hardly tell you that the Rosary is in general use at the present day among Roman Catholic Christians, being used in connection with the five joyful, the five sorrowful, and the five glorious mysteries of our Lord's life, death, and resurrection.

It consists of three groups of fifty-five beads each, with a large bead as a medal to begin with, and the professed object of its use is to aid in meditations on the special subject before the worshipper, when the "Paternoster" or the angelical salutation, "Ave Maria," are respectively repeated.

Protestant Christians we know have, whether wisely or otherwise I will not venture to say, altogether abandoned the use of the Rosary, as of many other ceremonies.

But this part of the subject trenches on delicate grounds, and I will not, therefore, dwell on it, but offer some observations on the mention which we find of it in some Christian writers.

It may, perhaps, be new to those who do not much trouble themselves with the intricacies of etymology to know that the word "bead" is the past participle of *biddan*, the Saxon word for "to pray," and thus originally signified string praying, or a prayer. The transition of the signification from the prayer to the accompaniment shows how general in olden times was the practice of using beads at the time of prayer. Spencer, in the "Fairy Queen," says:—

> "Where that old woman day and night did pray
> Upon her beads, devoutly penitent,
> Nine hundred paternosters every day,
> And thrice nine hundred aves she was wont to say."

And, again:—

> "All night she spent in bidding of her bedes,
> And all the day in doing good and Godly deeds."

The introduction of the beads or Rosary among Christians is generally attributed to St. Dominic, in the 13th century, but there is reason to believe that it was, in fact, much earlier; some, indeed, maintain that it was first introduced in the time of St. Benedict, about the 6th century. It was just at this period that the Buddhists were finally driven out of India by the Brahmins, and scattered themselves over the world.

That the Rosary, or bead-chaplet, was in general use in India long before the Christian era, I have already shown; and that it was borrowed by Christians from the Buddhists appears to be the most reasonable assumption. The extraordinary similarity between the ceremonial of the Buddhists and Roman Catholics has been a frequent subject of remark. The tonsure, the bare feet, the long dark gown, and the Rosary are common to both, while the mitre is in ordinary use among the higher orders of the priesthood.

I well remember, on my return from Nepal, where I had been sketching the Buddhist Lamas from life, coming to a village at a place called Bettia, entirely inhabited by converted Christians, in one of our districts near the foot of the hills, and being struck with the exact resemblance of the excellent Christian priest who lived with them and the Buddhist Lamas, whom I had just left. The whole scene was most interesting; the entire village was Christian, and the order, quiet, and cleanliness of the villages formed a most striking contrast with the neighbouring native communities. The priest lived among the people, and was evidently much beloved; he had, however, forgotten his Latin. I prepared, as I thought, a highly classical sentence, but we could not understand each other, and took refuge in Hindustanee.

But whenever and by whomsoever introduced among Christians, beads very soon assumed considerable importance in Europe, and their use became more frequent on the return of Christians from the crusades. In England the "beadsman" was a very prominent personage.

In the "Two Gentlemen of Verona," Proteus says to his friend—

> "And in thy danger,
> If ever danger do environ thee,
> Commend thy grievance to my holy prayers,
> For I will be thy beadsman, Valentine."

The ill-fated monarch. Richard II., thus alludes to the beads of beadsmen—

> "What must the king do now? Must he submit?
> The king shall do it. Must he be deposed?
> The king shall be contented. O' God's name, let it go!
> I'll give my jewels for a set of beads;
> My gorgeous palace for a hermitage;
> My gay apparel for an alms-man's gown;
> My figured goblets for a dish of wood."
> —*Richard II.*, Act iii., Scene iv.

In the introduction to the "Antiquary," the author thus writes of the beadsman. Referring to the portraiture of Edie Ochiltree, and after describing the Scottish mendicant of the eighteenth century, he says:—"If, in addition to his personal qualifications, the mendicant chanced to be a king's bedesman, or blue-gown, he belonged, in virtue thereof, to the aristocracy of his orders, and was esteemed a person of great importance. These bedesmen are an order of paupers to whom the kings of Scotland were in the custom of distributing certain alms, in conformity with the ordinances of the Catholic Church, and who were expected in return to pray for the royal welfare and that of the state."

In Knight's edition of Shakspeare, we find the following note on the speech of Proteus which I have quoted above:—"The Anglo-Saxon beade—a prayer, something prayed—has given the name to the mechanical help which the ritual of the early church associated with the act of praying. To drop a ball down a string at every prayer, whether enjoined by the priest or by voluntary obligation, has been the practice in the Roman Church for many centuries. In our language, the ball, from its use, came to be called a bead. To "bid the beads" and to "pray" were synonymous. Burnet, in his "History of the Reformation," says:—"The form of bidding prayer was not begun by King Henry, as some have weakly imagined, but was used in the times of popery, as will appear by the form of bidding the beads in King Henry the Seventh's time. The way was, first for the preacher to name and open his text, and then to call on the people to go to their prayers, and to tell them what to pray for; after which all the people said their beads in a general silence, and the minister kneeled down also and said his." We find the expression "bedes byddyng" in the "Vision of Piers Plowman," which was written, according to Tyrwhitt, about 1362. In the same remarkable poem we also find "bedman," "beadman," or "beadsman." A beadsman, in the sense of "I will be thy beadsman," is one who offers up prayers for the welfare of another. In this general sense it is used by Sir Henry Lee to Queen Elizabeth. "Thy poor daily orator and beadsman" was the common subscription to a petition to any great man or person in authority. We retain the substance, if not the form, of this courtly humiliation, when we memorialise the Crown and the Houses of Parliament, concluding in the assurance that their '*petitioners will ever pray.*' But the great men of old did not wholly depend upon the efficacy of those prayers for their welfare, which proceeded from the expectation or gratitude of their suitors. They had regularly-appointed beadsmen, who were paid to propitiate Heaven with their supplications. It is to this practice that Shakspeare alludes in the speech of "Scroop" to "Richard II."—

> "Thy very beadsmen learn to bend their bows
> Of double-fatal yew against thy State.'

But all this is past, and Sir Walter Scott tells us in his advertisement to the Antiquary, "The poor orators and beadsmen" of England live now only in a few musty records, or in the allusions of Spenser and Shakespeare; and in the same way the "Blue Gowns," or "King's Bedesmen" of Scotland, who "are now seldom to be seen in the streets of Edinburgh," will be chiefly remembered in the imperishable pages of the author of Waverley.

Having now detained you so long, and, I fear, to very little purpose or profit, I will only venture to say a few, and a very few words, as to the general conclusions which the philosopher and philanthropist may deduce from the facts stated.

We have seen that among the great majority of civilised nations of the world, artificial aids to prayers have been for many centuries in general use.

The universality of the custom—whatever be its special motive or purpose—establishes, as observed at the beginning of my address, and that by tangible and material evidence, the one great fact which is of interest to us all, viz., the world-wide instinctive conviction of the existence of a God, of a Being to be propitiated and worshipped by prayer.

And if we thus find proof of this universal conviction, we also see in this regular organisation of artificial aids to prayer the universality also of that melancholy and humiliating experience—which we must all recognise in ourselves at the present day, viz.:—the extreme difficulty of abstracting the mind from the cares, pursuits, or fascinations of the present life, and fixing it on things unseen.

It is obvious that when prayer or devotion is once considered to be a distinct duty, meriting reward and effective in itself, to the attainment of everlasting happiness, the difficulty of continuous prayer without artificial and external assistance is felt as a grievance, and at once suggests such devices as the rosary, the phylactery, and, to carry the thing *ad absurdum*, the mechanical prayer barrel, which will wind out prayers and praises for the proprietor like a skein of silk, while he is comfortably engaged in the duties of everyday life, enjoying his dinner, smoking his pipe, or taking an afternoon nap, and very probably virtually unwinding the prayers that the machine is performing for him.

That the Hindoo, the Buddhist, and the Mahommedan did thus regard the duty and the efficacy of prayer, I think I have shown; in what exact light the use of the Rosary is a Christian worship I do not feel qualified to suggest; and whether viewed as a mere aid to pious contemplation and devotional thought, it is a thing to be accepted or ignored, I leave to learned theologians to discuss.

It is, however, a curious circumstance that so many mortal men of different religions, different ideas of right and wrong, inhabiting different climes, and not unfrequently hating or despising one another, should, by common consent, have hit upon a string of round beads for one of the most momentous purposes of life, and retained it for so many centuries without modification or change.

It is a strange illustration of the old adage, "One touch of nature makes the whole world kin," and it is remarkable, if not humiliating, to think that the "touch of nature" in this case is the difficulty of spiritual exercise without external and material help.

The somnolent party of the present day who snores during the sermon, is remarkably like the sleepy Buddhist or dozing Brahmin of three thousand years ago, and would probably be saved from exposing himself if he had some beads to pass through his fingers, and were possessed with the idea that his future state depended, to some extent at least, on the number and accuracy of those revolutions.

With this moral I will conclude my paper, and earnestly express my hope that the observations and facts I have ventured to offer, though out of the routine of lectures in this society, and neither learned nor scientific, may not be considered altogether uninteresting or unprofitable.

DISCUSSION.

Dr. Archibald Campbell begged to apologise for not having fulfilled the promise he made his friend Mr. Tayler, to lend him some articles of Buddhist attire, but his excuse was that the gentleman who had charge of his collection at the Crystal Palace had been suddenly called away, and he had not been able to get at them in time. Amongst the Buddhists, as with most other religions, there were two sects, distinguished from one another by the colour of their robes, and they were usually known as the Red Lamas and the Yellow Lamas. The dress that he had hoped to place before the meeting was that of a Yellow Lama, with his mitre cap, brown girdle, and the altar table, behind which he was seated when at prayers. On this table were placed the bell and dhorje or thunderbolt. The Lama always held the rosary in his hand when engaged in prayer, while the praying wheel was placed beside him. It had been correctly said that quietism was the essence of the Buddhist religion, but, having lived for thirty years amongst Buddhists in Nepal and Sikkim, he had come to the conclusion that an equally striking feature was the remarkable amount of toleration they displayed, and this, perhaps, was the cause of their great success. The religion originated in India, spread thence to Tibet, then on to Mongolia, Mantchuria, Turkistan; descended south to China and Birmah, and thence through Siam, Cambodin, and the Straits of Malacca, to the various islands in that region. There was no examination or profession of faith required, but any one might enter a Buddhist temple and join in the worship, and this tolerant spirit had no doubt largely contributed to the wonderful spread of the religion. The use of the Rosary was universal, not only amongst the priesthood, but amongst all classes of educated persons who paid any attention to their religious duties. They were generally formed of smooth beads, as had been stated, but he had seen them made from small bones punched out of the skull of a lama, and looking like a string of shirt buttons. This was supposed to possess peculiar sanctity. Coral was universally used in rosaries, either in single beads at intervals, or as the sole material of which they were formed. On one occasion, when he wished to make a present to the Rajah of Sikkim, he inquired of his agent what would be most acceptable to him, and was informed that three of the largest coral beads procurable would please him as much as anything. He accordingly procured three very large coral beads from Calcutta, which he had reason to believe gave great satisfaction. The similarity of the dress of a Buddhist lama to that of a Roman Catholic priest was very striking. In the town of Bettia, on the frontier of Tibet, he visited a colony of Christians who came from Tibet. They were founded by a Jesuit named Father Giuseppe, who found his way somehow into the city of Lassa, converted a number of the inhabitants, and formed a library. As had often happened in China and elsewhere, the Christians incurred the displeasure of the authorities, were driven out, and took refuge in Nepal. After remaining there some time they incurred the displeasure of the Nepalese also, were driven into British territory, and took up their quarters in the town of Bettia, where Mr. Tayler saw them. When he was in Nepal, his friend Mr. Hodgson, who had been receiving a quantity of Buddhist theological literature from Lassa, found included in it about forty volumes of Latin books which had belonged to the Jesuit colony there.

Mr. Hyde Clarke said that in many parts of the East almost the last test of the thorough acclimatisation of a European was his ability to pass the beads of a rosary through his fingers in the orthodox manner. Mr. Tayler had given proof on former occasions of his proficiency in all that related to India, but he had scarcely done himself justice in saying that his present paper was not of practical value, and had no connection with the objects of the Society. It was, in fact, hardly possible to have a better illustration of the intimate connection which generally existed between learning and commerce. Looking at these objects, which were used for religious purposes by at least 100 millions of British subjects in India, and by hundreds of millions more beyond that jurisdiction, it became evident that they constituted an object of commerce of very great importance, not merely as a local manufacture, but one which it would be competent to manufacturers in this country to engage in if they had a proper idea, such as they might receive from Mr. Tayler's paper, of the importance and extent of the subject, and of the manner in which these wants could be supplied. It seldom happened that, unless with instructions such as had been given by Mr. Tayler, those engaged in particular banches of trade could ascertain how to meet the requirements of distant and unknown markets, and a curious illustration of this fact was given before a committee of the House of Commons fifty years ago. A manufacturer, speaking with reference to the importance of small objects, said he was asked on one occasion whether he could make *dolls' eyes?* At first he was indignant at the suspicion that he would engage in such a manufacture, until his questioner took him through a warehouse filled with dolls from the floor to the roof, and on looking into the matter he found some thousand pounds worth of eyes were required to supply all these dolls, besides what might be required by other dealers. When, however, manufacturers had to deal, not with their own countrymen, but with vast populations such as Mr. Tayler alluded to, more obtruse learning was required in order to meet the market. One thing particularly had struck him—namely, the distinction between smooth and rough beads, on which it appeared great stress was laid, so that if rough beads were sent to a district where smooth rosaries only were used, they would be totally unsaleable. It was absolutely necessary, therefore, for manufacturers to know the articles required, though the differences were apparently so trifling. Another distinction was that the Soonnee Mahommedans attached much less importance to the rosary than the Sheahs, and thus, if a manufacturer was simply told that in a Mussulman country rosaries were required, he must go on to study further the geography of the place, and obtain more particular information as to the prevailing manners and customs. Those who had visited Venice would recollect the vast extent of the bead manufactory there, and might form some idea of its importance. With reference to this subject, many persons were in the habit of thinking that these Venetian beads were made chiefly for necklaces, but in reality many were used for rosaries; and then again some of the information conveyed by Mr. Tayler was of great value. In many classes of rosaries it was absolutely essential that coral beads should be introduced, and thus again the manufacturers might lose a market for want of sufficient knowledge. He would suggest to Mr. Tayler that the antiquity of the use of beads might be carried still further than he had mentioned, because amongst the remains from the pre-historic period some of the most frequent were small cowrie shells, which somewhat resembled beads, and were widely distributed all over the globe. These must have been used for thousands and thousands of years. As to the purpose to which they were applied, any theory could only be conjectured, but probably there were many applications besides those which had been referred to. At a very early period the circle was considered an emblem of eternity, and in that way a necklace, being a continuous ring, might have become associated wiah religious ideas. He considered the whole trading community were much indebted to any gentleman like Mr. Tayler, who, being practically acquainted with the habits of the population of India, came forward to give reliable information; and it was matter of congratulation also to know that this information would pass into the hands of many manufacturers, and might ultimately have the effect of giving employment to numbers of our fellow countrymen. In conclusion, he remarked that it was pleasing to know that nothing had been said which could be held to imply contempt for the genuine religious convictions of the races under our protection in the East; and Mr. Tayler's concluding remarks on that subject would, he was sure, redeem his country from any such imputation. Considering in what light intelligent Hindoos, and even some Englishmen, were tempted to view some of our own religious practices, he thought all should look with tenderness upon ceremonies, which, however trivial they might appear, were connected with some of the highest moral obligations, and were based on serious religious convictions.

Dr. Zerffi said that necklaces were found constantly in use amongst the ancient Egyptians. In Peru, also, the idols were everywhere invested with a large necklace of beads. Mr. Layard, also, in his book on Nineveh, gave an illustration of a number of women worshipping with clear, distinct chaplets in their hands; and the same kinds of figures were often seen in Roman models. This showed that the mode of worship with chaplets was not only customary amongst the Buddhists, but was afterwards, probably through them, introduced among the more western nations. He believed Buddhism had been much underrated, and that it had influenced humanity to a much greater extent than was often supposed; and the more other parts of the world were studied, and those actions and developments, which had taken place in ideas, as well as in matter, were investigated, the more it would be found that this was the case. Amongst the people who believed in the Zend-avesta, beads were constantly used, and the Egyptians also used them at a later period, and so they came down to the Catholics, to Mahommedans, and even to our own period. With reference to the introduction of the Rosary into the Romish church there were many interesting legends. It was said that in the church of Santa Maria Compostella, they showed the rosary of the Holy Virgin, the beads, of course, representing paternosters said. Amongst the Anglo-Saxons, also, beads were in constant use long before the so-called rosary was introduced, when the Virgin Mary was worshipped, the beads being used simply to count the number of paternosters. Rosaries of this kind were common in the fourth and fifth centuries, among Anglo-Saxons. It was not, therefore, extraordinary to find it believed that the Virgin herself used a rosary. Others ascribed its introduction to the Apostle St. Bartholomew, but all these hypotheses would not interfere with the suggestion that in reality these were merely customs taken over from the Egyptians, who again had, perhaps, taken them from the Buddhists. There was no doubt that there was the origin of the practice, because Buddhist beads had been mentioned thousands of years before Christ. In the 42 points of doctrine, Article 10, these words occur, which showed the deep moral ideas these Buddhists had:—"The man who in the practice of virtue applies himself to the extirpation of all his vices is like one who is rolling between his fingers the beads of the chaplet. If he continues taking hold of them one by one he arrives speedily at the end. By extirpating his bad inclinations one by one a man arrives thus at perfection." There was surely a deep morality in this, and at the same time it showed the real use of the chaplet; that it was not at first a mechanical operation, but was connected with real deep-rooted sentiments and feelings. He must protest against Mr. Tayler's saying that his paper was neither scientific nor artistic, for he had never listened to any paper more deeply interesting, and it rested upon that intrinsic inherent religious feeling which was the basis of all true art and science.

Mr. George Bowring desired to express his concurrence in the concluding remarks of Dr. Zerffi, observing that the illustrations on the wall from Mr. Tayler's own hand were not only illustrations of the manners and customs of the people of India, but specimens of high art.

The Chairman desired to add his testimony to the great value of the paper which they had heard from Mr. Tayler. It was such a one as had not only been prepared from books, but also from long and intimate knowledge of the habits of the people. Every district which was the field of Mr. Tayler's labours was included in the supplemental survey originally carried out under the auspices of the Marquis of Wellesley, that of Mysore, and which was brought to such a perfect state under the influence of a gentleman who did an immense deal for India, Dr. Buchanan. It was a very common idea that the knowledge of that field was due to Mr. Montgomery Martin; but the matter was really originated under the superintendence of Dr. Buchanan, although a great deal might be the result of native observation. Mr. Tayler's paper very strongly reminded him of the wonderful collection of facts there brought together, and those who had had an opportunity of studying that most remarkable illustration of antiquities and beautiful native products and manufactures—because this was only a minute fraction of the fields of study—must have felt much delighted at hearing the result of Mr. Tayler's observation. He had been situated in one of the most interesting districts in India, and in the intervals of his residential duties, instead of wasting his time in frivolous amusements, he had devoted himself to study the habits of the people, and had been constantly collecting illustrations of the arts of India. It was only a very minute fraction of that superabundant knowledge which he had acquired that he had submitted that evening, and there were several collateral branches of the subject which would be intensely interesting. In the first place, among the ancients it was very common to ascribe a supernatural value to gems and precious stones, as amulets, or protection from the evil eye—sometimes in relation to certain divinities, and sometimes with regard to their supposed medicinal value. These were matters which Theophrastus and others in later times had studied with great profundity, and they were of much interest to those who had the materials for dealing with them. When one looked at the quantity of necklaces and beads that were used from the very earliest ages in every quarter of the world, one was struck with the curious prominence of the subject amongst all savage races; necklaces were, in fact, the earliest ornament, and he almost felt a sensation of awe in considering the numbers of people who had used it, and the continuity of the use, because the numbers at any one time must be multiplied by the intense duration, almost of the immutability of custom amongst oriental nations. During long periods of time customs changed almost imperceptibly, so that civilisation might be compared to a kind of glacier motion. In conclusion he moved a most cordial vote of thanks to Mr. Tayler for his valuable and interesting paper.

Mr. Tayler, in reply, said it was very satisfactory to find that an address which he had really believed to be of a light and trifling character, glancing simply at the surface of things, though interesting in itself, had had such far deeper interest given to it than he had expected. He should certainly be rejoiced to find that he had been in any way the means of extending British commerce. It was, no doubt, the case that a very large number of the Indian idols, even of the more approved sort, in some of their magnificent temples, were Brummagen manufacture, and therefore it was very possible that if the exact religious feeling could be hit upon, a large number of these rosaries might be sold. There would be great difficulty, however, as the natives were very particular. They would also have to compete on very low terms with the favourite rosaries among the Hindoos, which were formed of rough seeds, of which about 1,000 could be got for 2d., and these had been used for some 3,000 years. He then proceeded to describe more in detail to the audience various rosaries—particularly a very beautiful and valuable one, believed to have belonged to the Emperor of China—and other articles of Buddhist worship; and noticed in connection with the use of the human thigh-bone for the sacred trumpet, that the ancient Latin word for trumpet (*tibia*) was also the word for the leg-bone.

TWENTY-FIRST ORDINARY MEETING.

Wednesday, May 7th, 1873; W. S. Squire, Esq., in the chair.

The following Candidates were proposed for election as Members of the Society:—

Baker, William, 46, High-street, Sheffield.
Dick, Alexander, 110, Cannon-street, E.C.
Henman, E. T., 12, Blomfield-street, Finsbury, E.C.
Turner, Walter James, C.E., Town-hall-chambers, New Market-street, Bradford.
Watts, Joseph, Fulshaw-park, Wilmslow, Cheshire.
Whiteman, R. H., M.D., Hotham-house, Putney.

The following Candidates were balloted for and duly elected Members of the Society:—

Bleckly, John J., Daresbury-lodge, Warrington.
Crossley, William, Greenscot-house, Dalton-in-Furness.
Dunlop, Alexander Milne, 28, Clanricarde-gardens, Kensington, W.
Forbes, David, F.R.S., 11, York-place, Portman-square, W.
Henman, Edward Thomas, 12, Blomfield-street, London-wall, E.C.
Ramsden, William, Cliffe Mills, Great Horton, Yorks.

The paper read was—

IMPROVEMENTS IN THE MANUFACTURE OF GUN-COTTON.

By S. J. Mackie, C.E.

I must ask the attention of this audience, in the first place, to as brief an epitome of the history of gun-cotton as I can draw, before I go to the main details of my present discourse, which has for its essential objects to put before the world some of the chief improvements which have been made in the manufacture of gun-cotton and ammunition therefrom, as about to be carried out in the large and extensive works of the Patent Cotton Gunpowder Company, in the marshes of Ore, near Faversham, in Kent.

I regret that the state of progress in some of the departments not having yet been patented, I am in consequence a little restricted in my explanations; but this circumstance will, I am sure, be accepted as frankly as it is stated, as an apology for any reticence on my part to which, in the interests of the Company, I may be constrained.

The cause of my being before you is very concisely told. The secretary of this Institution having seen some specimens of the Patent Cotton Gunpowder in my office, expressed a strong desire that I should read a paper on the subject in this room; and, although I would have liked to have deferred this discourse until next Session, when I should be able to invite you to see the various processes in practical operation, his request was so pleasantly and perseveringly urged, that, notwithstanding my time is more than fully occupied, I consented, feeling also that, in so doing, I should be rendering service by the publication of the extreme care and precaution with which every part and portion of the manufacture has been studied, notwithstanding that no production of gun-cotton or any product of pyroxilin whatever has yet attained to the same degree of safety, purity, or excellence as this new explosive. I may without egotism say this, because I am not the inventor of the "controlled gun-cotton," although, as engineer to the Patent Cotton Gunpowder Company, who have purchased Mr. Punshon's patent, I have prepared the plans of the works, and have instigated the whole of the new machinery by which the gun-cotton and the gunpowder and other compounds from it will be prepared.

To commence, then, with the practical history of modern explosives :—

Xyloidin, the lowest substitution product of the nitro-cellulose class, was discovered by Braconnet, in 1833. It was produced from wood-shavings, saw-dust, starch, and linen fabric, treated with concentrated nitric acid.

Gun-cotton, tri-nitro-cellulose, or pyroxilin, was made known by Pelouze, in 1836, who applied strong nitric acid to paper and fabrics of cotton and linen. Ten years later it was produced in a pure form by Schonbein, who employed a mixture of concentrated nitric and sulphuric acids for the treatment of cotton wool, the object of the sulphuric acid being to abstract water of hydration, and generally to absorb moisture.

Messrs. Hall, the gunpowder makers of Faversham, in 1846, entered into the manufacture of this material upon Schonbein's original process, the cotton being treated for about one hour with a mixture of 1 part of nitric acid, 1·45 to 1·5 specific gravity, and 3 parts sulphuric acid, 1·85 specific gravity. The gun-cotton produced was washed in running water until no acid was detected by litmus paper, and subsequently it was dipped in carbonate of potash. The finished cotton was sometimes steeped in a solution of nitrate of potash. The manufacture at Faversham was terminated within a year by a disastrous explosion, reputed to have been caused by throwing together in a heap a large quantity of the acid skeins.

At this period also gun-cotton was manufactured in France, at Bouchet, near Paris, where several disastrous explosions occurred; one in a drying chamber, one in a magazine, where it was believed no one had been for several days, and one in a packing place. These disasters put an end to the manufacture in 1848.

The Austrian government took up earnestly the consideration of gun-cotton in 1852, and practice was made with a battery of twelve-pounder field guns. In consequence of want of uniformity in the shooting and the damage done to the guns, its use for artillery was abandoned. It was, however, received with great favour by the engineers, and was applied with success to mining and submarine operations. General Von Lenk was the moving spirit. The explosion of the magazine at Simmoning, near Vienna, brought the manufacture to an end in 1862.

The system of manufacture, as carried on in Austria, was as follows:—Superior quality of cotton was carded loosely and twisted into skeins, the strands being of larger or smaller size according as the future produce was intended for cannon or small arms. These skeins, about five or six to the pound, were immersed in a boiling solution of carbonate of potash, the liquor being afterwards extracted by means of centrifugal machines. The skeins were then washed in clear running water, separately and quickly, either by hand or by allowing the mass to remain in water for three or four hours. They were then again passed through a centrifugal machine, and subsequently dried, in summer by the rays of the sun, in winter in a drying-house, heated by air-pipes, to from 30 to 38 deg. Cent., in the latter place usually taking some four or five days in the operation. The dried skeins were next immersed in a mixture of three parts by weight of sulphuric acid, specific gravity of 1·82, and one part of nitric acid, specific gravity 1·52.

Only two skeins, of about three ounces each, of cotton were immersed at one time, and after being stirred about by iron paddles, the cotton was transferred to covered stone jars, each capable of containing six skeins, or about one pound, mixed acid being added, if necessary, to bring up the proportion of ten and-a-half pounds of acid to one pound of cotton. These jars stood for forty-eight hours in a cool place, in summer time in cold water. After the cotton had digested for this period, the acid was separated, as far as possible, by a centrifugal machine, the men working the acid being protected from the fumes by a wooden partition. The acids extracted by the centrifugals were not used again, in the manufacture of gun-cotton, until after re-manufacture. The skeins of gun-cotton thus made still however remained in a very acid condition, and were put into perforated receptacles and immersed in a stream of fresh water, where they were allowed to lie for at least three, and often as long as ten or twelve weeks. Each skein being finally separately rinsed in the stream to remove impurities, the water in the fibrous masses of gun-cotton was again extracted by the centrifugals. The gun-cotton was next treated with a solution of carbonate of potash, as in the preliminary process, and again washed in pure water, after the alkaline liquid had been extracted. These skeins of gun-cotton having been allowed to partially dry, by exposure to the air, were placed in a large wooden tub, containing a solution of silicate of soda, and in which it remained for an hour, the object being, by the formation of a varnish of the silicate over the fibres, to retard the combustion of the gun-cotton, the superfluous water-glass being expressed partly by hand and more fully by the centrifugal. The skeins were then thoroughly dried in a drying-house, similarly as in the preparatory operations, the period of their remaining there being from eight to ten days. The protection afforded by the soluble glass was found to be very ephemeral and treacherous of no real protective effect for the cotton, or permanent retarding influence on the explosion.

The Austrian mode of manufacturing gun-cotton was imported into this country in 1863 by Professor Abel, the Chemist to the War Department, and experiments upon a manufacturing scale were instituted at the Royal Gunpowder Works, at Waltham Abbey. Considerable difficulty was experienced, however, from the variation in compactness of the twist, which exerted so much influence upon the rapidity of the combustion of gun-cotton in ordnance, as to necessitate the hand-picking and separation of the mass into two or more portions. Mixed acids were used in the same proportions as the Austrian, sulphuric being 1·84 specific gravity; nitric, 1·52. The cotton was made up into skeins, those of the stout yarn weighing from four to six ounces, and those of the fine yarn from three to four ounces each. These were boiled in a solution of carbonate of potash, the excess of liquid held in suspension by the skeins being wrung out in a centrifugal machine. The cotton was then washed by hand in a large tank, and afterwards immersed in a stream for 48 hours, when the skeins were again centrifugalled, and the cleansed cotton dried. The acids were weighed off into stoneware barrels provided with taps, two of these receiving the sulphuric acid and the third nitric acid, these barrels being so arranged on a table that the acid would run from the taps into a deep and capacious stoneware vessel fitted with an iron lid and a tap. About twelve hours before the immersion of the cotton in the acids, the skeins, which had been previously dried in the air, were hung up in a large drying chamber, subjected to a temperature of not less than 49 deg. Centigrade.

For treating the cotton skeins with acid the following method was employed:—Into one large deep stoneware pan were drawn off the quantities of mixed acids required for a certain number of skeins; the second pan was fitted with a perforated ledge of iron, surrounded by cold water. Some of the acid being transferred to the second pan, two skeins were immersed in it and stirred about for two or three minutes. The superfluous acid was pressed off upon the iron shelf with an iron paddle, the quantity of acid absorbed by the skeins being replaced in the dipping-pan from the first vessel; two other skeins were treated in the same manner, and so on. The drained skeins were transferred to stoneware jars; six of the large, or nine of the fine, being the quantity for each, any additional quantity of acid necessary to cover the cotton being added, until the proportion of acid to cotton was as 15 to 1. The skeins were allowed to stand in these pots for digestion 48 hours, as in the Austrian process; the contents of the jars were then centrifugalled, by which the great bulk of the acid was separated from the cotton. In the Austrian works at Hirtenberg copper centrifugals were employed; at Waltham Abbey the centrifugals were of iron. The Austrian finished cotton had been quickly immersed, by a special machine, under a cascade, where its saturation by water had been effected with great rapidity; at Waltham Abbey the skeins were plunged singly, as rapidly as possible, into a large body of water, and moved violently about, they were then washed by hand, and afterwards immersed in a stream for a period of not less than two days, the skeins being arranged on rows of poles, so placed that the skeins were in a vertical position, the water circulating among them freely. At the expiration of this time the skeins were removed and the water separated by centrifugalling, they were then boiled for a few minutes in a solution of carbonate of potash, and after being centrifugalled, to separate the alkaline liquor, they were again placed on the poles and left in the stream from 14 to 18 days. On final removal from the stream, each skein was washed by hand and allowed to remain in distilled water for some hours. The amount of gun-cotton which theoretically 100 lbs. of cotton should furnish, is 183·3 lbs.; the increase of weight under the process at Waltham Abbey, was determined at 177 lbs. per 100 lbs. of cotton.

The gun cotton, when finally purified, was dried at Waltham Abbey in the open air, exposed to daylight and very often to powerful sunlight; when dry it was packed in ammunition boxes lined with tinned copper, and having very tightly-closing double lids. The cotton so packed was found upon subsequent examination to exhibit considerable traces of acidity, the odour of which, after the boxes had been closed for 24 hours, was such as to change litmus paper. Experiments were also made by steeping cotton in the residual mixed acids left after the first steeping, but the lower substitution products obtained were not satisfactory. In 1864 the English Government appointed a committee, upon the recommendation of the British Association, to inquire into the properties of gun-cotton as a substitute for gunpowder, General Sabine being the president, and Colonel Boxer, R.A., and Mr. Abel, the two chief officers of the Royal Laboratory at Woolwich Arsenal, being amongst the members. This committee experimented in that year with 12-pound brass field guns and gun-cotton cartridges made at the small works then already established at Stowmarket for working the patents of M. Revy. The cartridges, which were 10 inches long, were divided into outer and inner portions by an intermediate pasteboard cylinder; the charges, from 1 lb. to 21 oz., were made in different degrees of compactness, the most compact giving 1,374 feet, the medium 1,390, and the least compact 1,416 feet velocity to the projectile; those giving the two former velocities having hollow centres for the expansion of the gases, and the last being made solid. The cotton thread supplied by M. Revy was strongly pressed in winding, and thereby flattened, thus becoming more compact. The next year further cartridges were supplied from Stowmarket of very high degrees of compactness, the most compact of which, 40 lb. to the cubic foot, had cores large enough to reduce the greatest density to 18 lb. These gave a maximum velocity of 1,673 feet. These charges, however, enlarged the bore of the gun at every round—in some cases so much, that only three rounds were fired out of the piece.

In June, 1865, Mr. Abel informed the committee that he had made gun-cotton in a new form prepared from pulp, and as the results were satisfactory, he was desirous of making further trials in a more complete manner than he could do with the means at his own disposal. The committee, therefore, provided such materials and facilities as from time to time Mr. Abel required for the application of gun-cotton to artillery and small arms. A memorandum was drawn up by Mr. Abel, in 1868, which states that—

> "Mr. Abel has applied to the production of cannon cartridges the system of reducing gun-cotton to a fine state of division or pulp, and then moulding or compressing it into solid or homogeneous masses of any desired form or density, whereby the desired compactness may be given to the charge without the necessity of employing any considerable amount of foreign matter in the shape of strong cases or cylinders in the construction of the cartridges, the charges being simply enclosed in thin cases or envelopes of brown paper.
>
> "In the cartridges prepared from compressed gun-cotton pulp, which has been gradually developed in the course of experiments with gun-cotton in this condition, the charge consists of three parts:—
>
> "1. A small quantity of loose or quickly-burning cotton placed at the rear, and serving as 'priming' to take up the fire from the friction-tube, and to furnish sufficient flame and pressure for determining the proper ignition of the cartridge.
>
> "2. A solid disc of compressed gun-cotton, of which one surface is exposed, and which comprises about one-third of the entire charge. The exposed surface of this disc constitutes the rear end of the cartridge against which the priming is fixed, and the initial pressure in the gun essential to the action of the remainder of the charge is established by the explosion of this disc.
>
> "3. A number of pellets of compressed gun-cotton, which constitute the remaining two-thirds of the charge. These pellets are about 0·5 inch thick, and one-third the diameter of the large disc."

The gun-cotton pellets fired from the Enfield rifle were wanting in uniformity, and, although better and satisfactory results were attained from the Whitworth rifle with mechanically-fitting bullets, still the percussioning of both those rifles failed to give that full inflammation of the charge which was desirable. Attempts were also made about this time, by Mr. Abel, to apply the pellets to the Snider rifle. Mining operations were also tried in 1864 and 1865, both with M. Revy's hollow rope, and Mr. Abel's compressed discs. Mr. Sopwith, the mining engineer, also a member of the government committee, was associated with these experiments, and, in his report, remarks on the entire safety in the transmission and stowage of gun-cotton in a moist state. He also notes the occurrence of accidents by the ignition of dry gun-cotton charges by friction and sharp concussion. The committee, in their report of 1867, observe that the value of gun-cotton for submarine purposes has been fully established by the experiments of the Floating Obstruction—otherwise the Torpedo—Committee, of which Mr. Abel was also a member.

In 1867 M. Nobel made public demonstration in this country of dynamite, a mixture of nitro-glycerine with siliceous earth, and detonated his charges by means of a strong fulminate-cap. This gentleman has done for nitro-glycerine the like service which Baron Lenk and Professor Abel have done for gun-cotton by their persistent perseverance. M. Nobel devised various modes of effecting this detonation, or initiative explosion. He also showed that nitro-glycerine and its compounds could be violently exploded in the open air, unconfined, by this initiative detonation. M. Nobel also saturated gunpowder with nitro-glycerine, and obtained increased explosive power thereby.

In 1869, Mr. E. O. Brown, the assistant of Professor Abel in the chemical department in Woolwich Arsenal, applied the same means to the detonation of gun-cotton; and Mr. Abel impregnated gun-cotton with nitro-glycerine, forming a compound of increased power, which he called glyoxilin.

Gunpowder, too, has been detonated with improved effect; but the difference is not so marked as in the case of nitro-glycerine and gun-cotton.

The Stowmarket works of Messrs. Prentice, at which Revy's gun-cotton has been made, were greatly enlarged, and the manufacture of Abel's compressed gun-cotton commenced on a large scale in 1870.

In 1870 also Mr. Punshon brought forward his controlled gun-cotton, and experiments were carried on at Woolwich Arsenal, no profitable results therefrom accruing to the inventor at that time, or, indeed, subsequently from the government. Without doubt the want of substantial official appreciation was a temporary detriment to that gentleman's interest, as the submission of novelties to government examination, under past or present circumstances habitually is to those who adopt such a course either in military or naval matters. Independent of all other reasons, the submission to government of an invention, not at the time commercially in the market, causes commercial men to await the results of official investigations, which, however honest they may be, are invariably tardy, and consequently expose the applicant to most injurious delay. The proper time to put any new article before the government is, to my mind, when the owner is requested to tender for a large supply.

In 1871, experiments were carried on by the Government Committee on Explosives, under the presidency of Colonel Younghusband, and of which committee Professor Abel was one of the members, for the purpose of showing the safety of Abel's gun-cotton, then being manufactured in large quantities by Messrs. Prentice, at Stowmarket, under the title of the "Patent Safety Gun-cotton Company." The chief of these experiments was the one upon which the "safety" of Abel's gun-cotton was afterwards based and publicly advertised, that company being at the time under a contract to deliver 200 tons to the Government stores. This experiment was, to my mind, so unsatisfactory and fallacious that, although for years I had been in constant correspondence with one of the chief organs of the press, I never publicly reported it, but I took occasion, as soon as I knew of it, to express my distinct opinion that the experiment was not reliable for the true object of determining the non-explosibility of the residual heated masses of gun-cotton stores in a state of violent conflagration. These experiments were, however, reported in the *Globe*, and extracts from that journal were distributed as circular advertisements by the Patent Safety Gun-cotton Company and gentlemen therein interested.

In July, 1871, the following paragraph appeared in the *Scientific American*:—

> "A number of mysterious explosions of various nitrogen compounds have attracted the notice of chemists, and some experiments have been instituted, with a view to an explanation of the phenomena. It has been found that nearly all the mixtures composed of nitrogenous substances, and used as explosives, are decomposed with more or less violence by ozone. A powder, in which picric acid was a constituent, caused great damage in the laboratory where it was made, in consequence of the action of ozone. At first the cause of the

accident was inexplicable, but careful search traced it to the ozone in the atmosphere. Nitro-glycerine is at once decomposed by ozone into nitric acid and other compounds. Gun-cotton is also destroyed, sometimes with explosive force, and so on through the list of explosive compounds. An extension of these researches may eventually afford an explanation of the spontaneous decomposition of certain bodies, and may suggest precautions to be observed to prevent a recurrence of the accidents, and it has been suggested that a new test for ozone might be found in this way."

Explosion of gun-cotton as a test of ozone in the air is one, to my mind at least, not suitable for general adoption. There may be, however, a great deal in the philosophy of the subject. Ozone is three volumes of oxygen condensed into two volumes; and as we know that ozone is able to effect oxidations which common oxygen is unable to bring about, it is obviously well to have regard to those conditions of the atmosphere in which ozone is most freely generated. All the serious explosions of gun-cotton attributed to spontaneous decomposition have taken place in the hot weather of July and August, and it is in those months that one would expect that ozone would exist in the most active state in the atmosphere. Unfortunately, no records exist, or are anywhere kept, of the daily presence of ozone in the air, whereby definite information can be had to serve as data for any scientific investigation of this question. In one of Faraday's charming lectures at the Royal Institution, he took a glass jar, and first demonstrating, by the usual test of iodide of potassium and starch paper, the total absence of ozone from the air within it, he poured into it a little ether. Still no ozone was there; but immediately that he immersed a glass rod heated in a spirit lamp, the presence of ozone was at once shown by the test. In the same lecture he noticed the decomposition of gun-paper by exposure to oxygen. The slow combustion of the sheets of gun-paper so produced would become spontaneous combustion of a very dangerous character where masses of gun-paper or gun-cotton were left under conditions in which the heat of decomposition could be retained and accumulated.

On the 14th August, 1871, the great catastrophe occurred at Messrs. Prentice's place, at Stowmarket, in which 13½ tons of Abel's patent safety gun-cotton exploded, hurling devastation all around the works, killing 23 and wounding 56 of the persons employed. Two reasons have been assigned for this sad occurrence,—one spontaneous ignition, the other diabolical act. That impure gun-cotton had been produced at the Stowmarket factory is certain, because the stock of gun-cotton received into store by the Government at the Upnor magazines, on the Medway, was, on examination after the calamity, found to be in a decomposing state, and the whole of it was consequently at once opened out on the floors and kept well watered.

From the time of this occurrence up to the present moment, gun-cotton has been out of the market, and none of it made in commercial quantities. The nitro-glycerine compounds have thus, in the absence of that cleanly and powerful explosive, had the markets during the past two years entirely to themselves.

After the demolition of the Stowmarket works, the Government took up the manufacture of gun-cotton, voting about £5,000 per annum for the establishment of works at Waltham Abbey of some magnitude, capable of producing about three tons per week. These works, which are situated in the High Street of the town, have been in operation more than two years, but have recently been suspended on account of an explosion in one of the hydraulic presses.

The works of Mr. Prentice are at this time stated to be in process of resuscitation, and will, as soon as completed, go on with the manufacture of 180 tons—the balance of contract due at the time of the disaster. I have been informed that opposition has been made by the Great Eastern Railway to the license to store at Stowmarket. Those works, when in full swing, were hard pressed to produce five tons a week. The magnitude of the new works at Faversham will stand out prominently in view of these proportions.

It has become therefore—as this audience and every one hereafter who reads this paper when printed in the Society's transactions will perceive—a matter not only of duty but of conscience on my part in putting up the largest works for the manufacture of gun-cotton ever contemplated, to leave nothing unthought of, nothing undone that human knowledge or foresight can suggest. It is this feeling which so thoroughly animates my assistants as well as myself, and it is a feeling which is most fitly and most honourably encouraged by the directors of the company who have sanctioned any provision for security, which has been requested by myself, by the magistrates in granting the requisite license to manufacture, or the Home-office in regard to the security of the public and the workpeople. Undoubtedly the Stowmarket catastrophe has given us great annoyance and obstruction on account of the alarm which has been raised through it in men's minds, as well as by the basis which this fear has afforded for interested opposition against the acquirement of a site by our company. I should, however, be wanting in justice if I did not speak in the highest terms of the knowledge, care, and caution which have been displayed by those of the county magistrates of Kent who considered the company's application for a license, under the Gunpowder Act, for the company's site at Faversham; and personally I am bound also to acknowledge the prompt attention and courtesy received from the Home-office and from the Inspector of Gunpowder Factories, Major Majendie.

The company's site at Ore extends over more than 40 acres, and occupies the shore of the Swale for a length of some 800 yards. The distance from the town of Faversham is two miles, and the extensive gunpowder works of Messrs. Hall are 1½ miles away.

The land lies low, but the marsh is not of wet, unwholesome character; the tertiary strata rise gradually behind it until they attain an elevation of 40 or 50 feet at Uplees and Ore village. The proximity of the sea along so great an extent of frontage affords every facility for the reception and loading of the materials and goods. The situation is clearly advantageous as well as suitable.

We come now to the arrangement of the works. First, there will be small works, in which the process of commercial manufacture will be perfected and assured before the general works to make 20 tons of gun-cotton per week will be commenced, and these small works will be, after the erection of the large works, continued in operation as laboratory works for the manufacture of small orders of special brands of the cotton-gunpowder, which can be made to any required degree of strength or mildness, to suit particular kinds of rocks, or for any other special purpose. The system therein followed will be (proportionate in scale) the same as that adopted for the general works—namely, full distinction will be made between the wet works and the dry works, or, in other words, the manufacture of gun-cotton in a wet state and the subsequent processes in which it is being prepared for its final dry state as a finished explosive, the buildings being more isolated, and the quantities in work restricted, as the processes approach more and more to dryness.

The site at Ore is divided into two portions, the factory area and the magazine area, the intake jetty for acids, cotton, and raw materials being at one end of the ground, and the output, or shipping jetty, for the finished gunpowder being at the other, and separated by an interval of seven hundred yards. The magazines are separated from the sea-wall by a space of one hundred yards, and from each other by a similar distance, these isolations being ample for explosions of fifteen tons, although none of the magazines will be constructed to hold more than five tons. Indeed, throughout the whole of the works all the danger-distances are arranged upon the known effects of the explosion of thirteen and-a-half tons of absolute gun-cotton at Stowmarket.

This disposition of the works, therefore, commands confidence from its thorough efficiency; whilst the Company's interests are in nowise thereby sacrificed, but, on the contrary, ample margin is afforded for the extension of the manufacture at a future period, when the cotton gunpowder shall have become a standard article of trade, and when the magistrates and the Home Office can, by the light of actual experience, sanction such modifications as in the infancy of the manufacture it is neither desirable to ask for nor for mere prudence sake to encourage. At the Stowmarket explosion, the material damage—that is, any greater damage than the breaking of windows—was limited to 400 yards. There is nothing at the Ore site whatever—not even a hut or a shed within nearly twice that distance of the most proximate of the company's magazine; and, indeed, such is the security afforded by mere distance of unoccupied space around, that 100 tons might be exploded above ground on the Company's magazine area without doing material damage to any of the dwellings in the district.

Equal care and precaution have been taken in the processes of manufacture. The acids will be mixed in the usual proportions, but instead of being stirred about in a primitive fashion in iron retorts, they will be decanted in the required quantities in separate earthenware vessels, and then, after commingling in an earthenware worm, surrounded with water, to conduct away the heat developed, the mixed acids will be received in closed tanks and pumped up as wanted, the pump being continuously driven from the shafting and returning excess quantities, thus keeping the acids thoroughly mixed. The acids flow in pipes from the store tanks into the service tank, where they are kept at one definite level by a float-valve, and whence, as the acid is abstracted by the cotton in the process of dipping, the supply is automatically let on to replace the quantity used at each operation; the disagreeableness of the acid fumes is thus greatly avoided. After the dipping, the pots of steeped cotton are dealt with most conveniently. These pots of steeped cotton are then left to digest for a sufficient period to insure the conversion of the cotton. The adoption of stoneware and the general neatness and the cleanliness of the above arrangements are far in advance of the iron dipping-pan and pressing grid and rough-and-ready means with which the preparation of the gun-cotton has been carried on in any previous works. The greatest care, too, will be taken in the selection as well as in the cleansing and drying of the cotton previous to steeping, whereby gun-cotton of the purest character will primarily result.

The great barrier to perfection in gun-cotton has, up to the present time, been the tenacity with which the fibre retains the acid; and the presence of acid in the finished gun-cotton has been universally admitted to be the root of all evils, and the direct cause of that spontaneous heating and igniting to which the terrible catastrophes which have alike terminated all the large operation hitherto attempted in Germany, France, and England have been attributed. Professor Abel, when he adapted the machinery for paper-making to the preparation of gun-cotton, made a most important advance. It was not, however, enough; although it made gun-cotton practicable for military engineering. The system of pulping by means of the rag-beater cut short, it is true, the fibres of the cotton, but it still left the individual particles of the pulp in a fibrous condition, and this necessarily to this extent that a felting property was as necessary for the subsequent compression of the gun-cotton pulp into Abel's discs as the felting property in paper-pulp is required for the manufacture of paper into sheets. But the fibre, however short, still might retain, by capillary attraction, particles of acid in the tube and in the cellular structure of the fibre; and although, therefore, the subsequent washing of the gun-cotton pulp in the poachers was a much accelerated process over the slow method of washing and immersing gun-cotton skeins in running streams, yet under careless manufacture, or short time in the poachers, a retention of acid in the finished discs was highly probable; and indeed complete freedom from a slight per centage of retained acid is by these means impossible, even with the greatest care in manufacture, and this cannot be eliminated by any amount of sampling and testing. Indeed, as against a small residual percentage, a proportion of one per cent. of alkali has always been added as a neutraliser in all the gun-cotton made or accepted by government. Now, with the warnings before me of the danger accruing from the presence of acid in the finished gun-cotton, I determined to get rid fundamentally of all harbourage for it. I made up my mind to crush out every particle of fibre, and to reduce the gun-cotton to an impalpable powder. To this end I passed it between polished rollers, under very severe pressure, and the result has realised every possible expectation. The gun-cotton waste, dripping with water, is thrown into the crushing-mill; the jaws of the rollers seize it, it passes through flattened into a compact mass; it passes through again, and is crushed into a short breaking-cake (water jets playing all the time to keep all safe) again and again, and it becomes more and more powdery at each operation, until, in about six passages, it is reduced to veritable dust. Reduced to this condition, the manufacture of gunpowder from gun-cotton became a commercial practicability—became indeed an accomplished fact, as is evidenced by the sample of finished cotton gunpowder which I have now the pleasure as well as the honour to submit to your inspection. What rejoices me in this result is the thorough conviction of the purity of the gun-cotton so prepared; and, as consequent upon that purity, the certainty of the safety which will ever after belong to the finished product.

Mr. Punshon's "controllable gun-cotton" was, at the time it was bought by the company, exactly what its name indicates. It was gun-cotton of the finest quality which could be made under the old system, the fibre of the cotton being coated and intermixed with sugar and nitre, in the proportion of 67 parts of gun-cotton, 32 of nitre, and one of cane sugar. This mixture was pressed and cut up into shreds, the cartridges for rifle-shooting being carefully made with charges weighed out to the grain, to secure uniformity of shooting. The sugar is the controlled element. In proportion as the quantity of it is increased or diminished, so the controllable gun-cotton exhibits more violent or less violent action when fired. Of the efficiency of the control I have myself been frequent witness. On one occasion a new Martini-Henry rifle was fired repeatedly with charges of 50 grains of Mr. Punshon's controlled gun-cotton, with perfect safety, and less recoil than from an ordinary charge of Curtis and Harvey's gunpowder. The same rifle fired with a charge of 34 grains of ordinary gun-cotton was burst at the chamber, the lock blown to pieces, and the stock split right down to the guard over the butt.

As I have said, the control by means of the sugar is perfect; and the entire merit of the discovery belongs to Mr. Punshon—nothing whatever in respect to it is due to myself. My own labours and progress begin where his terminate. The crushing machine has enabled me to carry out that which, from the outset of my connection with the company, has been the desideratum to be attained, namely, the manufacture of a perfect gunpowder, with which cartridges could be filled by measure with the same rapidity as with ordinary black gunpowder. The reduction of the gun-cotton into dust has not only permitted the most perfect cleansing of the gun-cotton from acid, which has no longer a lair to hide in, but is brought on to the surface and instantly cleared away; but this finely-divided state enables the gun-cotton to be regularly and intimately incorporated with the sugar and the nitre, and thus formed into a paste, from which a granulated powder fit for guns can be made. This never could have been done with gun-cotton made upon the old processes, nor under Mr. Abel's, for such gunpowder could not be made even from pulped gun-cotton, since the fibre of the pulp would give a beard to the grains, which would cause them to cling together, and prevent the mechanical filling of the cartridge cases. Moreover, the residual acid would be very likely to prove defiant of all orders to "keep the powder dry."

The incorporating mill, which will be used in the cotton gunpowder works, is a modification of the ordinary incorporating mill to suit the special requirements of the case. In all these processes, up to and including the granulation, the materials are all of them in a wet or moist condition, and free from danger of explosion, and, indeed, of ignition. The one point of difficulty, that of obtaining the requisite weight of gun-cotton proportionate to the weight of the other ingredients without drying it, has been overcome by constructing a special balance to weigh the quantities by specific gravity. In this way the dangerous element in the manufacture of the cotton gunpowder—gun-cotton—is never allowed to exist in a dangerous state; it is never, indeed, in even an inflammable condition. And, notwithstanding all the world has recently heard about exploding gun-cotton discs in a damp state, no fear need be entertained for stores of gun-cotton kept immersed in water, or from quantities unconfined and wet. I have long understood how far damp gun-cotton could be exploded; and how the circumstances of degrees of moisture, compactness of material, strength of detonation, or proportion of dry gun-cotton to the damp charge, and extent of confinement, are most essential elements in the possibility of the operation. I have myself frequently tried to explode considerable charges of wet gun-cotton waste and gun-cotton pulp, in large glass bottles, without stoppers, floating in water; and in the efforts to get them off have attempted to detonate them, not merely by strong fulminate-caps, but also by caps combined with small charges of other strong explosives, the result having been that the wet gun-cotton has been blown all over the place unscathed, whilst the glass bottles have been shivered to atoms by the violence of the detonating charge. Mr. Abel, at the recent torpedo experiments at Stokes Bay, put eight or ten nine-ounce discs of Waltham Abbey gun-cotton, containing about 20 per cent. of moisture, upon the ground in line one inch apart, and attempted to fire them by a detonating fuse implanted in a dry 9-ounce disc laid a-top of the two central wet discs; but only these three discs exploded, the remainder were riven into flakes, and the pieces blown about all around to the extent of 40 or 50 paces away from the centre of explosion. At the same time charges of 500 lbs. of similar damp gun-cotton were exploded with great effect in submarine mines in the bay, under a head of 40 feet of water. The confinement and the heat driven into the charge, to vapourise the water into steam, are the essential requirements, as shown by Mr. Abel. Shells filled with water could be exploded by a very small charge of gun-cotton fired into the confined water by detonation, and I expect to see this mode practically applied at some future time in warfare, as the shells would probably be more completely disrupted in this way than by gunpowder, or by bursting charges, or any other explosive. I have long since burst stoneware bottles and pots in this way into innumerable very equally sized fragments. I believe, indeed, that the idea of detonating wet gun-cotton may have been suggested to the chemists at Woolwich Arsenal through my application, when the company contemplated having their works at Esher—for they have had long and anxious seekings for a location—to store our gun-cotton in unlimited quantity, in magazines submerged in a large pool or basin formed by the waste overflow of the river which passed by the factory, and in respect to which Major Majendie had my distinct approval for consulting with Colonel Younghusband and the members of the Government Committee on Explosives. The power of exploding damp gun-cotton would, moreover, eliminate from the Waltham Abbey process the danger of drying the discs, which, under the system of drying by hot air or by steam pipes, and on metal tables as at Stowmarket, or in enclosed chambers as at Waltham Abbey, is very considerable where the rules for the workmen cannot be rigidly enforced, as they are in the Government factories. To be able to explode Abel's discs just as they come from the hydraulic presses, would not only save drying at the works and facilitate the safety of transport and storage, but it would also save the inconvenience and danger of drying gun-cotton charges on board ships.

Wet gunpowder, whether made of "villainous saltpetre" or of gun-cotton, would be of no use to sportsmen or soldiers in their respective fields. "Keep your powder dry" is as necessary a proverb for cotton gunpowder as any other; and as, therefore, the cotton gunpowder must be dried, it will be dried in the least objectionable manner. Instead of drying it by heat, it will be dried in vacuo. It is well known that water will boil at much less temperature as the atmospheric pressure is diminished. This, then, is the principle. The ordinary summer temperature will suffice of itself, and in no case where artificial heat is applied will it go—or will be possible for it to go—beyond 36 deg. Cent. At this temperature the moisture in our granulated cotton gunpowder can be drawn off by an exhaust, and the powder made ready for packing in the cases to go into magazine for transportation in execution of orders. As this method will shortly receive very important development, I will not dwell longer on it. Neither will I dwell on the process of granulation, as that also is in a stage of further consideration. Left to itself, however, the paste compounded in the incorporating mill will have a natural tendency in drying, to segregate into small granules, which can be at once sifted into three sizes of very convenient dimensions for small arms and sporting guns.

I come finally to the magazines. These will be sunk some ten or twelve feet below the surface of the earth; the magazine itself will be made of zinc, and it will be entirely surrounded by a pool of water, the breadth of that water ring or wet ditch being 40 feet. In this way not only is a water bed formed in case of explosion, but an earth mortar also; and the effect would be that the gases of explosion would be sent, if not straight up into the air, at least in such a narrow cone of dispersion that all lateral effects of the explosion would be completely cut off from all surroundings, even from the nearest buildings or the works themselves; whilst the solid earth would form an impenetrable traverse between one magazine and the rest. The zinc would give no fragments to be hurled into the air, but would be fused into metallic vapour by the high temperature of the explosion; if indeed the heat of the flames of combustion, which would, unless the magazine were purposely detonated, undoubtedly arise for some time, did not melt the walls of the magazines before the residual mass of cotton gunpowder became heated to explosiveness, and so let in volumes of water from the surrounding pool, sufficient, at least, to prevent explosion, if not to put out the conflagration.

For mining purposes, for cannon, for rifles, and for general shooting, the cotton powder will present special and valuable qualities. Charges for wet or dry blastings of very great destructive power can be made, and equally a rolling or gradually expanding force can be obtained at will to order. The cotton powder—which is not, so far as we yet know, of an explosive character until confined—will be at least free from those dangers to which the ramming home of the Stowmarket compressed discs expose the miner and the quarry-man. Upon the cannon powder I shall hope hereafter to have the honour again of meeting you, what has already been done giving the highest promise of unsurpassed results. For rifles and sporting guns the powder will be very soon in the market, when public opinion will criticise it, I feel sure, in a higher manner than I should myself like to do; and, therefore, I will content myself with showing you this card of fired cartridges, and this board of results, by which you will see that whilst charges of 75 grains of Curtis and Harvey's No. 6 gunpowder—the best in the world—penetrates at 100 yards range five stout elm boards placed in a rack at ½ inch. apart, the bullets from the same rifle were driven into the sixth plank with charges of thirty grains of the cotton gunpowder, the bulk of both being the same, the cartridges being filled from the identical measure. The recoil from the cotton powder was less than the recoil from gunpowder, the smoke very light indeed, without smell, and the barrel of the gun keeps perfectly clean, and its surface is not at all corroded by the action of the gases generated.

And now, gentlemen, thanking you for your patience and favour, I beg you to excuse any self-glorification I may seemed to have indulged in, by believing that motive has not in the remotest degree actuated either my speech or my endeavours. The patent cotton gunpowder will go into the market untarnished. It will be my most earnest endeavour to keep it without a stain as long as I live. In the conviction of being able do so I rejoice, and with the endeavour I am sure I shall have your hearty sympathy.

DISCUSSION.

The Chairman, in inviting discussion, said there were many objections to which gun-cotton was originally liable, but which seemed to some extent remedied by the method employed by the company Mr. Mackie represented. The washing had always presented great difficulties, in consequence of the porous nature of the fibre and the way in which the acid was held by capillary attraction, and the fibre being so completely crushed and divided, the acid would be more thoroughly exposed to the action of the water. Again, the controllability of the gun-cotton appeared to be accomplished in a very ingenious way. When the explosion occurred, the gases formed by the decomposition must find a vent, and if it were exploded too suddenly in a gun, the ball had not time to escape, and the gun burst. By the new method of treatment the explosion was somewhat retarded, so that the ball had time to be driven along the gun before the mass of the gun-cotton was entirely decomposed, and thus danger was avoided.

Mr. Wallis Nash said he had taken interest in the question of gun-cotton for some years, and had had the advantage of seeing the results of the experiments at Stowmarket, as well as having suffered to some extent from the result of the explosion there. He thought Mr. Mackie had somewhat too easily passed over the various modes which had been suggested from time to time for protecting gun-cotton, and especially Mr. Abel's improvements in this respect. As far as he understood the matter, he should agree with the history which had been given of the manufacture up to the time of Revy's process, which was an improvement on Baron Lenk's; but subsequent improvements, he thought, had not been fully dealt with. The first requirement was to control the rate of explosion, which had been attempted in various ways; first, by pressing the fibres together; secondly, by braiding or weaving them; and, thirdly, by the more perfect incorporation adopted by Mr. Abel. In the meanwhile attention had been also turned to retarding the explosion by dividing the filaments as widely as possible, and separating them by particles of some non-explosive material, and he had with him a patent taken out in 1867 by a gentleman named Rollaston, which appeared very similar, in principle, at any rate, to that since patented by Mr. Punshon, though, for some reason, it appeared to have been dropped. This patent, in the most explicit terms, spoke of separating the particles of the gun-cotton by pulverised materials of an inert nature. He thought that the pulping process of Mr. Abel was really all that could be desired in that respect, for the operation could be carried, by means of a machine similar to that used in paper-making, to any point desired, in fact, until, in the words of the paper, the material was converted into an impalpable powder. That principle, therefore, could hardly be called an original idea. With regard to the uses of gun-cotton, all those who had had anything to do with it were aware that these were two-fold; first, as applied to sporting and ammunition purposes; and, secondly, for mining, torpedoes, &c., but the requirements in each case were different. For sporting purposes you required the powder to be exceedingly dry. and that the combustion should be strictly regulated by the capacity and strength of the gun with which it was to be used; and his experience had been that for many years the great difficulty found was to prevent the gun-cotton absorbing moisture from the atmosphere. Many devices were adopted to overcome this, and some years ago he had the opportunity of firing about 1,000 cartridges made at Stowmarket, which were surrounded by a highly inflammable portion of gun-cotton muslin. The results were very satisfactory at the beginning of the season, but as time went on, it was found the moisture was taken up, and there was great irregularity in the firing. The next improvement was that of woven braids for cartridges cut off in certain lengths, and various methods of waterproofing were tried. Then they were encased in a fine film of india-rubber, the charge being tied in the centre; and these were very perfect in the first place, but it was found that if they were exposed to damp for any length of time, the india-rubber, in consequence of increased tension, gave way, and the charge again became exposed to damp. The next improvement took place after Mr. Abel's process was adopted, the particles being submitted to a solution of india-rubber or gutta-percha, the spirit being afterwards evaporated, so as to leave a coating of waterproofing substance around them, and the resulting cartridges were very good indeed. He was quite at a loss to see how the admixture of sugar with gun-cotton could in any way tend to get over this difficulty, which he believed was the principal one, of preventing the action of moisture; and, with regard to the other main purpose for which gun-cotton was used, viz., submarine and mining operations, it appeared to him that the admixture of any weakening element with the gun-cotton was so far an adulteration and unfair to the purchaser, inasmuch as it was requiring him to pay for sugar the price of gun-cotton. The real object in such cases was to obtain the greatest amount of explosive force wrapped up in the smallest compass compatible with safety in use. He failed to see how these conditions were attained better by the process which had been described than in those well known and in process of work both at Waltham Abbey and Stowmarket. He did not wish in any way to throw a damper on the zeal of any one advocating the use of gun-cotton; for he hoped the next time Mr. Mackie came before them he would be able to put forward something more tangible than his anticipations of what was to be. For his own part, he believed that the manufacture, as at present understood, might be carried on with perfect safety, and that the sad accidents which had happened might, by the further knowledge now possessed, be guarded against in future. In conclusion, he believed every possible precaution was taken, both at Waltham Abbey and at Stowmarket, where Mr. Abel's process was being carried on under the superintendence of Mr. Prentice, who had had great experience, and whose name he regretted had not been alluded to by the lecturer.

Mr. Hale inquired what was the price of gun-cotton as compared with gunpowder, as he thought it was an important consideration.

Mr. Lawrence said it occurred to him that the method of storing described in the paper was something like very large cartridges inserted in water, and that if by any chance they exploded, they might act almost as gigantic rockets, and explode in mid air, doing great damage to everything around. If such an accident occurred, it would be productive of very serious consequences.

Mr. Botly said he had no doubt that the drying being carried on *in vacuo* would be an immense advantage in the manufacture, as the same principle had proved in many other branches of mechanical science.

Mr. Abel, F.R.S., inquired if the material had been subjected to any special test which enabled Mr. Mackie to speak confidently as to its perfect freedom from acid.

Mr. Mackie replied that he was not a chemist, but an engineer, and therefore he could only say that whatever test could be applied to any other gun-cotton could be equally applied to that manufactured by the company. All he claimed to have done was to have devised a means for so crushing down the cotton that the least possible portion of fibre, if any, remained, and in that he considered he had carried the process farther than Mr. Abel had done, though he gave that gentleman all credit for having made immense advances on his predecessors. He must repeat that he could not give the full details he should like of his process, for the reasons he had already stated.

Mr. Abel said he asked the question because he understood Mr. Mackie to claim that he had absolutely removed all acid from the gun-cotton, and therefore he was anxious to know if any other than the usual tests had been applied, in order to ascertain its freedom from impurities. He might add, however, that the idea of the want of stability in gun-cotton being due to the presence in it of any portion of the acids used in the manufacture, had proved to be a popular error, and Mr. Mackie would, no doubt, discover by experience, when he began to manufacture on a large scale, that there were difficulties which had nothing to do with the treatment of the cellulose, or pure cotton fibre, by acids. Whether he ground it up into impalpable powder, or cut it into very small pieces, he would find he had other matters to deal with as impurities far more refractory than acids, upon the removal of which he had laid so much stress. There were one or two other matters on which Mr. Mackie would gain a little experience after his experimental factory had been established; for instance, he would probably find that his beautiful earthenware vessels, and the automatic arrangements for keeping the acids constantly mixed—which, when once mixed, did not unmix again—and for allowing the liquid to flow in due proportions, would gradually disappear from his model factory; and when he arranged his machinery for producing 20 tons per week, he would fall back on those rough and ready methods which he had seen in operation elsewhere. In other matters, also, it would be found that allowance would have to be made for the zeal of a sanguine man, leading him to believe that greater results were to be obtained from the perfection of a process of manufacture to which he had paid a great deal of attention than would be found to be the case. It would be found, he believed, that either with edged rollers, rollers in pairs, or knives, a finely-divided material could be produced, which would have much the same appearance and properties in all instances. He could show samples of granulated gun cotton made with the pulp from a beating engine in 1866 or 1867, which, though old, was still beardless. No doubt it was an important point to have the material in a fine state of division, but how that state was produced did not so much matter; and long before it got to that stage, if the previous processes had been properly carried out, all the acid would be removed; but there would remain other impurities which were not so easily displaced, even if the cotton presented no structure at all, which would prevent their removal by washing. There were several inaccuracies in the paper, which he would not detail, and which might have arisen from Mr. Mackie not having full materials before him in drawing up the historical portion of his subject. In conclusion, he wished him all possible success in the elaboration of those details from which he expected so much, though, for himself, he must say he considered the title a little premature, to speak of them as improvements, until actual experience had proved them to be novelties which which were really improvements.

Lord Clarence Paget said the question of cost, as compared with gunpowder, was one of considerable practical importance.

Capt. C. Jones, R.E., remarked that at present gun-cotton, when compressed into discs, was preserved wet; but in the case of that mixed with sugar he should be afraid that if kept in the same way the sugar would dissolve out. With regard to the trial of Mr Punshon's gun-cotton by the Explosive Committee he did not think there had been so much delay as seemed to be implied, and, according to his recollection, the report made upon it was only adverse to the material for military purposes. He believed it would answer very well for sporting, but for a military rifle the greatest uniformity and accuracy of fire was requisite. He had not the figures with him, but he was quite confident that with the Martini-Henry rifle the radial deviation was more than twice as much with the gun-cotton as with gunpowder, and, therefore, the committee reported against it. Considering that for every invention of any value submitted to government there were at least 99 utterly worthless, it was not to be wondered at that dissatisfaction should be expressed by those who were disappointed, and hence many of the complaints as to government delay and unfairness.

Mr. Mackie, in replying, said he could not go into some points so fully as he could have wished, from the circumstance already mentioned, that some of the company's processes were not yet protected by patent. Mr. Nash's position as solicitor to the Stowmarket Company would account for the tone of many of his remarks, and by his own account all the experiments they had made with the view of preventing the cartridges being spoiled by damp, had, more or less, resulted in failure. He certainly was under the impression that he had named Mr. Prentice, and if he had not done so it was solely from the hurried way in which the paper had unavoidably been prepared. He certainly intended to speak with the highest appreciation of what had been done by Mr. Prentice, having no feeling of enmity to him, nor, indeed, to any one else; and he felt, and should feel, much indebted to Mr. Abel for any hints he might give him, either in public or private. Captain Jones appeared to have quite mistaken his views with regard to government committees; he brought no charge against them, but he did firmly believe that so long as the government had arsenals and factories of their own, all inventors who came forward with their inventions in an imperfect or incomplete state must do so at a great disadvantage. No one could have less reason to abuse government committees, for he had for twenty years experienced the greatest courtesy at their hands. No doubt there was a great deal of truth in what had been said by Mr. Abel, but had he been able to speak freely of the whole process, it would have been seen that he by no means considered he had done all that was required when he had crushed the gun-cotton. It was precisely one of the latter processes that he was unable to describe minutely without a breach of duty towards the company whose interests he was bound to protect. It was absurd to talk of sugar being an adulteration when it was used in the manufacture of an article in order to produce a certain specified effect, but it by no means followed that because the product was controlled in that way for the purpose of ammunition, it should be made of precisely the same ingredients for every purpose. Under Mr. Punshon's patent it could be granulated into powder, made into discs, or in any form whatever, to suit the requirements of customers, so that they did not interfere with the rights of others. He had endeavoured to walk in a road in which he interfered with no one, and that would be his aim throughout. He was liberal-minded enough to believe that there was room enough in the world for works at Stowmarket, Faversham, and other places. There was no reason why one should abuse or detract from the other. Each should endeavour, while pursuing his own path, to aid in the general rate of progress. He could not state the exact price at which the company would sell their product, but it would probably depend on the price asked by other people for explosives of something like the same power. Most likely its value in the market would depend upon the work done as compared with ordinary gunpowder, and, as far as he could judge, each explosive had a distinctive character, suiting it for particular kinds of work, so that nitro-glycerine, dynamite, and all others would be used as circumstances dictated. In conclusion, he thanked Mr. Abel for the friendly manner in which he had referred to him, and said that he had no object in reading the paper but to receive the fullest and freest criticism upon the process; in fact, he had not asked a single personal friend to be present, or speak in its favour. He believed the crushing process was an improvement which would render it possible, if necessary, to place the article on the market at a lower price than had yet been reached by gun-cotton.

On the motion of the **Chairman,** a unanimous vote of thanks was passed to Mr. Mackie.

Mr. Bessemer intends to found a gold medal, to be given annually to any member of the Iron and Steel Institute who may have displayed literary capacity, or promoted the progress of metallurgical science by original research.

The State Mineralogist of Wisconsin announces that there is enough iron ore in the neighbourhood of the Black River Falls to supply the whole demand of the United States for the next ten centuries.

Soundings to the depth of nearly four and a half miles have been taken by the *Challenger* expedition, but the scientific results were comparatively poor.

ANNUAL INTERNATIONAL EXHIBITIONS.

◆

The number of visitors admitted on Friday last was, season tickets, 245; on payment of 1s., 3,076 total 3,321; on Saturday, season tickets, 1,286; on payment of 1s., 5,566; total, 6,852; on Saturday, after 6 p.m., season tickets, 26; on payment of 6d., 272; total, 298.

The number of visitors admitted to the Exhibition during the week ending Saturday, May 3, was as follows:—Season tickets, 2,667; on payment of 2s. 6d., 1,354; on payment of 1s., 19,116; total, 23,137.

The number admitted on Monday was, season tickets, 170; on payment of 1s., 2,032; total, 2,202. On Tuesday, season tickets, 193; on payment of 1s., 2,930; total, 3,123. On Wednesday, season tickets, 288; on payment of 2s. 6d., 1,300; total, 1,588.

MR. BUCKLAND'S FISH.

Few portions of the collection of food products at the South Kensington Exhibition will, perhaps, attract more interest than the section devoted to the exhibition of fish and fishing implements. For years past Mr. Buckland's Museum has received the attention not only of our own pisciculturists, but of all the best known foreign naturalists. As yet, however, he has obtained little or no assistance from the authorities, being obliged to depend almost entirely on his own personal exertions for the collection of specimens and the preparation of casts, while his investigations regarding the rearing and habits of fish have been greatly retarded owing to the limited space placed at his disposal for the carrying out of his experiments. In spite, however, of these drawbacks, the fish museum at South Kensington has gradually become of great value, and has, moreover, proved of much use as a reference and studying room for students of natural history, who, until Mr. Buckland started his museum, some nine or ten years ago, had few, if any, opportunities of supplementing their reading with observations of the formation and peculiarities of the various kinds of sea and fresh water fish. This they can now do by means of many beautifully executed casts which are being added almost daily to the collection, all of which have been made by Mr. Buckland himself, or with the assistance of his secretary, Mr. Searle. It is true that the formation of the aquaria at Brighton and the Crystal Palace have opened up new opportunities for the study of fish life which are not afforded at South Kensington; yet in some respects the smaller and less pretending London museum has the advantage over the larger establishments at Brighton and Sydenham.

This year, as last, Mr. Buckland's museum forms part of the International Exhibition, and although many of the specimens shown have been on view for many years, all have been rearranged, and many important additions have been made to them. Of the new arrivals those which will doubtless interest Londoners most are the stuffed specimens of remarkable fish taken in the waters round the metropolis. These have been collected under the management of Mr. Sachs, late secretary of the Piscatorial Society, who has given Mr. Buckland much assistance in collecting and arranging the various cases. Of the angling societies which have contributed to the exhibition, the True Waltonians show seventeen cases; the Piscatorial Society, twenty-four; the Amicable Waltonians, four; the Alliance, six; while the United Society of Anglers and several private persons have also contributed some specimens. Among the fish shown we may mention some splendid Thames trout—one of 14lb. 9oz. This fish is also represented by a fine cast, coloured by Mr. H. L. Rolfe; and as it lies in a basket on some straw it looks so like the real fish that many are obliged to touch it before they can be convinced that it is only a cast. We believe the largest trout ever known to have been taken in the Thames was captured some fifteen years ago, at Shepperton, and weighed 16lb.; one was taken at Marlow, about six years ago, which weighed 15lb.; while the two largest taken last season weighed together 23lb., their several weights being almost equally divided. Some good pike are also shown; one weighing 28lb. Of carp are exhibited a case of five beautiful fish, weighing in the aggregate 32lb. 5 oz. One taken at Bushey-park pond some time ago, weighing 15½ lb., is also shown. The collection, besides these, contains a curious Albino perch caught in the river Lea, three magnificent rudd (5 lb. 6 oz.), five bream (23 lb.), two carp (11 lb.), a perch of 3¾ lb., a barbel 9 lb., two grayling caught in the Itchen—one of 1 lb. 14 oz., the other of 1 lb. 13 oz. Many other fine fish are also shown; the whole forming, perhaps, the finest collection of "London fish" ever brought together.

Casts of fish are much more numerous than the stuffed specimens, and represent many curious species of both fresh and salt water varieties, collected from different parts of the world. All of one side of the gallery is occupied by coloured representations of sea fish, most of which have been in the museum for some time. In no collection in the world, we believe, is there such a large and finely executed number of casts exhibited as that now on view at South Kensington. Of salmon there are plenty of representatives of English, Irish, and Scotch bred fish in both the fresh-run and foul state, from the magnificent Tay salmon of 70 lb., taken in 1870, to the lanky, ill-conditioned kelt of 49 lb., taken in the Shannon; perhaps the most beautiful in the whole Exhibition being a cast of a magnificent salmon of 34 lb. taken by Colonel Keane. These casts have been beautifully coloured to the life by Mr. Rolfe.

Fish-hatching operations are also to be seen in full working order, the troughs being filled with eggs and young fish in various stages of development and growth. The hatching was most successful this year, and a very varied stock of eggs was deposited, as the following list will show:—*Salmo ferox* (hatched out February 22); Rhine salmon (March 9); Norway trout, Great Lake trout (hatched February 22); Tyne salmon (hatched February 26); Newstead Abbey trout (hatched March 14); Neuchâtel trout, common trout (hatched February 20); *Salmo faro* (hatched March 9); silver char, salmon and trout hybrids; sea trout hybrids from Nuninguen (hatched Feb. 27). The hatching boxes and the whole collection are placed under the superintendence of an intelligent assistant, Mr. Edon, who is always ready to show the fish and explain operations to visitors, and to whose care in attending to the eggs and young fish much of the success of this year's hatching operations is due. Tanks and small aquaria are placed about the museum, some of which contain fish of different ages, bred in the tanks, while a pretty model of a mill-dam and salmon ladder, designed by the late Mr. G. P. Ffennel, a son of the late inspector, forms an attractive feature of the exhibition. Some fresh arrivals are shortly expected; a tank is being prepared for some specimens of the "Spiegel," or "looking-glass" carp, from Silesia, of which Mr. Buckland, in a late number of *Land and Water*, writes:—"It is not yet determined whether the 'looking-glass carp' is a distinct species, or, as some have it, whether it is a hybrid between a carp and a tench. It, again, may possibly be an established species, originally a hybrid." The last interesting arrival consists of a specimen of the lander, or "pike perch," from Stettin. This fish has thus been introduced into this country for the first time by Mr. Sachs, who unfortunately, out of fifteen fish despatched, received only one alive, and that in rather a sickly condition. Under Mr. Edon's care it has, however, thoroughly revived, and now forms a novel feature in

Mr. Buckland's museum, and will doubtless prove a valuable addition to the ordinary run of our pond fish, Mr. Buckland considering that many waters in England are admirably suited for its cultivation. Another important addition to the fish exhibition is the skeleton of an enormous whale. This specimen, being too large to exhibit in the museum, has been set up on a plot of land adjoining the western annexe; the body was found by some fishermen floating in the sea, in 1869, about fifteen miles from Havre; the skeleton measures sixty feet, and was lately purchased by a gentleman for £50, who has lent it to Mr. Buckland for the exhibition. Besides the specimens above specified, the fish collections contains a number of nets and other implements used in fishing, specimens of oysters from various districts, models of fishing boats lent by Mr. Wiseman, and many other objects of interest and value to naturalists and pisciculturists.—*Pall-Mall Gazette.*

EXHIBITIONS.

VIENNA EXHIBITION.

The opening of the Exhibition took place, as announced, on Thursday, May 1st. The following account of the opening ceremony is extracted from the *Times*:—

"A very few minutes after the stroke of noon the hall woke up to a flourish of trumpets, and then the Emperor made his appearance. Arriving with the Empress in a close carriage, drawn by six bays, he had been received at the grand entrance by his brother, the Archduke Protector, and by Baron Schwarz, Director-General of the Exhibition, who presented the Empress with a magnificent bouquet. Entering the rotunda through the southern portal, the Emperor crossed the hall, conducting the Princess Imperial of Germany. Behind them walked the Prince Imperial of Austria and Prince Frederick William of Prussia. Then followed the Prince Imperial of Germany with the Empress, the Prince of Wales with one of the Archduchesses, the Crown Prince of Denmark, Prince Arthur of England, the Crown Prince of Saxony, &c. As they moved across to take their places on the elevated tribune the members of the *Gesangverein* chaunted the Imperial Anthem to the magnificent accompaniment of the Exhibition band and the orchestra of the Imperial Opera House. His Royal Highness the Prince of Wales had his place on the tribune to the right of the Emperor, with whom he frequently conversed during the proceedings. When the Imperial party were seated and the anthem had been sung, the Archduke Charles Louis, Protector of the Exhibition, came forward to the front of the tribune, and addressed the Emperor in the following terms:—

"Your Majesty. Most Gracious Lord,—With joyous feelings *(festlicher stimming)*, I welcome your Majesty, in these halls, dedicated to peaceful progress. Your Majesty's most gracious sympathy crowns the work which draws on Austria the eyes of the world, and insures our Fatherland the recognition of a prominent participation in the advancement of human happiness through education and labour. It does not become us, whom your Majesty's confidence has intrusted with the realisation of your sublime ideas, to be the judges of our own work. Yet we may be permitted to indicate the elements to which it owes its accomplishment:—The sublime initiative of your Majesty; the intelligent and self co-operation of our own and friendly peoples; the moral and political force of labour and cultivation—these are the elements which lend to-day to this creation of your Majesty its intrinsic value, and will bequeath to future generations its honour and memory.

"May it please your Majesty to accept the Exhibition catalogue and the report of the historical development of the Exhibition, and to declare the Universal Exhibition of the year 1873 to be opened."

The Emperor read his reply in tones that were disinctly audible far over the hall:—

"With lively satisfaction I behold the accomplishment of an undertaking whose significance and importance I appreciate in their fullest extent. My confidence in the patriotism and energy of my people, and in the sympathy and support of friendly nations, has accompanied the development of the great work. My Imperial good wishes and my grateful acknowledgments are dedicated to its consummation. I declare the Universal Exhibition of the year 1873 to be opened."

Then followed the address of thanks, read by Prince Auersperg, in the name of the people of Austria. The address, while congratulating the nation on the great work it had achieved, attributed the credit and glory of it to the initiative of his Imperial Majesty.

To the Prince succeeded Dr. Cajetan Felder, Burgomaster of Vienna, who expressed the gratitude of the citizens for all his Majesty had done for the city.

Then the choir intoned the *Festgesang*, composed by Josef Weilen after the Pæan of Victory in Handel's *Judas Maccabœus.* Nothing in the programme of the day was more impressive than the marvellous effect of the music in a hall that was certainly not constructed primarily for purposes of sound. The volume of melody seemed to gain in richness as it swelled and rolled round among the arches; and, with the prospect of band-playings and grand concerts before one, it was satisfactory to know that the Rotunda was a success in acoustics as well as a triumph in architectural engineering. The *Festgesang* over, the Imperial party, followed by a brilliant suite, started to make the tour of the building. The various Commissioners and officials had previously made their way to their respective departments, where they were in readiness to receive and act as cicerones to the illustrious visitors. Of course, even after the almost superhuman exertions which have been made in some quarters during the last few days, the Exhibition is but the shadow and skeleton of what it will be. Thanks to the indefatigable labours of Mr. Owen and his staff, who never relaxed their exertions to the last moment, England shows most creditably. There are blank cases there as elsewhere, but already most of the important machinery is in place, while the most attractive objects in goldsmiths' work, china, and crystal show brilliantly in their completed arrangement. India, too, is gorgeous and richly stocked, which is more than can be said for the court allotted to the Australasian colonies, where the coming display is as yet all left to the imagination. Thanks to the dispute among the commissioners, America is represented mainly by a dentist's chair, a case of photographs, a piano, and a stand of scent bottles filled with 'Mississippi water.' France, too, is excessively backward; Germany makes but little show; and among the rest Austria leads, as she ought to do, with perhaps the single exception of Switzerland, whose little court seems a marvel of beauty and snugness, while Egypt treads hard on the heel of both."

The Exhibition itself, however, is very far indeed from being in a state of completion. The correspondent of the *Daily Telegraph* says:—"All sorts of expedients were adopted on the opening day to cover the nakedness of the land. In some of the apartments acres of grey calico were nailed over wooden skeletons, and propped up by girders to fill up blanks, or screen the entrances to covered courts, wherein deal boards were the only objects ready for exhibition. Triumphs of ingenuity were achieved with carpets and woollen fabrics—readily lent by manufacturers whose allotted exhibiting space was not fully prepared for the display of their articles. In a word, the best was made of a bad job; for, with the exception of three or four foreign departments, no entire section of the whole Exhibition was ready; nor do I believe that everything will be in its place even by the 1st of June. What has been done hitherto has to a great extent been provisional. For instance, our Indian Department, of which we have good reason to feel proud, is now about to commence a thoroughgoing re-arrangement of its show, which it will shortly dispose in a manner that may be considered definitive. Ninety cases arrived from India on Wednesday, too late, of course, to be opened in time for the morrow's ceremony; these, and a few others expected shortly, will complete the contributions from Hindostan. The colonies are at present represented by a sparse selection of natural products in little linen sacks and glass bottles. The Cape, Australia, New Zealand, and Queensland are in a gallery of their own, but a small slip of which has been ceded to India; and there, in a sort of cool and melancholy retirement, they are awaiting the arrival of corpulent chests by dozens, now reposing in some shunted truck or goods shed in an obscure Continental railway station. Things do seem to take a terrible time getting here just now. For instance, the beer-engine of the English dining-room was despatched from London towards the end of March; it is not yet forthcoming! Some hundreds of French cases have been six weeks on the road; and the American *colis*, where are they?"

The same correspondent adds:—"The English jewellery is, as always, unsurpassed either in beauty of design or solidity of make by any other; and the gold and silver plate in our department is already become one of the lions of the palace. It cannot but be highly satisfactory to Englishmen to notice that, without a single exception, all the Viennese journals speak of the display within the British section in terms of unqualified admiration. The highest encomiums are passed upon our agricultural machinery, our pottery and porcelain wares, and our glass."

UTILISATION OF SILK DOWNS.

By P. L. Simmonds.

Among the various raw materials and products long neglected or unemployed, to which I have from time to drawn attention, by papers read at meetings of the Society, or by communications in the Society's *Journal*, several have risen into important industries.

The various economic uses of cotton-seed is one example; for we imported into this country alone, on the average of the last two years, 171,000 tons, of the value of £1,500,000, for making oil-cake for cattle food, paper from the husk, &c.

Another recent industrial application, which is becoming of some importance, is the use of the silky down, clothing the seeds of several plants, a substance which has been for a long time suffered to run to waste. In Holland, at the International Exhibition of Domestic Economy, a few years ago, I had the pleasure, as a juror, of rewarding an extensive economic application of this material, and now it is working its way in commerce in this country, where private firms and companies are turning their attention to it. The Ceiba Down Company of Stockport use it for down quilts, ladies' quilted petticoats, and other stuffing purposes. It may be well to draw attention to what the Society of Arts and others have done in this direction, so as to concentrate the floating information about these various vegetable downs or silky cotton substances.

So far back as 1835, the Society of Arts received two large pieces of cloth made from the down of the simool, or tree-cotton (*Bombax heptaphyllum*) forwarded by Captain Jenkins from Gowhatty, in Assam, the place of their manufacture. From a report then made on it, it appeared that the fine, short down of the *Bombax* is spun into a large, loose, slightly-twisted cord or roving, and this is made into cloth by interweaving it with a warp and shoot of common thin cotton thread, in the manner of carpeting. It composes a loose cloth, incapable, probably, of being washed without injury, but warm, very elastic, and light. From the shortness of the staple, and the great elasticity of the fibre, it is not at all probable that it could be worked by the machinery now in use for spinning cotton, but the combination which it exhibits of fineness of fibre with great elasticity, will no doubt make it rank high as a non-conductor of heat, and therefore fit it for making wadding and for stuffing muffs, and perhaps mattrasses. When combined with wool, it might probably form the basis of fabrics of great warmth, lightness, and silky softness. These predictions have been fully realised as the wants of commerce developed themselves.

Very fine collections of silk-cotton of various kinds were shown at the London International Exhibition of 1862, from Jamaica, Dominica, Brazil, the Philippines, and other quarters; and I also exhibited a large and varied collection from the capsules of different trees and plants at the London Annual Exhibition of 1872.

In the India Museum will be found down cotton or floss (*Damia extensa*), *gupsal*, silk cotton of *Salmalia malaribica*, Madras, cloth made entirely of mudar floss (*Calotropis gigantea*), cloth of one part of cotton and four of mudar floss, and cloth of one-half of cotton and one-half of mudar floss from Agra.

In Africa this silky down of the *Bombax* is utilised, for Captain Burton, in his "Lake Region of Central Africa," mentions its being brought daily to the bazaars as a favourite substitute for cotton, being but half the price. The people spend their waste time in spinning yarn of it with the rude implements they have at their command. In Liberia stockings have been made of it, showing the result of African skill in spinning and manufacturing.

The Indians make beautiful fabrics, about the Rio Negro and Amazon, of the down of *Eriodendron Saumama*. At Guayaquil this silky fibre is used to stuff cushions and in manufactures.

The species of *Bombax* are remarkable on account of their capsules, which, on bursting, display a flocculent substance, often mistaken by travellers for cotton. This material, being more silky than cotton, has been distinguished by the name of "silk cotton." It differs also in not spinning so well as cotton does. Some difficulty, therefore, has been experienced in making use of this very abundant cotton-like produce. Mr. Williams, of Jubbulpore, succeeded in spinning and weaving some of it so as to form a good coverlet. It has lately been made use of extensively for stuffing pillows, muffs, coverlets, and wadding, and could be converted into half-stuff for paper-making, and perhaps for gun-cotton, and as a moxa. The jury of the Exhibition of 1851 suggested that it might advantageously be used, in combination with other substances, not merely for the purposes of upholstery, but even in the manufacture of mixed fabrics for various other uses in the arts.

At one of the Society's Exhibitions, silk cotton was shown among other useful paper-making materials. It could not be employed, however, extensively for this purpose, on account of its price.

The *Bombax* down, for several years past, has entered into commerce in the Dutch ports, on the Continent, under the name of kapok, the local name in the Eastern Archipelago. The increased price of horse-hair, feathers, flocks, and other animal substances for upholstery, has caused more inquiry to be directed to vegetable materials, and these silk cotton downs are cheaper by 50 per cent. than animal substances.

The qualities which recommend it to notice are:—

1. Its immunity from attacks by moths and vermin.
2. Its lightness.
3. Its elasticity and softness.
4. Its medium warmth.
5. Its cheapness.

Its price as compared with feathers for a double bed was stated at Amsterdam, in 1869, to be:—

	lbs.	£	s.	d.
Kapok	22	1	1	0
Feathers	35	2	13	6

And as compared with horse-hair for a double mattrass

	lbs.	£	s.	d.
Kapok	33	1	11	6
Horse-hair	44	3	7	0

The beds being in each case equally well stuffed. Two Dutch houses showed its application at the Amsterdam Exhibition, in 1869; Mr. F. G. Kratzenstein, of Amsterdam, who received a gold medal from the jurors, and Messrs. Klutgen, of Rotterdam.

About five grammes of silk down are obtained from each capsule. By care and attention in carding, the quality of the down for beds is much improved, and it is sold at sixpence per pound. One house alone in Holland imports from the Dutch-India colonies 1,000 to 1,500 bales annually, having found a considerable sale for it in Holland, France, Germany, Belgium, and England. The oily seeds, when separated from the down, sell for about 12s. the 100 kilogrammes; the oil extracted from them at 40 to 45 florins per hectolitre; and the oil cake for cattle at 10 florins per 100 kilogrammes.

The silky down of barriguda, called paina, is used in Brazil for filling beds and pillows. In the province of Parahyba-do-Norte, it is known by the indigenous name of Saumama (*Eriodendron Saumama*), and is sold at four to six dollars per arroba. In the province of Maragnon it is called "Paina-tyberina." In Venezuela the silk downs are termed Algodon de Seida.

In Porto Rico and Cuba the down from *Eriodendron caribaeum* is used for stuffing pillows, mattresses, &c., and is preferred to feathers or flock. It is called locally "guana."

The capsules of *Bombax malaribicum*, which are ripe in Tahiti in October, weigh 32 grammes, of which the shell forms 15 grammes, the seeds 10, the down 5, and the trophosperms or divisions 2 grammes.

The brownish down of *Ochroma Lagopus*, and some of the species of *Bombax*, is said to have been used in hat making, in place of beaver or rabbit furs. The purple down of *B. villosum* is spun and wove into a cloth, of which garments are made and worn by the inhabitants of Mexico.

The old genus *Asclepias* abounds in plants yielding a strong fibre, as the *Asclepias gigantea*, &c. The Syrian dogbane (*Asclepias syriaca*) is cultivated as far north as Upper Silesia. The silk-like down which surrounds the seed of this plant is not more than an inch or two in length, but it has, nevertheless, been usefully applied and articles of dress manufactured of it, both in France and in Russia.

In 1872, Madame Maralin David, of Clamart, submitted samples of the fibres of the stem and of the down of *Asclepias syriaca* to the Industrial Society of Mulhouse lately, suggesting that the silky down might be usefully employed. Dr. Koechlin thereupon published a descriptive note respecting the plant in the *Bulletin* of the Society for January, 1873, p. 32, in which he states there are many species of *Apocynum* in which the fruit is furnished with a similar cottony substance, but only that of Syria or Canada has been yet employed to any extent under the name of silk down. It is received from Alexandria by way of Marseilles. It also bears the name of cotton of Silesia, and is found in the environs of Hirsenberg and Guiffenberg. The down is as fine as silk, and as white as snow, but so short that it cannot be spun. It serves well for stuffing and wadding. It grows spontaneously in the environs of Strasbourg, and is largely cultivated in Silesia and the United States. It resists perfectly the cold of Europe, and lives to twenty years. The separation of the down from the seed is very easy. After obtaining this the stems are cut down and treated like hemp, and a similar useful fibre is obtained. The flowers are rich in honey, and it is for this purpose it is cultivated in North America and Silesia. The industrial use of the silky down dates back to the last century, for about 1780 a factory was established at Leignitz, in Silesia, which worked it up alone, or mixed with cotton into stockings and gloves. Others also utilised it.

Emile Dollfus found the length of the fibres of this down to be from 0·020 m. to 0·025 m., formed, like those of cotton, of a flattened tube, but not turned in a screw form, which diminished the value, from the want of felting property. The fibre is very weak. He found it necessary to mix one-fourth part of cotton with it to work it mechanically, and even with this admixture the filaments have a strong inclination to separate and float in the air. The twist and the fabrics lose all their brilliancy, which he attributes to the fraction of the filaments in working.

Mr. Moncton proposed making use of the downy substances contained in the follicles of the mudar (*Calotropis gigantea*), and indeed had paper made of it alone, and also mixed with two-fifths of the pulp of sunn hemp, such as the natives use for making paper. As the glossy and silky but comparatively short fibre is difficult to spin, a mixture of one-fifth of cotton was used, in order to enable it to be worked. A good wearing cloth, which stands washing and takes a dye, was produced. It is, however, well suited for stuffing pillows or coverlets. Mr. Moncton calculated that its cost would be one rupee a maund (2s. per ¾ cwt.). This silky down of the pod is used by the natives of the Madras Presidency in making a soft cotton-like thread.

This plant grows all over India, and seems to thrive on soils that either reject or destroy everything else. If its cotton could be generally utilised, the waste lands of India might be covered with it, as it requires no culture and no water, and is productive on dry land. It comes to maturity in a year, but is perennial, and when once planted or sown would require no further care; where thickly planted it might be made the means of reclaiming poor soils, as the leaves and some of the upper branches rot, while the root and stem remain.

Lania du Bombardiere (*Asclepias gigantea*) was shown in the Portuguese section at the Paris Exhibition in 1867, from the Isle of Santiago, Cape Verdes, and from Angola. It grows spontaneously. If it were cultivated it could be extensively exported. It is used for filling mattrasses, and recently it has been made into fabrics, which are very durable mixed with cotton. The price of the raw material is about 4½d. the kilogramme, or, if cleaned, 6½d.

In the United States, under the name of silk-weed, the thistle-like down is used for stuffing bedding. Messrs. Thresher and Glenny made a variety of fabrics of a light, soft texture, some well suited as a substitute for flannel, from the silky down of *Calotropis gigantea*, called yercum. Speaking of the silk cotton of the *Asclepias*, among others *Calotropis gigantea*, *curassiviva*, and *procera*, Mr. H. Carcenac, juror and reporter on Cotton at the Exhibition of 1862, and at Paris in 1867, stated that he had examined, in the department of the French colonies, tissues partly made with this fibre, which, although very fine and smooth, were not suited to form an elastic and resistant thread. But it could be employed as tram in a mixed fabric, which would have a silky feel and a brilliant aspect, resembling handkerchiefs made with the wadding or waste of silk. This substance is also well fitted for making counterpanes, which would have the double advantage of being light and very warm.

Another vegetable silk, very fine, downy, and glistening, is ascribed to an *Echites*, and to a *Strophantus*. From its nature it cannot be spun, but may be employed as a vegetable eider down.

From the West Indian colonies and Guiana, the silk cottons of *Bombax pentandrum*, *heptaphyllum*, and *Ceiba*, *Ochroma Lagopus*, and that of several species of *Asclepias*, together with the vegetable hair of an Epiphyte *Tillandsia usnoides*, although as yet not largely used, could be employed as waddings, downs, and for counterpanes. From Reunion a natural eider down, obtained from *Typha angustifolia*, was shown, and the silky cotton of several species of *Bombax*, among others *B. malaribicum*.

The sale of sewing-machines during the past year in America reached the enormous figure of 851,736.

The mineral products of Pennsylvania in the last census year was £15,241,678, while that of all the other States and territories amounted to but £15,278,121.

THE YIELD OF COCOONS IN ITALY.

The yield of cocoons in Italy in 1871 is considered to have been superior in quantity, as it was in quality, to that of the previous year. The greater portion was formed of the imported eggs of the Japanese breeds, both green and white, the green sorts predominating. The total quantity of silkworms' eggs imported into Italy for the season, deducting the exports, amounted to 92,155 kilog., of an estimated value of 22,117,200 Italian lire. This estimate is, however, below the selling value of the eggs, which, in Lombardy and Piedmont, is stated to have averaged 28 lire per card of 28 grammes for Japanese eggs of good quality. The high price, if maintained, cannot but be a serious obstacle to the further development of the silk industry of Italy, so long as the bulk of the crops is based on the Japanese eggs. Mr. Consul Colnaghi remarks upon the discrepancies contained in the estimates of the yields of cocoons for the whole of Italy, but attaches importance to the more positive facts obtainable with reference to the yield of cocoons in Piedmont and Lombardy alone, which regions, with Venetia, form the most important silk-growing districts of Italy. The yield in Piedmont in 1871 was above mediocrity, and showed signs of considerable progress over the results of previous years. From the returns published by the Chamber of Commerce of Turin, some idea of the present condition of the silk husbandry may be obtained. In 1871, in Piedmont, including that portion of the province of Pavia which formed part of the kingdom of Sardinia, public markets for the sale of cocoons were held in thirty towns, between the 30th of May and the 11th of July. The total number of market days was 712, and the number of markets held at each town varied from eleven to thirty, according to the importance of the locality. The total quantity of cocoons sold and weighed in these markets amounted to 602,156, of a value of 23,820,831 lire, to which must be added 211,958 myriagrams brought to the markets, but not publicly weighed, and sold by private contract. The registered sales of cocoons in the public markets during the last ten years give an average of 329,818 myriagrams, being 872,338 less than in the year 1871, which also surpassed the most abundant yield of any of the series. These results have been obtained almost entirely, however, by means of importations of Japanese eggs. The persevering and intelligent attempts to overcome the silkworm disease and rear healthy worms in Italy, though giving fair hopes of ultimate success, have not yet made this country independent of foreign supplies.

In Lombardy, the yield of cocoons in 1871 was somewhat greater than in 1870, and amounted to 1,820,000 myrsigrams. The quality was decidedly better, 14 kilog. of cocoons giving 1 kilog. of silk, whereas, in 1870, 15 kilog. were required to produce the same quantity. The production of cocoons in Lombardy may be calculated at about one-half the entire crop of the whole of Italy. Hopes are however entertained, based on the more healthy condition observed to exist in the reproductiveness of the Japanese breed, that the silkworm disease is on the decrease. During the first years of the disease, which deprived that region of nearly one-half the usual produce, dealers imported large quantities of Asiatic raw silk to enable them to work their mills. The importations of raw silk into Italy, in 1864, was about 1,000,000 kilog., the greater part of which came from French ports, England importing direct only 13,717 kilog. As the production of silk gradually increased in Italy there was a corresponding decrease in the imports of raw silk, which, in 1870, had fallen to 844,429 kilog., of which 12,676 kilog. were received from England. This increase in the production of Italian silk will, in all probability, continue until the produce of the country reaches the original state. Such as least is the hope generally entertained, and there seems no reason to doubt its fulfilment.

GRAMME'S NEW ELECTRIC LIGHT.

Some experiments have lately been made in the Westminster Bridge-road with a new electric light, developed with a new magneto-electric machine, the invention of M. Gramme, of Paris. M. Gramme has been engaged in the French capital for a number of years in the works of the "Alliance," where he had great facilities for perfecting his ingenious invention. The Committee of Industry of the Academy of Science, after having put it to a severe test, awarded him the prize of 50,000 francs, and it is at present being rapidly introduced in France. The difference between the Gramme and other machines lies chiefly in the application of rotary, instead of reciprocating magnetism. The construction is briefly as follows:—"A ring of soft iron encircled with an endless coil of copper wire is rotated between the two poles of a strong magnet; that half of the ring which is in proximity with the north end of the magnet takes south polarity; whilst the opposite half, near to the south end, takes north polarity; the two neutral points of the system being equidistant on each side. When the iron ring with its wire convolutions is rotated, the polarity of the ring remains unchanged in position in regard to the operator, so that the action is equivalent to the coils alone being rotated over a stationary ring-shaped magnet. The effect of this is to produce currents in the two halves of the ring, in opposite directions, between its two neutral points. At these points, however, contacts are placed, which touch in succession a series of studs, in connection, at regular intervals, with the wire coil, so that the opposite currents in the two halves of the ring, instead of neutralising each other, join together and form a single current." In the course of the experiments the machine, which was driven with about 2½ horse power, did its work in a most satisfactory manner. A copper wire, about 1¼ millemetre in thickness, was suspended between the poles, and became instantly red-hot with a revolution of little over 300 in a minute. The 2½ horse power is sufficient to produce an illumination equal to eight thousand candles. The *Daily News*, in reporting the experiments, says:—There was some facility given for testing the accuracy of the statement in a small street running into the main road. The carbon points had been placed at the end of this street, and at the application of the current, an intense light was thrown on the shed at the opposite end, a distance of about 300 yards, which illuminated every object within that space with a painful brilliancy. At that distance it was not only quite easy to read the smallest print, but the flame of an ordinary gas lamp threw a distinct shadow upon the board behind it. At the same time the light burned with a steadiness which we have never seen equalled in any other magneto-electric machine, partly in consequence of a very delicate piece of machinery, also a new invention, by which the carbon points are always kept at the proper distance. It is obvious that the cost of the light can be easily ascertained, as it consists simply of the Gramme machine, the steam engine and the cost of its working, and the trifling cost of carbon. These being all the requisites, we imagine that the estimate of two shillings per hour is a good deal beyond the actual experience. Larger machines are now being made that will easily throw a light equal to 25,000 candles at a comparatively smaller expense, and it is said for a distance of thirty miles. The small compass of the whole apparatus renders it of great use, not only to lighthouses, but to large vessels, which will be able to make themselves seen for a safe distance in a dense fog. By the application of the current, pig iron can also be freed in a very short time of all noxious elements, and turned into steel in something less than an hour.

Experiments have also been made with this light, with a view to adopting it on the clock tower of the Houses of Parliament, and it is probable that it will ultimately be used for this purpose.

MEDIÆVAL COOKING UTENSILS.

In a former article we gave some account of ancient cooking utensils. We now propose to follow this up by a short notice of those in use in mediæval times.

Italy seems to have been the birth-place in Europe of the cooking art, thence it passed to France, and from that country it came to us.

A very curious old Italian work, by Bartolomeo Scappi, "Maestro dell' Arte del cucinare," published first at Rome, in 1572, and afterwards reprinted at Venice in 1622, gives a complete account of the kitchens of the times, and the utensils used in them. The book is copiously illustrated, and there are representations of almost every sort of vessel. There are cauldrons and kettles of all shapes and sizes; some with strainers in them. One very large one is represented as swinging at the end of a lever, by which it can be removed from the fire. There are knives, forks, ladles, and spoons; graters, rasps, and stirrers; buckets, jars, meat-safes, screw presses, gridirons, and frying-pans of various sorts. Several roasting-jacks are represented, one worked by smoke or hot air and one by a spring. In the latter there are three horizontal spits, connected by gearing, and the line from the barrel of the spring passes round a fusee. Such are some of the multifarious implements figured and described. The curious thing about them is, that they so exactly resemble those in use at the present day. There is even a whisk, to be rotated by holding it between the hands, while they are rapidly rubbed backwards and forwards. So far as the actual cooking vessels are concerned, we seem to have made but little improvement since Signor Scappi wrote.

In France, to judge from the receipts in the old cookery books, the appliances must have been as numerous as those above described, and as complicated, but it was a long time before the English kitchens were so well supplied. Our ancestors, the first English, or Saxons, do not seem to have excelled in cookery; perhaps they preferred quantity to quality, for they were great eaters. Strutt, in his "Manners and Customs of the English," engraved a representation of a Saxon feast, in which the meat is served on spits, as cooked, and fish and other matters in bowls. Hardicanute, we learn, was a great feaster, and "caused cunyng cooks in curiositie."

The Normans probably brought over French cookery with them, which, even then, was greatly esteemed. William had a large kitchen establishment, with many servants. Of the culinary vessels in use we have not found any description. Perhaps we may feel pretty sure that they were not very elaborate or numerous. Coming down to times a little later, we find that, in the sixteenth century, the great Earl of Northumberland ate from a wooden trencher. Probably most of the cooking vessels were of earthenware, though in the earl's household book it is mentioned that two brass cooking pots were bought for 26s. 4d. This was at a time when a quarter of wheat cost 6s. 8d., and a sheep 17d. Pewter vessels were a luxury for table use, and were generally hired. Even in Elizabeth's time, plates of metal and earthenware were uncommon, though Hollingshead tells us that "treene" (wooden) platters and spoons were going out, and tin and silver coming in. Forks were, of course, unknown in England till long after this. Coryat, who travelled through Europe in James II.'s day's, remarked that the Italians had a curious custom of using forks in cutting their meat, and was much laughed at for attempting to introduce forks into England. Here, or in France, they were not used for a long period afterwards. Even Montaigne used to eat with his fingers.

Spoons are said to have been introduced in the reign of Elizabeth. Fynes Morrison, in his "Travels," cautions Englishmen against using the "spoone and forke" of Italy.

For a long time our neighbours the Scots were considerably behind us in their domestic appliances. Joshua Barnes, in his "History of Edward III." (quoted in Southey's "Common-place Book," vol. iv., p. 29), says:—

> "Nor yet had they (the Scots) any pans or cauldrons to dress their meat in, for what beasts they found (as they always did good store in those northern parts) they would seeth them in their own skins, stretched out bellying on stakes in the manner of cauldrons; and having thus sod their meat, they would take out a little plate of metal, which they used to truss somewhere in or under their saddles, and laying it on the fire, take forth some oatmeal (which they carried in little bags behind them for that purpose), and having kneaded and tempered it with water, spread that thereon; this being baked."

In England the spit was for a long time turned by hand, though, as we have seen above, jacks were used on the Continent. In "Gammer Gurton's Needle," our very old English comedy, written about A.D. 1550, a beggar says:—

> "And many a broche-spit have I turned and basted."

Also in a "Book of Account," A.D. 1569, there is an entry,

> "For turnynge the spytte, iiiid."

It is well-known that dogs were trained to this duty.

A "Portable spring jack" was patented in 1773, by which motion was given from a spring to the spit by means of wheelwork, or by a string coiled over a fusee. The spit might be either horizontal or vertical. A reflector was used in which the spit is fixed, and this reflector might also be used when the spit was turned by a "ventilator." For roasting small birds, &c., a wheel, set round with a series of hooks, was employed, instead of the spit.

The first English patent relating to cookery is dated 1634. It was granted to John and Jacob Drebble, Abraham Rusfeler, and Anne the wife of Rusfeler. It was for "C'tayne stoves and furnaces of yron, of brickworke, and of earth, very comodiouse and fitt for heating of water or any other liquor, making of salt out of salt water alone, or of salt upon salt, for the heating of any roomes in dwelling howses, or any househould affayres, or hott howses for the drying of saffron, hoppes, fruites, sweetmeates, gunnes, gunpowder, saltpeter, or the like, and of mault, or any other kynde of grayne to be donne with seacole, charcoale, peate, turfe, or any other kynde of fewell, and that the said stoves and furnaces doe convey both the heate and smoke thereof soe secretly and so safely that noe daunger or annoyance can happen to be, either in regard the heate may thereby be increased, moderated, or abated to any proporcion or degree that shal bee held most fitt or requisite for any the uses aforesaide, with much lesse charge, shorter tyme, lesse attendaunce, and without any touch of smoake, and of fayrer hue, and much sweeter, both for smell and taste, then heeretofore hath bin donne by any other."

The process of cooking by steam is by no means of recent invention, for in 1769 George Scott took out a patent for "A boiler, pot or utensil, to be made of any kind of metal, for the more convenient dressing of ships' provisions with sea water or any kind of water; for making sea water fresh; for purifying and making sweet any kind of water; and for the more expeditious method of boiling any kind of fish, flesh, or provisions of any sort, and extracting broths or soups." In this vessel the process was carried on by steaming, the steam being conveyed from a vessel where it was generated through a pipe to a separate cooking vessel.

The amount of gas consumed by the city of New York alone each year is estimated to be not less than 4,000,000,000ft.

CORRESPONDENCE.

FOOD ADULTERATION.

Sir,—With reference to some of the statements made by Mr. Merriam in his paper on condensed milk, may I draw your attention to the fact that Dr. Whetmore, medical officer of health for Marylebone, has just issued his first report as food analyst. He deals first mainly with milk, as constituting largely the sole nutriment of infants. Of 62 samples, 22 were genuine, 15 deteriorated, and 25 adulterated by dilution with water, in some instances to the extent of 75 per cent., that is to say, to every quart of milk a pint and a-half of water has been added. As regards other food matters, it is stated that a specimen of lard contained 7 per cent. of water; and wine, sold as "fine, rich, full-flavoured port for invalids," he found of inferior quality, highly acid, and containing logwood and alum. Upon further analysis and similar discoveries, he states he shall recommend prosecution of the vendors of the adulterated articles.

It seems to me that here there is a subject well deserving the attention of the Society.—I am, &c.,

A. P. R.

ECONOMY OF FUEL FOR DOMESTIC PURPOSES.

Sir,—There is a very simple addition to any ordinary open fire grate that, at very slight cost, will diminish to some extent the amount of fuel consumed, and very much lessen the dust and noise of falling cinders, as well as the trouble required to keep up a fire in our open fireplaces. It is merely a cinder shelf, of sheet-iron, bright or black-leaded, elliptical in shape, 6 or 7 inches broad in the middle, with the two ends turned up, which carry two wire hooks to suspend it to the middle bar of the grate. The inner edge of the shelf rests upon the bottom of the grate, and should slope a trifle inwards, in order to prevent rolling off.

The comfort is immediately felt, for it does not interfere with the view of the open fire, and nothing is seen under the grate but fine ash, undisturbed by the perpetual fall of cinders and pieces of coal, and what rolls on the shelf is easily put back on the fire with a tiny shovel, without noise or dust.

The ashes from a grate so furnished require no sifting, as they are entirely free from cinder.

This appliance in furnace-work is called the dead-plate, and no steam boiler furnace is without it.—I am, &c.,

Henry W. Reveley.

Reading.

CHEAP TELEGRAPHY.

Sir,—Since I read my paper to the Society on "Telegraphy without Insulation," for which they were good enough to vote me a medal, I have tried many experiments, which show that, though this can be effected for very long distances in fresh water, or underground, yet there are certain disadvantages attending it, and that in salt water a good deal of insulation is required for any distance.

But I have still more done away with the disadvantages of it in point of cheapness, by discovering a very cheap method of perfect insulation.

I find that the admixture of certain substances with vegetable tar—notably the oxides of lead—almost instantaneously changes it into a solid substance, more or less elastic, and of very remarkable insulating power. For instance, I found by experiments at Silvertown that a No. 18 copper wire, covered with only 21lbs. of gutta-percha to the mile, had its insulating power increased nearly 200,000 per cent., giving an insulation per knot of about 2,800,000,000 units—an insulation sufficient for a wire girdling the world.

This makes subterranean wires so cheap that I think they are likely to supersede suspended wires, which are always exposed to accident, and which are too often rendered useless by the weather. Besides this, it secures perfect insulation for submarine cables.—I am, &c.,

H. Highton.

Putney, April 30, 1873.

PRINTING TYPES.

Sir,—I observe that Mr. Johnson supplements the discussion which followed his Paper "On Certain Improvements in the Manufacture of Printing Types," by remarks which reiterate the very inaccurate sketch presented by that paper, of the progress of the art in this country. I use this expression reluctantly, and simply in the interest of the Society, as the promulgator of information to the industrial world. I must therefore ask you to allow me to give the facts found wanting in the paper.

It is affirmed in that paper that at the date of the Great Exhibition of 1851, this country was lamentably inferior to many others in type-founding, and that "machinery was not used, not on account of its imperfections or want of efficiency, but because English Trades' Unionism deemed the introduction of machinery hostile to its interests." Mr. Johnson informs us that his connexion with type-founding dated from that time; that his patents followed a year or two afterwards; and that he altered one part of his machine because of an alleged piracy of an existing patent, for his own would have been vitiated by using what had been previously worked. He claims "to have been the means of having effected a total revolution in the respect of hard metal," and he avows and vindicates the practice of taking electro-matrices from other founders' types. He assumes a superiority for his automaton process as accomplishing all the manipulations of a type in one operation. He affirms that the three hundred machines, stated by Mr. Figgins to be in operation in this country, were made of the only models to which the founders had access, and that they had no opportunity of purchasing the automatic machinery before their own had been constructed.

I may state, as within the knowledge of the founders generally at the time, that as far back as 1848, type-casting machines were in successful operation in her Majesty's type-foundry, Edinburgh, in greater numbers than have been built of Mr. Johnson's to this date. That in 1849 a patent was sealed for improvements in them; that their number was being constantly increased; that the Great Exhibition of 1851 contained specimens of type cast by them, for which an award was made; that the illustrated catalogues of the Exhibition were printed by the Messrs. Clowes, with type so produced; that these machines were driven by steam very shortly after; that no trades' union existed at that time, the competition among the founders being notorious. All this apparently without Mr. Johnson's knowledge.

With regard to hard metal it was always a question simply of price, so much, more or less, of antimony and tin to lead, as shown at the trial alluded to, by samples proved to have been cast long anterior to the patent claimed, and produced from such offices as the *Times*, the Clarendon Press, Oxford, and others. There was no discovery, and therefore no patent.

In the interest of the art, I may ask, is it a "certain improvement in the manufacture of printing types" to produce a *fac-simile* of an existing type? Were Mr. Johnson the author of a costly and authentic work, would he consider it an "improvement" to see his first copy carried off and re-printed by another publisher without any reference to his interests? Would the accident of such a thing not being illegal render it honest?

The fallacy of economy in conducting a number of processes in one operation which require the most varied time, must be felt in Mr. Johnson's own foundry, where manual labour, in greater degree in proportion to the number of machines, is employed, than could be accounted for if the machines were all competent. Has Mr. Johnson forgotten his offer of his machines to the founders generally, soon after the completion of his patent, and their rejection of them, simply because they did not secure sufficient accuracy of work, nor show any economy in results? Moreover, but recently the patents have again been offered, and again rejected.

In his competition with all the world, the British type-founder is not likely to reject any real improvement, whatever he may already have expended in the advancement of his appliances.—I am, &c.,

R. M. Gill.

FINE ARTS EXHIBITION AT DIEPPE.

Sir,—I have to inform you that the annual exhibition of works of art will take place in Dieppe this year from the 20th of July to the 31st of August.

As the Société des Amis des Arts is most desirous that this exhibition should be of an international character, we feel our object cannot be more fully carried out than by a friendly and encouraging notice in the valuable *Journal* of your Society.

The Council admits the original works of living artists of all nations. No artist is allowed to exhibit more than three different works; the size of each must not exceed six feet nine inches in any way, frame included. Works for exhibition must be sent, *viâ* Newhaven, to the President of the Société des Amis des Arts, Dieppe, before the 1st of July next. A description of each work, with the address of the artist, must be sent to the secretary before the 1st of June next. All works are submitted to the approval or rejection of a jury, and the Council will pay the carriage to and from London on every work exhibited. Every care will be taken of works sent for exhibition, but the Council will not hold itself responsible in any case of injury or loss.

The whole of the proceeds of admission to the exhibition, and the balance of subscriptions of the members, are devoted to the purchase of works exhibited. A subvention from the town is granted towards the same object, and the secretary is authorised to act as the agent of exhibitors for the disposal of their works.

Such are some of the inducements we can offer, and which I trust may cause our English school to be largely and worthily represented. I may add, I will personally see that care is taken of these works.

I am, &c.,
Frederick Chapman,
Vice-President.

Société des Amis des Arts de Dieppe, May 6.

NOTES ON BOOKS.

Dictionnaire Technologique. Par Alexandre Tolhausen et Louis Tolhausen. (London: Sampson Low, 1873.)—This is the first part of a dictionary intended to give in French, German, and English, the technical terms used in the arts, sciences, manufactures, and industries generally. The portion before us is half of the French-English-German part, and goes down to the letter F. This part, of course, will have to be supplemented by two others in which translations of English and German terms will be given. About the use of such a book, if properly prepared, there can be no question. We do not know that any one like it exists even for any two of the languages treated, and of course when all three are given at once its value is enhanced. As a case in which the want was felt of a similar book may be instanced, the translation of foreign exhibition catalogues into English. On more than one occasion such works have been full of errors, arising from a want of the knowledge of technical terms on the part of the compilers. Of course such a book can only be tested by experience, but so far as a cursory examination justifies an opinion, this one seems remarkably complete. The ground covered is very extensive, and words relating to industries of the most varied nature are all carefully included. The book is one likely to prove of considerable service to all engaged in work of any sort which brings them into connexion with foreign trades or industries of any sort.

Theory and Practice of Linear Perspective. From the French of V. Pellegrin. London: Bickers and Son, 1873.—The chief object of this little book is to provide useful practical rules for artists and art-students. As Professor at St. Cyr, M. Pellegrin has had considerable experience in tuition, and he has consequently been able to perceive what are the great difficulties of learners. The work is consequently likely to be a useful one. Should a second edition be called for, a revision would be advisable, as here and there occasional French idioms may be noticed.

GENERAL NOTES.

Railway Carriage Seats.—An inventor in Toledo, United States, has just received a patent for an invention consisting of a combined seat and desk for railway cars. The device comprises a stiff spiral spring, situated in the base of an ordinary-shaped stool, in such a manner as to receive the full weight of the occupant of the stool without permitting it to touch the floor. The spring serves to break all the jar and jolt caused by the motion of the train, thus affording a perfectly steady position to the small desk attached to the front of the stool. It is claimed by the inventor that the occupant may write while travelling at the rate of thirty miles an hour, with perfect ease and legibility.

New York Crystal Palace.—The New York Crystal Palace Company proposes to erect a permanent industrial exhibition building, together with an art gallery, a public library, and a garden of plants. The cost of the whole enterprise is estimated at about 10,000,000 dols. The cost of the site, which will be between Ninety-eight and One Hundred and Second-streets and Third and Fourth Avenues, will be 1,500,000 dols. A Bill has passed the lower house of the New York legislature authorising the city to subscribe to the stock.

Technical Lectures in the Glasgow Industrial Museum.—The Parks and Galleries Committee of the Glasgow Town Council are making an effort to establish an industrial museum, and they have already got together a very good nucleus. With the view of rendering the temporary museum a place of instruction, several lectures have lately been delivered upon certain series of industrial products by scientific gentlemen in Glasgow. Two of these were delivered by Mr. John Mayer, F.C.S., Government Lecturer on Science, and Professor Gustav Bischof, of the Young Technical Chair of Chemistry, the first named gentleman giving a rapid sketch of the manufacture of iron and steel, illustrated by diagrams, specimens, models, &c., and Professor Bischof discoursing upon phosphorus and its application in the manufacture of lucifer matches. Both lectures were largely attended and much appreciated.

United States Silk Manufacture.—The statistics of silk manufacture in the United States indicate a very great increase. Ten years ago it was in its infancy, and purely an experiment; now it has attained to vast proportions, and bids fair speedily to become one of the most prominent manufactures of the country. The recently published annual report of the Silk Manufacturers' Association contains the statement that £6,000,000 are invested in this industry in the country, and sixteen thousand operatives are employed, whose wages reach £1,600,000, and the value of whose production is estimated at between six and eight millions sterling.

Canadian Patent-office.—We have received the first number of the *Canadian Patent Office Record*, a counterpart of our own Patent Commissioners' *Journal*. It is after the American model, and is illustrated with wood-cuts from the drawings attached to the filed specifications.

The Catoptric Lamp.—The upper part of Trafalgar-square is now lighted with some of the "Catoptric" lamps recently shown before the Society by Mr. Skelton, the inventor. The improvement is very decided, and the difference in the illumination of the street will be obvious to those who remember its former darkness.

Aniline.—M. Langorrois has found that putrefaction and decomposition of animal matters can be prevented, even when exposed to the air and in an elevated temperature, by the use of small quantities of aniline.—*Medical Press and Circular.*

Platinum Coinage.—At a time when gold is said to be rising in value, and when nickel has come to be in great demand for coinage, the claims of platinum, as a useful material for the same purpose, may fairly be reconsidered. In many of its qualities it is fully equal to gold and silver. It is scarce, therefore intrinsically valuable; it is quite as refractory as gold to ordinary chemical agencies, and far less fusible; it stands wear very well; and its high specific gravity renders it even less liable than gold to imitation by base alloys. Apart from all abstract reasons, however, is the fact that platinum was actually used in Russia for coining purposes, and its use was abandoned in 1845, only because of the difficulties of working which then existed. Now, however, when comparatively large ingots are manipulated by modern improved methods, such an objection can no longer be urged. The feasibility of a platinum coinage is at least worthy of careful consideration, and we commend the subject to the thoughts of those interested in such matters.

NOTICES.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. The following meetings have been arranged:—

May 14.—"Improvements in Rifles." By Capt. O'Hea.

May 21.—"On Recent Processes for the Production of Gas for Illuminating Purposes." By Thomas Wills, Esq.

CANTOR LECTURES.

The Third Course of Cantor Lectures for the present session is "On Wines; their Production, Treatment, and Use," by J. L. W. Thudichum, Esq., M.D. The Course consists of six lectures, the fourth of which will be given on Monday evening, the 12th of May, the remaining two on the Monday evenings succeeding.

Lecture IV.

The varieties of wines produced in the Alto Douro; how treated at Oporto. Lodges. Brandy. Legend of elderberry. Unbrandied and dry natural Alto Douro wines. Neglect of scientific guidance here also, but processes more simple, and varieties of results not so great as at Jerez. Description of other Portuguese vineyards—the Beiras, Valley of the Tagus, Bucellas. Fable of the transplanted Rhenish grapes. Collares. Torres Vedras. General remarks on the nature and difficulties of Portuguese viticulture and vinification, all based upon personal observation of the lecturer.

Lecture V.

The wines of France compared to those of Spain and Portugal. The Gironde, its vineyards, wines, and varieties of wines. The Bourgogne and its productions. Belgian appreciation, and sweetness of Burgundy wine. The wine requires the procédé. The Champagne; peculiarities of viticulture. Chemical treatment of effervescent wine to ensure its soundness. Absurd notion of some writers on champagne; of the same on second wines and sugar-water wines; exposure of the sycophancy.

Lecture VI.

The wines of Germany; Riessling a type of bouquetted wines. Classification of the wines of the world, as determined by quality, quantity, value in the market of highest and lowest qualities. Active ingredients of wine. Use of chemical analysis. Use of wine to the healthy, whether old or young; wine, under which condition preferable to all other alcoholic liquids. Wine should be a beverage, not a dram. Use of wine to the delicate and sick. Selection and prices of wine. Proposed modification of the import duties, to adjust them to the climatic difficulties of Spain and Portugal.

INDIA COMMITTEE.

A Conference will be held this evening (Friday, 9th instant), at 8 o'clock, when a paper will be read by Lieut.-General Sir Arthur Cotton, R.E., on "The Harbours of India." Lord William Hay, F.R.G.S., will preside. This Conference will be the last of the Session.

Members are entitled to attend these Conferences free, and to admit two friends to each of them.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...**SOCIETY OF ARTS, 8.** Cantor Lectures. Dr. Thudichum, "On Wines; their Production, Treatment, and Use."
Stationers' Company, 7½. Technological Lectures. Mr. E. A. Davidson, "Copper and Steel Plate Engraving and Lithography."
Royal Geographical, 8½. Mr. Ney Elias, "Journey through Western Mongolia."
London Institution, 4.

Tues. ...Medical and Chirurgical, 8½.
Civil Engineers, 8. Sir Charles A. Hartley, "On the Delta of the Danube, and of the Provincial Works executed at the Sulina Mouth."
Royal Institution, 3. Mr. J. H. Parker, "Roman History and Architecture."
Photographic, 8.

Wed. ...**SOCIETY OF ARTS, 8.** Capt. O'Hea, "Improvements in Rifles."
Geological, 8. 1. Mr. J. R. Mortimer, "Notes on Structure in the Chalk of the Yorkshire Wolds." Communicated by Mr. W. Whitaker. 2. Prof. P. Martin Duncan, "On the genus *Palæocoryne*, Duncan and Jenkins, and its Affinities." 3. Sir Philip de M. Grey-Egerton, "On *Platysiagum sclerocephalum* and *Palæospinax priscus*." 4. Dr. Thos. Wright, "On a New genus of Silurian Asteriadæ."
Royal Literary Fund, 3.
Royal Society of Literature, 4¼.
Archæological Association, 8. Annual Meeting.

Thurs...Society for Encouragrment of Fine Arts, 8. Herr Ernst Pauer, "Louis van Beethoven."
Royal, 8½.
Antiquaries, 8½.
Chemical, 8. Dr. H. E. Armstrong, "On Isomerism."
Numismatic, 8.
Royal Society Club, 6.
Royal Institution, 3. Professor Tyndall, "Light."

Fri ......Architectural, 7½. Mr. Wynfield, "On Taste in Colour."
Royal Institution, 9. Professor Sidney Colvin, "Limits of Certainty in Taste."
Philological, 8¼. Annual Meeting.

Sat......Royal Institution, 3. Professor Odling, "Ozone."

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FRIDAY, MAY 16, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ENDOWMENT FUND.

The following donations and subscriptions in aid of the Endowment Fund have been received:—

	£	s.	d.
Wm. Atkinson	50	0	0
W. R. Sandbach	50	0	0
Sir Walter C. Trevelyan, Bart.,	50	0	0
James Bentley	20	0	0
Col. A. Angus Croll	20	0	0
John Noble	20	0	0
G. T. Saul	5	0	0
W. R. Spicer	5	0	0
Chas. H. L. Woodd	5	0	0
Geo. W. Hart	2	2	0
John E. Evans	2	2	0
E. T. Blakely	1	1	0
Thomas Dixon	1	1	0
John S. Lapraik	1	1	0

PROCEEDINGS OF THE SOCIETY.

TWENTY-SECOND ORDINARY MEETING.

Wednesday, May 14th, 1873; the Right Hon. the Earl of Ducie, F.R.S., in the chair.

The following Candidates were proposed for election as Members of the Society:—

Clulow, George, 87, Caversham-road, N.W.
Croudall, W. S., Dundee.
Hardess, William Mantz, Sydenham-rise, Forest-hill, S.E., and 4, Coal Exchange, E.C.
Snowden, William, 151, Boyson-road, S.E.
Wilson, William, 21, Havelock-road, Hastings.

The following Candidates were balloted for and duly elected Members of the Society:—

Barclay, John, Seedley Printing Works, Manchester.
Beck, W. H., 139, Cannon-street, E.C.
Bleckly, W. H., Ashfield, near Warrington.
Buckley, John Charles, Carr-hill, Mossley, near Manchester.
Cassels, Walter Richard, 54, Queen's-gate, S.W.
Dunn, William, Messrs. William Dunn and Co., 6, Lime-street-square, E.C.
Muir, John, James Finlay and Co., Glasgow.
Robertson, Archibald David, 53, Queen's-gate, S.W.
Sandall, Frederick, 114, St. George's-road, Southwark, E.C.
Shaw, Robert B., Waterloo Hotel, Jermyn-street, S.W.
Turney, John, Trent Bridge Leather Works, Nottingham.
Tyser, George Walter, Parkside, Reigate, and Lloyd's, E.C.
Young, William, 33, Blandford-square, N.W.

The paper read was—

ON RECENT IMPROVEMENTS IN MILITARY BREECH-LOADING RIFLES AND AMMUNITION.

By Captain O'Hea.

On the 2nd February, 1870, I had the honour to read in this room a paper on "Progress in the Invention and Improvement of Breech-loading Small Arms and Ammunition." To-night, on the invitation of the Council of the Society of Arts, I again address you in continuation of the subject of that paper.

Although the years which have passed by since 1869 have been more remarkable for modifications and improvements in existing systems—for the discovery of defects, and, in some instances, for their correction, than for inventions, nevertheless these years have not been altogether barren of novelty; more than one invention of merit and promise has appeared.

On the previous occasion, I broadly divided my subject into the Ammunition and the Arm, giving precedence to the Cartridge. I see no reason why I should depart from this order to-night; on the contrary, three years of experience have rendered me more satisfied than ever that the ammunition is the premier division of the subject on which I write. Without proper ammunition the weapon would be worthless as a fire-arm; and even in a mercantile point of view, a small arm of our time fires away in a few years—and in many cases in a few months—more than three times its value in the cost of ammunition. I shall not then depose the Cartridge.

The past three years have not been remarkable for improvements in the gunpowder ammunition for breech-loading small-arms; while one of the best, if not the very best, British metallic cartridges —that which gained the Government prize of £400 in the cartridge competition—has become, I regret to say, difficult to obtain. One or two modifications of existing systems have been put forward; I am not, however, in a position to say that they are improvements; nevertheless, although the time has been unprofitable as regards improvement, it has not been so as regards information on the subject of ammunition. In this comparatively short period a great European war has been fought out, the first in which the breech-loader has been used against the breech-loader, both the armies engaged having also used, to a large extent, the paper-cased ammunition. The subsequent rejection of this system of cartridge by both armies, and their adoption of the metallic re-loading case, afford the strongest evidence of the superiority not only of the metallic cartridge, but also of the system which furnishes facilities for re-utilisation.

Before leaving the subject of ammunition, I would offer a few brief observations on the metallic cartridge for breech-loading small-arms, in particular on the cartridge in general use in this country with small-bore arms. In so doing I must, to some extent, repeat what I stated here on a former occasion.

With reference to the case, it is now, I believe, acknowledged—all other conditions, save the primary cost of manufacture, being equal—that the cartridge-case which can be reloaded the greatest number of times, in the simplest, readiest, and least expensive manner, is the best—the primary cost of the case being reduced in proportion to the number of times it can be re-utilised, the weight of the case also being taken into special consideration. Not many years ago a certain number of soldiers per company had, by our Musketry Instruction, to be trained to the manufacture of cartridges for the Enfield rifle. Might not the practice as regards refilling the metallic case be continued, with advantage to the service and to the revenue? I would suggest that there might be instances of troops being temporarily shut out from supplies in a detached position, when, having expended their supply of the loaded metallic cartridges, the practicability of reloading the case might be tantamount to the holding possession of the post.

I would further remind the best marksmen in the world—the Volunteers of England—that if the cartridge-cases which they extract and throw away in such large quantities annually were capable of being returned to store and re-utilised as ball ammunition, instead of being sold as waste metal, it would be a considerable saving to those who expend so much ammunition in the year.

With respect to the powder charge, the greater the powder power which, in a given length and diameter of bore, can be utilised to propel a projectile of defined weight, the greater the initial velocity—convenience to the soldier, as regards recoil, &c., being duly considered. The greater the initial velocity the flatter the trajectory, and, as a consequence, the longer the dangerous space; and the military arm giving the flattest trajectory to the longest distance *must* be the most efficient; for, all other points being equal, there is a gain in vertical accuracy, and, as a consequence, a diminution of the chance of error in judging distance.

With regard to the projectile:—without referring to the best form (on which Major-General Boileau, R.E., is unquestionably one of the best authorities) or to the component material, further than to remark, that the harder the material of the projectile the better, especially for penetration, I would venture to offer a few suggestive remarks, the result of practical experience, during the past few years, of many thousand rounds of ammunition.

In the first place, it would appear to have escaped special notice, but it is nevertheless a fact, that to impart to the projectile in its after-flight the rotation due to the pitch of rifling in the bore from which it is fired, it is not at all necessary that the metallic surface of the bullet itself should be compelled to take or conform to the rifling. On the contrary, the indenting or defacing of the surface of the projectile, by means of the rifling in the barrel, becomes materially injurious in its after-flight, and detrimental to its penetration. All the rotation due to pitch of rifling can be obtained with equal certainty by the medium of a proper system of paper or other wrapping on the bullet. The projectile of the Prussian needle gun (*Zündnadelgewehr*) never touches the barrel from breech to muzzle; it is carried along the rifling and receives otation by means of the *sabot* in which it is seated. I have used bullets which, without any wrapping, passed through the rifle bore without receiving the slightest mark or indentation from the rifling, but which, when fired enveloped in tough paper, gave all the accurate results obtained from the rifled bullet. I have recovered, in an almost uninjured state, a large number of the Henry projectiles used with the Government small-bore ammunition, and on almost all of those so recovered there is scarcely a mark of rifling in front of the cannelure, and in many instances not a mark of rifling even below the cannelure. I would, however, remark, that, to really utilise the tough paper (or other slight substance medium), for the purpose of rotating the projectile, a fine description and a blunt pattern of rifling ought to be adopted. Rifling of a sharp angular pattern is likely to cut the wrapping instead of indenting it, and thus becomes detrimental to accuracy of after-flight.

Again, I would draw attention to the curious misapplication of our national rule of weight in the case of the small-bore projectile adopted by the Government, and in general use with the small-bore breech-loaders of this country. The weight of the projectile is 480 grains—1 oz. troy, or apothecaries' weight. Now, as lead and all other metals, except gold and silver, are weighed by avoirdupois weight, if the national ounce bullet is be retained, might it not be well to make it 437½ grains, or the ounce avoirdupois? That this could be done without any lessening of accuracy, even to a longer range than 900 yards, I can assert from experience.

I will now refer to the arm, the *engine* by means of which the power stored up in the cartridge is utilised, and to the improvements which have been brought forward during the past three or four years:—

The arm I shall, as before, divide into the breech mechanism, the rifled barrel, and the mountings.

I would remind you that the breech-action of a small arm is the means by which the loading of the arm, the firing of the cartridge, and the extraction of the case are effected; in fact, the action is the means of assisting and facilitating the manipulation of the arm; and that action which affords the greatest and most perfect assistance, combined with safety, is the best.

The rifled barrel is the means by which the projectile receives initial direction, and the rotation round its axis of progression necessary for steadiness in after-flight.

The mountings are intended to facilitate the handling of the arm; in some cases they add to the general appearance and strength of the weapon, but they very often impair its efficiency.

Under the separate heads of block and bolt action, I shall, to-night, refer to late improvements in the breech mechanism.

In the block-breech mechanism there are five distinct classes, but I shall only speak of three.

1st. The rear-hinged or pivoted dropping block, of the American Peabody class.

2nd. The vertical sliding or wedge-block, of the American Sharpe class, represented in this country by the well-known Henry, which in connection with the Henry rifled barrel obtained the government prize of £600.

3rd. The side-hinged swinging block of the Snider class.

Of the other two classes, namely the front-hinged block turning over on the barrel on the Mont-Storm plan, and the top or balance-lever block of the Money-Walker class, there may be recent modifications, but they have not come under my notice.

Of the first class, without any wish to ignore others of merit, if such there be, I ask your attention to four modifications.

In point of time of production, the Tranter stands first; this, like every arm brought forward by Mr. Tranter, of Birmingham, bears the stamp of much mechanical ingenuity and first-class manufacture.

Next, the Zeller, a clever modification by Zeller, a gun maker of the Hague, of the Bavarian small arm, in which, by means of a second trigger placed inside the trigger-guard, the full and half cocking of the arm is accomplished without the necessity of using the lever or moving the block. The main spring is also noticeable in this action.

The next is the Harston, the modification of C. Greville Harston of Birmingham, for which the patentee claims, in addition to simplicity of construction, &c., increased safety in using the rifle, from the fact that the action has three points of resistance to the discharge instead of one—viz., the hinge of the block, the lug of the lever engaging with the lug of the block, and the hammer, when the arm has been discharged.

And, lastly, the Swinburn, patented within the last year, a very clever modification of the Martini, for which, among others, the patentee claims the following advantages:—Great reduction of wear and tear upon the working surfaces, in consequence of the main-spring offering no resistance to the closing of the breech; a lighter main-spring by 50 per cent. than the Martini, giving greater certainty of fire; the use of a safety half-cock, dispensing with the complicated safety bolt, and placing the firing apparatus under control of the person firing, independently of the breech-closing apparatus; and finally, a pull-off of trigger capable of being regulated and made as easy as that of a sporting rifle; a more powerful extractor, and a considerable lessening in number of pieces.

In the foregoing, the avoidance of the use of a spiral spring as a main or driving spring, and the adoption of the old or ribbon mainspring, will be noticed; a waste of power in compression and propulsion is avoided, and the light or medium pull-off, absolutely essential to accuracy of shooting, obtained.

Of the vertical sliding block there have been two or three modifications, but I trust I may be excused for introducing only one to your notice, the Aston, the invention of Mr. Aston, armourer to the School of Musketry at Hythe. An examination of this breech-action will well repay those present who take an interest in mechanism of an ingenious and very simple character. I would only remark that in the Aston action there are ten parts or pieces, as against thirty in the Martini.

The rifle has a block action, fitted with two flat springs. It cocks when opening the breech. There are two bents for full and half cock. The hammer, in striking the cap, moves a quarter circle, doing away with the usual piston and spiral spring, and is not so liable to miss-fire with a light spring. The breech is opened and closed by a lever on the right side; there are no projections above or below when the rifle is opened or closed. It is easy to strip and put together, and not liable to get out of order. The barrel can be cleaned from breech or muzzle. In the construction of the rifle all projections have been avoided. It is a simple action, with very few parts, and can be made very cheaply.

Of the third class, the side-hinged swinging block, I will also mention only one, the Dunstan. Indeed, I am not aware that any other improvement on this description of block has appeared during the past three or four years. This is really a very clever modification, for Mr. Dunstan, the patentee, not only manages to enclose the limbs or pieces of the ordinary side-lock in a small swinging box-block, but he uses a safety thumb-pressure trigger, by means of which he claims, with reason, to lessen the disturbing influence to accuracy attending the pull of trigger as usually used in the small arm.

The bolt system of breech-action has not been the subject of much modification or improvement of late years. The Chassepôt, however, has been or is being modified for the use of a metallic cartridge, and the Prussian needle gun is also being modified on a system called the Mauser.

I feel that I cannot close my description of recent improvements in breech mechanism in a more fitting manner than by introducing to your notice the new Smith and Wasson pistol, a most perfect specimen of the revolver.

More than two years and a half ago the Smith and Wasson pistol was placed in my hands by Mr. William Read, the well-known gun and ordnance manufacturer of Boston, United States, and since that time the arm has been subjected to most severe tests. I have no hesitation in stating that it is the most perfect little weapon of its kind I have ever tried. A detailed description of this arm is unnecessary. The action tells its own tale.

In leaving the subject of the breech-loading action in general I would offer one or two observations on the pull-off of trigger. The pull-off of trigger is almost as essential to steadiness and accuracy of shooting as careful training, large practice, and good nerve. A long pull, a strong pull, and, above all, an uncertain pull as regards time and pressure, is not the pull-off to sustain accurate and steady shooting. The long retention of the breathing with such a pull-off is positively uncomfortable, not only to the individual about to fire, but to the individual looking on. A pull off of not more than five or six pounds, and a sharp and certain release of sear are requisite for accuracy of shooting.

A long reach for pull of trigger is also a certain cause of inaccurate practice. Our musketry instruction teaches us that the finger is to go round the trigger like a hook, while the remainder of the hand holds the small of the butt. Where the trigger is over forward, I would suggest the use of a curved trigger, to facilitate the steady pull or pressure of the trigger.

Before entering on the second division of this subject—the rifled barrel—it might be well to refer briefly to the origin of the rifle—to explain what a rifle really is, and the results attained by rifling.

Originally rifling was used as a system of drainage for fouling of previous discharge in the barrel, to facilitate loading from the muzzle, and the grooves or rifles were straight from muzzle to breach. A gunmaker at Nuremberg is said to have been the first who cut these drains or channels on a curve—it is supposed by accident, but our countryman, Benjamin Robins, in a tract on "Rifled-barrel

Pieces," published in 1747, was the first to point out the real effect of spiral rifling on the flight of projectiles propelled by gunpowder. A rifled barrel or tube is literally a female screw—the nut through which a bolt—the projectile—is driven with more or less velocity, according to the power applied to it, and the pitch or form of screw offering more or less opposition to its transmission; and rifling is now used for the purpose of giving rotation to the projectile round its axis of progression, by which more or less steadiness is given to it in its after-flight.

It is not my intention to enter into the history of the Rifle. For information on the subject I would refer to a lecture given by me on "Rifles and Rifling," at the Royal United Service Institution, on the 28th March last. My paper to-night has reference to what has been brought forward during the past three or four years. In that period, and, indeed, for many years previously, there has been but one radical improvement, one real novelty in rifling, brought forward. I refer to the invention of William J. Murphy, Esq., of Richmond, Cork. This invention, for it is an invention of an exceptional character, cannot be said to be rifling of a new pattern, since it embraces every known pattern; nor can it be referred to under the head of pitch, as it is applicable to pitch of any and every degree.

The peculiarity consists in rifling, with *inclined* rifling, only a portion of the bore—a comparatively small portion—towards or at the muzzle, the rifling being dispensed with in a large portion of the bore in front of the seat of shot, where it has hitherto been an impediment to the initial motion of the projectile, and consequently a cause of recoil. The peculiarity and novelty of the system consist in some measure in confining the rifling, not only to that portion of the bore where alone (as I have proved by experiment) rifling can be necessary, but to the very portion of it which has hitherto been considered the weakest; where, in fact, we have been taught to believe that any impediment to the free exit of the bullet would involve the destruction of the arm.

The patentee claims for his system the following advantages:—first, a great reduction of recoil, without any reduction of charge or increase in the weight of the arm. Secondly, increased velocity of projectile, and consequent flatness of trajectory, without any loss of accuracy of direction. Thirdly, from the position of the rifling, facility for punching, drawing, or cutting, and accurately guaging the same; and, though last, not least, a very considerable reduction in the cost of manufacture, with more exact evenness of pitch and form of rifling, consequent mainly on the small portion of the bore that will be rifled.

Mr. Murphy contends that the fact of the surface of the projectile having to travel along the incline of the rifling towards or near the muzzle, retards only slightly, without unduly checking, the velocity at that point, and that in consequence a larger quantity of the powder-charge is consumed, and a somewhat greater power is thus finally applied to expel the projectile from the bore than with the ordinary rifle.* In the case of this latter, the increasing velocity of the projectile is unimpeded, save by the column of air in the barrel, until it escapes from the muzzle, except when increasing pitch is used.

In August, 1871, Mr. Murphy placed his invention in my hands, and since that date I have subjected the system to extended trials with many arms having rifling of various patterns and degrees of pitch. My experience with these rifles, which extends to the firing of several thousand rounds of ammunition, enables me to state that the claims of the inventor have been borne out, to an unusual extent as inventions go; and this, too, under the difficulties attending primary manufacture, and a supply of ammunition of the most faulty and uncertain description that I have ever used—the only supply open to me.

With a Martini-Henry rifle, bitted out to within four inches of the muzzle, using the regulation cartridge, I have at 400 yards obtained very satisfactory shooting with elevation for 275 yards only; at 500 yards with elevation for 350; at 600 yards with elevation for 400. With a barrel rifled on Mr. Murphy's rib system, having the same length of rifling as above, I have, also with the regulation cartridge, at 500 yards got good targets with 400 yards elevation; at 600 yards, with sighting for 450; and at 700 yards with elevation for 550. With a Peabody-Murphy, the trajectory flattens in like ratio as with the last-named arm, as you get further from the target. With a Henry barrel attached to a Westley-Richards breech-action, using the Westley-Richards cartridge (76 grains powder, 480 grains projectile), I have got equally good results as regards trajectory, with extreme accuracy of direction. Lastly, not to weary you with a further account of experiments, I have, with a Navy Enfield, obtained admirable shooting up to 600 yards, but with less gain in flatness of trajectory, owing to the thinness of the metal at the muzzle.

I cannot hesitate to express my conviction—a conviction founded not on theory—but, as I have said, upon extended practice—that rifling barrels all through, from the seat of shot to the muzzle is, for all the advantages that rifling is intended to secure, unnecessary, and simply a waste of time, metal, and labour—which means money; and I have every confidence that when the Murphy principle is known, and the system fully and fairly tested, this arm will find its place.

I would add, that I have fired more than 100 rounds per barrel at a time, from nearly all the barrels converted on this system, without cleaning, and without having a strip, or failure as regards vertical accuracy. Of course, like many others, when I first commenced testing this system, there were failures, and bullets left the bore without taking the rifling.

With reference to the last section of this division, I will offer but one brief remark. Bands on a barrel are, to a certain extent, detrimental to even expansion, and consequently to accuracy. To all who use a divided stocked arm this must be evident. The bands, as well as the half-stock, of the Martini-Henry, have to be pinned, in order to prevent their being carried away over the muzzle by the wave of metal consequent on the passage of the bullet up the bore; and, besides, this fastening on necessitates the fixing of an additional lump of metal on the surface of the barrel.

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* I need scarcely remark that in all arms a certain amount of the powder-charge is blown away unconsumed; and this portion of the powder-charge Mr. Murphy claims to utilise.

DISCUSSION.

Captain Costin inquired whether Captain O'Hea had tried soft bullets as well as hardened ones?

The Chairman inquired whether the smooth portion of the barrel was bored out to the depth of the lands of the rifle, so that the lands stood out in opposition to the surface.

Captain O'Hea said he had used soft metal as well as hardened bullets, and that the smooth portion of the barrel was bored out, so that the bore was somewhat larger than originally made. He simply took the rifled barrel and bitted out a certain portion of the rifling, so that the bullet would slide easily along the smooth portion.

Captain J. Selwyn, R.N., said he was practically acquainted with the improvements now described. This was another instance of the fact that improvements in any art very seldom originated in those practising the art, this new method of rifling having been the invention of a distiller in Cork, Mr. Murphy. He had seen what others did not, that to put the bullet in rotation, so as to give it a rapid motion, means should be adopted, at the moment of its leaving the barrel, to give it a spin. It was thought, at one time, that a small bore and an elongated ball of three diameters would give the greatest results in lowering the trajectory, or, in other words, increasing the velocity, for if a ball went a certain distance in a certain time, and then by another method it went in less time, that simply meant a flattened trajectory. Now, in the invention of Mr. Murphy, this increased velocity was accomplished by allowing the bullet to obtain at once the full velocity given to it by the impact of the powder, and only stopping it so much as to give it the necessary rotation; and a moment's consideration of the means by which rotation was given to a ball would show that whenever these grooves or lands were continued through the whole length of the barrel, the velocity of the rotation would depend on the velocity with which the bullet passed along the spiral. If that velocity were diminished at the commencement, no effort afterwards could compensate for it, and give the bullet so great a rotation as it would have if it had taken the rifling at a higher velocity. This was the reason why so much better results had been obtained by confining the rifling to a few inches at the muzzle. Turning to the question of metallic cartridges, he must bear his testimony to the fact that they were of the greatest importance to breech-loading arms. The present government cartridges were made of three different metals, which invariably exercised a galvanic action upon each other, so much so, that several millions had been returned as useless from India. This faulty system had been attempted to be remedied by coating the cartridges over with a little varnish, in order to prevent the action of the iron on the other metals, but, of course, this could not be depended upon for any length of time, and therefore he considered it very foolish to attempt to ignore the fact that lead and copper, when in contact with iron, would always produce a galvanic action. In connection with this subject, it was to be noted that in all modern battles, where breech-loaders came into play, it was found that the ammunition was fired away too quickly, and it had been proposed to organise supplies of mules, and in other ways, to attempt to keep up the amount of ammunition, but of course such appliances were not always available, and it would be much better, if possible, to devise some plan by which the weight of the cartridge should be diminished without sacrificing efficiency. In the one proposed by Mr. Daw, who took the prize when Col. Boxer was at Woolwich, the point had been considered, and its weight was much below that of any cartridge then in use. Since then, however, further improvements had been made, and speaking as a naval officer, who had no interest in any particular cartridge, he would only appeal to those who had to use them, whether they would not rather carry ten rounds more cartridge at the same weight, than continue to use another pattern simply because certain individuals might be interested in its manufacture. One of those cartridges on the table carried ninety grains of powder in a space considerably less than that required for seventy grains by the other cartridges, and it was capable of being re-loaded a sufficient number of times for all practical purposes. It weighed only 103 grains as against 190 of one pattern, and 170 of another; or, in other words, ten rounds more might be carried for the same weight. There was another advantage also in the case of cartridges made of thin metal, that they were much more easily removed from the chamber, those of thick drawn metal being found to stick after repeated use, as minute scratches and other defects in course of time became formed. He hoped this subject would be taken up by the Society of Arts, and that some pressure would be put upon public officials, who were rather too apt to discourage anything new. However, in any case, whether another cartridge ought to be adopted or not, it was very evident that an enormous advantage was derived from adopting the system of rifling, as he could testify from personal experience, having fired these guns himself; and he should add that another change had been introduced which Captain O'Hea had not alluded to, that the pitch of the rifling was altered so as to avoid the error which generally arose from pulling the trigger, and the inclination which almost all persons had to shoot to the right. The pitch of these rifles was turned in the opposite direction, and it was found to compensate for that inaccuracy, so that much more accurate shooting was produced, as Captain O'Hea had demonstrated at Wormwood Scrubbs. In conclusion, he hoped the results of these improvements would be shown at Wimbledon.

Commander Dawson, R.N., said he had had an opportunity of seeing some of the practice carried out under this system of part-rifling, and it was evident that there was yet a great deal, both with regard to gunpowder and to the gun, which required patient experimental investigation and scientific research. If any one had told him that after taking all the rifling out of the barrel, except four inches at the muzzle, you could get sufficient rotation to keep the bullet true, he should have been inclined to smile, but the diagram exhibited plainly showed that this diminution, to whatever kind of rifle it was applied, really improved the accuracy of fire to a very great degree. He had seen all kinds of rifles on the Murphy part system fired, one after the other, by volunteer marksmen who had not seen any of them before and knew nothing about the system, and he observed that the sights were raised to 150 yards less than that fixed for the range. Another noticeable fact was the extremely small amount of recoil, which astonished those who fired the rifles more than anything else. Now there was a direct connection between the recoil and the lowering of the trajectory. As had been said, a low trajectory meant a high velocity—it was simply a question of increased velocity, and, of course, that increased velocity gave increased accuracy, not only at known but at unknown distances, which was a great advantage. There were always the influences of the atmosphere and of light, which were liable to occasion error, and the lower the trajectory the less these disturbing influences would be felt. The same elevation also gave a greater range and greater penetration, which, though not of much importance in small arms, was very material in great guns. The recoil was simply the measure of the obstruction which the bullet met with in getting out of the bore. If you had no shot in the bore there would be the minimum of recoil, and as its exit was obstructed so the recoil increased. In great guns, instead of measuring the recoil, the powder-pressure in the chamber was measured, and it was found that as the pressure went up there was no adequate increase in the velocity of the shot, so that it was found necessary sometimes to reduce the powder-charge below what the bore of the gun would naturally suggest. Of course, the highest velocity would be obtained with a perfectly smooth bore, but then you would have no spin in the bullet, and, consequently, no accuracy; and the question was, how this accuracy could be obtained with the least expenditure of force to rotate the bullet? A great deal of force might be absorbed by putting a bad system of rifling into a gun, and the pitch of the rifling had a considerable bearing upon this question. In the case of great guns, it was found that one-fourth of the maximum velocity of the shot was obtained when it had travelled $\frac{1}{25}$th of the grooved length of the barrel, and that $\frac{9}{10}$ths of the velocity was obtained when it had moved half the length of the barrel. Now, if the same held good with small arms, as it probably did, and probably to a still greater extent than would be expected, $\frac{9}{10}$ths of the velocity of the bullet in a small arm would be obtained long before it got half way along the barrel, and it was therefore of the greatest importance that no obstruction should take place to the exit of the shot in the first half. Now, under this new system, the nine-tenths of velocity were obtained without any obstruction, and there was only a comparatively small check interposed at the muzzle, which would take away but a small amount of that increment of velocity which it obtained before leaving the gun. He could not quite agree with Mr. Murphy's explanation as to the cause of the increase of velocity—viz., the increased consumption of powder—for experiments with great guns had shown that the maximum pressure in the powder-chambers took place by the time the shot had moved a very short distance indeed, and that it went on increasing very rapidly, so that the pressure to the gun was very small indeed by the time the bullet reached the muzzle. Therefore he did not think any little check at the muzzle would increase the pressure upon the base sufficiently to have any useful effect, or account for the great increase of velocity as suggested by Mr. Murphy.

Mr. W. Walker could endorse what Commander Dawson had said, and agreed that Mr. Murphy was wrong in his idea that the sudden retention of the bullet at the muzzle caused a complete consumption of the powder. That was entirely a question of the length of barrel and the size of grain; for, given sufficient cubic space for the powder to be burnt in, it did not matter whether it were rifled all the way up or only a few inches. The increased velocity was due to the diminution of resistance. Captain O'Hea had mentioned this matter to him some eighteen months ago; and although at first eight it appeared opposed to experience and theoretical considerations, he had gone into the matter mathematically, and satisfied himself, not only of its practical effects, but also that it was theoretically perfect. With regard to its supposed liability to strip the bullet, assuming the bullet to obtain its maximum velocity before reaching the muzzle, it appeared to him that a soft bullet encountering the sharp edge of the rifle would be liable to become cut and sheared off, but he was assured this was not the case, and that the bullets had been recovered from the sandbanks bearing a perfect impress of the rifling, nor had any injury been ever found to the barrel, which was another consequence which it had been supposed would arise from placing a sudden impediment at the muzzle. He had always looked upon that theory of a check at the muzzle doing damage as rather visionary, but it was a very commonly-received notion. Taking the ordinary Enfield rifle, and converting 30 inches of it into a smooth barrel, so as to leave only three inches of land, which thus became converted into ribs—and he himself had always looked upon ribbing as the best form to produce rotation—a very capital rifle was produced. The apparent paradox was easily explained when the question was asked, "What was the use of rifling thirty inches when the increment of rotation which the bullet carried with it to the end of its flight was only that which it received at the end of the muzzle?" If four of five inches of the rifling were cut away in the middle of the barrel, what would be the result? Not a particle of rotation which the bullet acquired at the beginning would be carried over the blank space, proving that the rotation imparted to the bullet was only given for the space during which it was in the barrel, consequently the rifling at the muzzle was all that was necessary. He fully concurred in what had been said by Capt. Selwyn with regard to the bad quality of the government cartridges, and the bad system on which they were constructed. He had tried government cartridges from Woolwich, both blank and ball, and with some of the first patterns he had found the space between the cap and the cap-chamber had been filled with a sort of greenish mould, proving that galvanic action had been set up by the different kinds of metals. He should like to know the cost of making the new rifle referred to, because, after all, economy in production was a very important consideration.

Mr. Hale inquired where the new description of rifle could be obtained.

Mr. Dougall asked what was the trajectory of the Martini rifle, as improved, at 100, 150, and 200 yards range.

Capt. O'Hea said he did not use the sight at all at any of these ranges, but fired point-blank, with the elevation due to 100 yards. With the Martini-Henry rifle, sighted for 500 yards, he had made good practice at 650, and lately at 700 yards.

Mr. Dougall said he inquired as to the trajectory, not the sights employed. He quite agreed with what had been said as to a low trajectory being due to high velocity, but the greater the velocity the greater the amount of friction against the small amount of projection in the barrel; so that it seemed to him the whole matter resolved itself into a question of the depth or shallowness of the rifling. Would it not be possible, instead of removing the rifling altogether, for a portion of the barrel to go much farther in reducing the depth, so as to retain as much as possible the velocity of the smooth bore, while still securing the accuracy of the rifle. The velocity also depended on the amount of the charge, and though he had no experience of military rifles, he was in the habit of making sporting "express" rifles, in which, by keeping the rifling as shallow as possible and using more powder, a trajectory was obtained at 200 yards almost mathematically level. It was a great mistake to rifle too deeply, as it caused extra friction; and he thought the question of increasing the charge in military rifles might be worth attention, considering that it was only about five-eighths of that used for sporting purposes.

Commander Dawson, R.N., asked if a heavier charge of powder than usual was used to get the very low trajectory mentioned.

Mr. Dougall said it was; the system was neither more nor less than an elongation of the old point blank range, which was 20 or 25 yards. By lightening the ball, decreasing the bore, and enormously increasing the charge of powder, that was increased to about 200 yards; but immediately the ball reached that distance it sank at once.

Commander Dawson said it was impossible to compare two things wholly unlike, as it appeared to him were the sporting and military rifle. An increased charge would, of course, produce increased velocity; but, as he understood, they were discussing an increase of velocity due to an improvement in the rifle itself.

The Chairman remarked that in military rifles the quantity of powder was strictly limited.

Mr. Walker said inventors of military small arms had by no means the same latitude as makers of sporting rifles, being limited very closely as to weight, length, and charge of powder.

Captain Costin desired to add, that in his opinion, under this new system of partial rifling, the amount of twist might be much reduced, so that instead of being 1 in 20 or 30, it might be almost a straight groove, because, as the ball passed through it at a much higher velocity, a very small twist would give it a sufficient rotation to carry it throughout its course. He should like to know whether Captain O'Hea had tried to find the minimum amount of rifling necessary for the different systems, and whether the Scott system, the Lancaster system, the Whitworth, and all others, could be treated in the same way; or whether one required four inches of rifling, another two inches, and so on. It was too much to expect a private individual to undertake all these experiments, but he thought it was worth trying whether one or two spots placed near the muzzle would not be sufficient to give rotation to the bullet. After all, it was nothing but a question of velocity as determined by friction.

Captain O'Hea, in reply, said he bitted out a portion of an ordinary rifle barrel so as to make the smooth portion of the bore, from the breech end, level with the bottom of the grooves, leaving the rifling at or near the muzzle standing out, like ribs, from the smooth portion. He had tried making the inner end of the rifling wedge-shaped, and also sloping it away, or reducing it in height, until it disappeared in the smooth portion of the barrel, and in each case he had obtained good results, but the best results he obtained from rifling which stood up out of the smooth portion of the bore. He had not tried the Whitworth rifle, but he had the Snider-Enfield, with the expanding bullet, and in the latter case had used a sloped-off rifling. In the Henry rifle he had at first a difficulty, but now there was no difficulty whatever—the bullet took the rifling, and was never found to strip. Strange to say, however, the best results were obtained where the metal of the bullet did not take the rifling at all, but derived its spinning motion from the paper. The remarks of Captains Selwyn and Dawson he so fully agreed with that he need not make any further observation upon them. Captain Selwyn and several other gentlemen had witnessed the practice, and in every instance the absence of recoil had been very much remarked upon. With regard to the price, he could only say that the cost of rifling on Mr. Murphy's system would be about 4s. as against 12s.; but he could not speak with certainty on the subject. The course he had adopted in his experiments had been to take an ordinary Martini-Henry or other rifle, and bit it out; similar rifles could be obtained of Mr. Cole, gunmaker, of 13, Newman-street, Oxford-street. He could not answer, with any certainty, as to the effect of an increased charge, as he had only used the ordinary government Eley-Boxer ammunition, 85 grains of powder and 480 grains of lead, or mixed metal; with the Westley Richards' rifle, however, he used only 76 grains of powder. The highest point of trajectory, at 650 yards, was 8 feet 1½ inch, or the same as with the ordinary Martini rifle at 500 yards. By his latest experiments the same height was secured at 700 yards.

The Chairman said there did not seem to be so much interest taken as formerly in the relative merits of the different kinds of breech-loaders; but this was probably because so many excellent systems had now been devised, each of them quite rapid enough in action for all military purposes. There were two main features in the improved rifles which Captain O'Hea had brought forward, both of great value, viz., the diminution of recoil, owing to decrease of resistance, and the consequent flatness of trajectory. The evidence of the flatness of trajectory was given in a comparatively rough way, by taking government ammunition and government sights, and ascertaining the results, and it would have been more satisfactory if he had the actual angle of elevation, but that probably required appliances which Captain O'Hea had not at command. It would also be necessary to ascertain whether the same accuracy which had been shown to be sustained up to 700 yards would continue at longer ranges, and whether the bullet acquired sufficient rotation to maintain its accuracy at the long distances at which the Martini-Henry and other rifles made good practice. Probably the best method of demonstrating to the public that this new system possessed all the merits it claimed, would be for Captain O'Hea to appear at Wimbledon, personally or by proxy, with his new rifle, and there he would have a perfectly fair field and no favour. He would caution him, however, that any one bringing forward a new rifle was often under disadvantages in not possessing many minute appliances such as were attached to rifles constantly in use, and which assisted greatly to produce accuracy of shooting. At the same time, there could be no doubt the real merits of the weapon would be fully displayed, and those acquainted with the subject would be quite prepared to make allowance for any imperfections such as he had alluded to. In conclusion, he proposed a vote of thanks to Captain O'Hea for his able paper.

The vote was carried unanimously.

In addition to the rifles exhibited by Captain O'Hea, Mr. Henry Reveley showed two weapons, a sword belonging to an officer of the Spanish Armada, and a dagger that had been used in the Inquisition.

COMMITTEE ON THE MEANS OF PROTECTING THE METROPOLIS AGAINST CONFLAGRATION.

The following evidence was given before the Committee (in continuation of that already published) by Mr. WILLIAM SWANTON, of the Metropolitan Salvage Corps:—

Q.—What structural arrangements for large warehouses does your observation suggest as the best for the prevention of the spread of fires?

A.—I have never doubted the advantages of brick piers, groined brick arches, and concrete floors, as the best description of incombustible and fire-resisting construction for any building, especially those containing large bulks of produce and manufacture; still the space required for this kind of construction is such an objection that it is seldom met with except in vaults. The next best description of fire-proof construction is that where, though the floors are supported by iron columns, these columns are filled in with concrete, and surrounded by the same material and cement, to a thickness of about six inches, so that the protection afforded to the iron prevents its being affected by the heat to so great an extent as it otherwise would be, and if the joists are of T-iron, ordinary hoop-iron taking the place of old-fashioned laths, the space between the joists being filled in with concrete, though timber flooring may cover the whole. This I consider a thoroughly good and incombustible mode of building, and one which would prove fire-resisting to a very great extent, even in ordinary private dwellings. If the spaces between the joists were filled in with concrete, say six inches thick, instead of shavings and sawdust, as is now generally to be found, very much protection would be provided, and it would not only prevent a building burning so rapidly as is now the case, but at the same time it would allow far more opportunity for the inmates to escape than now, owing to the rapidity with which a building burns when once on fire.

Q.—What do you consider the best materials for the construction of staircases?

A.—The question as to what material staircases should be constructed of I have long since considered, and I cannot agree with many who approve of stone staircases, except for external purposes. Of course there are warehouses and other buildings where a massive stone staircase leads to landings in the centre of a block, on which are good iron doors leading to the various rooms or floors filled with goods, and perhaps occupied with workpeople, the entrance being from the street and ending at the roof. Nothing can be better than this kind of staircase, where it is perfectly independent of the floors and their contents, because the probability is that any of those floors might be burnt out and the staircase by no means affected by the heat on account of the protection afforded to it by the iron doors; at the same time I am strongly opposed to stone staircases under almost any other circumstances for internal purposes. And I fully believe that if the ordinary timber staircases, as at present constructed, were filled in with good concrete before the tread is fixed, they would form about the best and most fire and water resisting description of staircase that has at present been devised, and would, in my opinion, be the next best to brickwork itself. I know well how nice a good stone staircase looks, and is for use, when no fire happens, but I also know the fearful consequences of a nice looking atone staircase suddenly giving way without any warning when it is heated and water is thrown upon it in extinguishing a fire.

Q.—What do you consider the best materials for the construction of roofs?

A.—The best description of roofs I can conceive are those covered in with stout slate, with about one inch of fine concrete between the laths and the slate. This would not only resist almost any fire from an adjoining building, but would, under most circumstances, withstand any use to which the roofs might be subjected by firemen and others.

Q.—What precautions do you recommend as respects the flues of furnaces?

A.—I cannot conceive that any difference of opinion ought to exist as to heating furnaces, or the precautions necessary to avoid accidents by fire from them, so long as all timber is kept well clear of the heated parts, and properly constructed flues only used. Furnaces are as safe as any other description of heating apparatus.

Q.—What precautions do you recommend as respects open fire places?

A.—So far as open fireplaces are concerned there is no doubt that, with ordinary care, nothing can be more safe, and accidental fires should not occur from anything in respect of them, so long as the hearth stones are not placed upon timber, and no such material is allowed within a reasonable distance of the fittings and flues; and no question ought to arise as to the advantage of open fire places in reference to ventilation over every other description of heating.

Q.—What precautions do you recommend as respects gas lights?

A.—Respecting gas and the risk of fire from its use, I have no doubt that it is the most safe mode of lighting, so long as proper care and attention is given to it. Having every light safely fixed, and properly protected from contact with any inflammable article near it, and having every room in which it is used fitted with a ventilator into the flue of such room, there need not be any apprehension on that head.

Q.—What do you mean by concrete?

A.—It may be made of many kinds of materials. What I refer to is that made with ordinary fine ballast and lime.

Q.—Would it not be better adapted to resist heat if made with clinkers, or things of that kind, which had been burned?

A.—I am not so sure about that. It might be more binding, but I believe the small ballast I speak of would not be greatly affected by heat any more than that made of clinkers. It simply introduces the idea of using a new description of material we know little or nothing about, instead of using that which has been proved to answer the purpose so well.

Q.—What would be the effect of a great fire on concrete?

A.—The effect of fire on concrete is scarcely perceptible in ordinary fires, especially where the ceilings and floors consist of this material, but in seriously large fires it would, under great heat, split into irregular forms, but not until being nearly red hot, and subject to the action of cold water being thrown upon it; even then the result cannot be compared to ordinary stone.

Colonel Beresford—At the great fire at Cotton's wharf it terminated in a floor in Alderman Humphrey's premises, termed Hay's wharf. The floor was full of bamboo canes, which were burning with an intense heat, but it had no effect on the roof, which was filled in with concrete. The roof was perfectly lurid, but the fire did not pass it.

Q.—Is it the case that not above one-third of the mains in the metropolis are constantly charged with water?

A.—It is principally the trunk mains that are now charged, and one-third would be about the average, but things are very much better in this respect now than they were a few years ago.

Q.—You desire that all the mains should be charged?

A.—Yes, and I think there would be no difficulty in reference to every main being always charged if the internal fittings were in order.

Q.—Is it not the fact generally that if hydrants and hose are provided, and they remain long unused, that when they are wanted they are frequently out of order? The hose leak or the junctions do not fit; and would it not be an advantage if they were kept in constant use, say for watering the streets?

A.—I think the wear and tear resulting from their use for watering the streets would not be anything like equal to the advantage which would be gained by having them frequently in use, and, consequently, always in working order.

Q.—Would not the form of hydrant you have suggested be very expensive?

A.—A great deal would depend on the quantity of pipe and fittings required. If the mains were 50 feet or more from where the hydrant was fixed, the expense of the connection would be far more than the cost of the hydrant itself, but not so where the main was within a few feet of where the hydrant is to be fixed.

Q.—Can you give any idea of the cost of such a hydrant?

A.—I should think the average, taking long and short distances together, and averaging the whole, would be about £12 a-piece; we may differ perhaps as to what description of hydrant should be used. The kind I would suggest would be something like that already brought out by Captain Shaw, because it could not be affected by frost, which, in reference to street hydrants, is an important consideration Therefore they would be at all times available, and not affected by the weather. Our present plugs do not always get frozen if they are properly packed with straw during the winter months, and if these are removed to make way for a cheap description of hydrants, which may become unserviceable in consequence of frost acting upon them, we should then be worse off than we are now. In Captain Shaw's hydrant, directly the water is turned off, that moment it becomes dry in consequence of the waste water running into the sewer, and therefore frost does not affect it as it does a hydrant which retains the water up to the screw connection.

Q.—There would be a diminution in the cost if the lamp-posts could be utilised?

A.—Yes, there would; and there would also be an additional protection from frost, if they were placed inside those boxes; and no doubt, if several thousand were required, instead of only a few, a great reduction in the cost might be effected, and my estimate of £12 reduced to half that amount.

Q.—How many hydrants in a mile of street would you put up?

A.—I should say they ought not to be more than 100 feet apart, on opposite sides of the street, so that they would really be 200 feet apart on the same side of the street.

Q.—What would be the maximum distance length at the end of which you could efficiently use water for the extinction of a fire?

A.—That would entirely depend upon the pressure in the mains. If the pressure was great, 300 or 400 feet or even more could be reached; whereas if the pressure was feeble, perhaps not more than 50 feet could be effectually reached from a hydrant under such circumstances.

Q.—That very much reduces the necessity for having a hydrant at every 100 feet?

A.—The advantage of having hydrants reasonably close together is that a smaller quantity of hose would be required for the immediate use of the police. I look to the supposition that a constable would be immediately on the spot; but if you render it necessary for him to connect several lengths of hose together, before he can attack a fire, he would not do that so readily as if he had one length already screwed on to the hydrant and ready for use. The great object is to save time. The distance of the hydrant should be regulated by the kind of property near where they were fixed. For instance—among the wharves and large stores of merchandise districts, 100 feet apart would not be too close; but amongst ordinary dwellings you might go 250 or 300 feet. Again, in a street like Regent-street or Cheapside, where there are large shops containing valuable goods, 100 feet apart would not be too close. In other places, among small dwellings, you might have them 200 feet or more.

Q.—What is the great objection to the high-pressure system? Why is it not adopted? Is there any prejudice against it?

A.—I have never heard of anything of the kind. I can readily understand why the water companies do not at present keep their mains charged, and I should be very much surprised to find them do so under existing circumstances; they would lose at least half their water, whereas if meters were introduced, I believe all that they now suffer from would be remedied.

Q.—Do you think meters are practically possible? Would people submit to be charged according to the quantity of water they consumed?

A.—My own opinion is they would be very glad to have meters, than otherwise; at present there is no check at all to the waste of water, when turned on by the intermittent system, for the daily consumption. Many people complain of the water companies charging them so much. People who are away from town more than half the year are now charged the same as their neighbours, who use the water continually all the year round, which objection, as in the case of gas, would be remedied if meters were used.

Q.—Are you at all acquainted with the water supply in various provincial towns, where the constant system is in operation?

A.—I know something about the water supply of Liverpool. They have not, I believe, introduced meters there, because they have not thought of it, perhaps, or do not care to introduce an expense while they do very fairly without it.

Q.—Are you aware that in Manchester, under the constant system, the consumption of water is less per head than it is in London, under the intermittent system?

A.—I can quite understand that to be so, and should always look for that result where constant supply is in use.

Q.—As a general rule throughout England, are you aware that in towns where the constant system is in force, the consumption per head of the population is less than it is where the intermittent system is adopted?

A.—I should think it would be so everywhere. I am sure that at least half the water in London is wasted in consequence of some cisterns being small and soon filled, while others, much larger, take double the time to fill, when the supply to the former is running to waste, which would not happen if water could always be found in the pipes.

Q.—Does not that show that it is not necessary to accompany the introduction of the constant system with meters?

A.—No, I think not. The inspection considered necessary, if meters were not introduced, would be so frequent that people would rather be without the constant supply if their homes were to be subject to continuous inspection. If you gave them the meter system, there would be little need for inspection, as they would then no more permit a waste of water than they do now an escape and waste of gas, and they would, of course, have an interest in seeing that the internal fittings were in proper order.

Q.—The meter system means shifting all the expense and responsibility of the constant system from the shoulders of the water companies to those of each individual occupier. Is it not doubtful whether that would be acceptable to the public?

A.—I speak from some experience of the difficulties and objections of inspection, even in business places. Seven years ago, when the insurance companies established a kind of inspection amongst the immense blocks of property where we were continually having fires, you would be astonished at the difficulties met with; such a number of objections had to be overcome, that at times I have thought we should never get the better of them, because people considered they ought not to be subject to this inspection, which simply aimed at preventing serious fires and occasional loss of life. I had to proceed very cautiously indeed for a long time, though now our presence is not objected to, but I very much question whether an inspection which necessitated frequent intrusion into people's houses would ever be permitted.

Q.—Would not the same thing eventually be brought about in the case of the public generally?

A.—I do not think so, because in the majority of dwelling houses an inspector would have to go through bedrooms, or some domestic apartment, to see the water fittings, as many of them are fixed through such apartments, and people would naturally object to a man going in, under circumstances of illness, or other domestic matters, at times when it would be exceedingly inconvenient, and he would not be so well received as the wharf inspectors have been, in places used solely for business purposes, without the presence of females and children.

Q.—You are aware that under the Water Companies Act, 1871, the companies have power to enter houses and attend to the fittings themselves?

A.—Yes, I know that is so.

Q.—Do you take into account the difference there would be between a public officer and the officer of a private company going in?

A.—I do not think it signifies very much whether the inspector is authorised by the water company or by the government. It is simply the inconvenience I refer to, which would necessarily be caused by a man going into a dwelling, and interfering for the time with the domestic arrangements, so as to enable him to look at the fittings.

Q.—Would it not be materially altered under a constant-supply system, by doing away with the cisterns?

A.—I do not think it would be wise to do away with cisterns under any circumstances, whatever you may do about a constant supply, as it is well known that repairs must at times be necessary, and unless the cisterns are continued, every time the water mains are under repair, a house without cisterns must be without water.

Q.—Are you aware that throughout the country, where towns have been brought under the constant-supply system, meters have been resorted to in cases of very large consumption, such as manufactories or railways?

A.—Yes, I am, but I do not know of any instance of their being used for domestic supply; at the same time I see no reason why they should not be used; everything else required for use is either weighed or measured, and paid for accordingly, and I see no reason why water should be exempt from what everything else is subject to.

Q.—You have made no calculation as to the expense of introducing meters for domestic consumption in London?

A.—No; I should think the expense would be something like that of a gas meter; very little, as compared with the fair and great advantage to be obtained by its use; every house having gas, has a meter—some houses three or four meters.

Q.—Do you know of a cheap reliable meter, suitable for such purposes—for domestic consumption?

A.—I know of several meters that go all the year round very well, and without getting out of order. I do not believe it matters whether they are intended for domestic or manufacturing purposes. You simply want to register the quantity of water passing through, and pay for it accordingly. And if such meters are not generally to be found, I think no difficulty would prevent the immediate production of such a one.

Q.—The police are the guardians of the streets, and as a rule, the policeman is the first to hear of a fire and to take action with regard to it. Have you considered the expediency of amalgamating the fire-prevention and the police services?

A.—I do not propose doing quite that; but simply suggest that the police should be a sort of auxiliary force, to hold a fire in check until the fire brigade arrives. I see no reason why they should not do that, without either service being interfered with beyond occasionally instructing the police in the way they should use the hose and appliances at a fire, when they happened to have one on their beat.

Q.—There are propositions for large augmentations of the fire brigade. If it were completely re-organised, would not the force be almost as large as the police?

A.—I do not think there is any need of that, especially if the police should act as I suggest. I think there are as many firemen in London as are now or will then be required. I rather believe the number could then be reduced.

Q.—**Mr. Reynolds.**—Are there not in London a regularly recognised class of persons who are fire-raisers?

A.—There used to be, and for many years they were successful. But I think they are quite out of date now, or nearly so, and no such class as a gang at present exists in London.

Q.—Are there not a class of persons who have made a living by fires, by means of making fraudulent claims, raising honest claims into fraudulent ones, and receiving a commission on the amount obtained?

A.—There were; but I think the public have to thank the insurance companies for having got rid of them, or very nearly so.

Q.—Within the last twelve months have you had any knowledge of persons being so engaged?

A.—Yes, I have known a few within the last year; but within the last five or six years they have been getting less in number every month, in consequence of several successful prosecutions and convictions. I venture to say that London is more wholesome now in this respect than it has been for the last twenty years, and this opinion is fully confirmed by the gradual reduction in the number of London fires during the last two years.

Q.—Do you think the duty of public prosecution for offences in connection with fires would be more efficiently discharged by the police?

A.—I think the answer to that will be found in Mr. M'Lagan's Fires Bill, at present before the House, which will, I feel sure, do a great amount of good in deterring dishonest persons from having fires, many of which are never suspected at the time.

Q.—That Bill proposes that wherever there is a fire there should be an inquiry by a coroner?

A.—Not every fire; only those when a requisition founded from suspicious circumstances, is reported.

Q.—Is that needed in the metropolis?

A.—I think so; the great advantage would be in the inquiry taking place on the spot, near where the fire happens, and without delay, and being made by a person having no interest in the inquiry beyond performing a public duty. I think then no one would purposely have a fire who would not have a very clean bill of health, in reference to pecuniary circumstances, when the inquiry took place.

Q.—**Mr. Reynolds**—Do you think that any of the large fires that have occurred have been caused by workmen, in order to conceal pilfering?

A.—There may have been some of this class, but I believe the better classification of wharf and warehouse property that is now carried out, almost entirely prevents the possibility of many fires occurring that used to take place.

Q.—Are you not aware that in Liverpool, a large portion of the fires that occurred in the cotton warehouses were reputed to have been occasioned in order to cover a good deal of pilfering which had been going on?

A.—I know some of these things have been brought to light, but I do not think such a state of things could exist in London as did in Liverpool, neither do I believe the same causes are at work here to the extent they were in Liverpool.

Q.—Do you know that about two years ago, in the cotton warehouses of Liverpool, a class of property in which there had not been any fires for a long time, five fires occurred in a fortnight?

A.—Yes, I know that; and believe the publicity given to the first case induced persons to attempt the others.

Q.—Do you attribute that to incendiarism?

A.—I take it that in many instances these fires arose from some quarrel or malicious feeling with regard to the people in charge, rather than from any desire to do the proprietor himself a wrong; besides, the class of persons employed at the warehouses in Liverpool are very different from those elsewhere or in London.

Q.—With regard to the construction of buildings, are there not some sandstones which will stand fire, and not split like granite?

A.—I do not think buildings constructed entirely of granite would be specially susceptible of fire beyond those of any other stone. I consider stone in general exceedingly objectionable, and inclined to split when a fire occurs; almost any description you can name.

Q.—It is said that in Paris, where, during the Communistic incendiarism, they had a good many fires, some of them, particularly that at the stables of the Omnibus Company, were stopped by asphalte. Is it a fact that there are two sorts of asphalte in use, the bituminous or inflammable, and one that is not inflammable—the Val de Travers?

A.—I believe it is difficult to find any asphalte that is not somewhat inflammable; I know of none; but I think a great deal of the immunity from fire which Paris enjoys is due to their system of building, and many other arrangements we have not in London. They have no hydrants, but almost every soldier understands extinguishing fires, so that there the means of putting out a fire at once are far preferable to ours in London, without taking into account the services rendered by the military generally in respect to fires. Then, again, in the buildings they use iron "winches," filled in with concrete, so that every floor is comparatively fireproof. As a rule, in English buildings, as the work progresses, the space between the flooring and the joists is made a sort of dust-hole, or receptacle for shavings, sawdust, &c., arising from the work. Therefore, if once a fire happens, you have all the materials ready introduced and thoroughly prepared for a very rapid combustion.

Q.—Some time after the large fire at the City Flour Mills it was noticed that many of the iron joists were still in their places, not twisted. Do you know whether they were filled in with concrete which had dropped out?

A.—They were, I know, fitted in with stone, not concrete. A great deal of the action of a fire upon iron materials of that kind depends upon the cubic contents of the building and the length of the iron in use; the shorter the iron the more likely is it to remain in its place without twisting. Had that building been divided into two, as it should have been, the action of the fire on the girders and rafters would have been very much less than has proved to be the result.

Q.—Do you place any reliance in the Extincteur?

A.—It is better than nothing for extinguishing fires, when in order, but for my own part I would far rather have something I could always depend upon, say a hand pump. It seldom fails, and if there should be a flaw about it it can be seen at once. But with these Extincteurs, covered in as they are, you never know whether they are reliable or not till they are wanted, apart from the expense of re-charging. But I am told they are more reliable now than they were formerly.

Q.—Probably they may be efficient at first, but lose that efficiency by not being quite gas-tight?

A.—Yes They used to have a hole for re-charging at the top, and in the course of time, like a bottle of soda-water with a bad cork, the gas escaped. Since then they were turned upside down, and charged from below; of course then the liquid covered the tube, and, as a rule, I am told, they are now reliable.

Q.—Do you mean reliable soon after it has been charged, or two or three years after it has been purchased, and when a fire happens to occur?

A.—I think it does not much matter, though I have no doubt the longer they are charged the less reliable they become. I have known some go to Australia and be sent back as perfectly useless. The whole secret, no doubt, was in the composition going wrong, no one being there at the time who knew how to re-charge it effectually.

Q.—So that, as a means of fire prevention, being required at the moment a fire occurs, the Extincteur may fail?

A.—Yes; whereas the hand-pump will seldom fail so long as water or any kind of liquor can be procured by which it can be supplied.

William Chadwell Mylne, Esq., Engineer to the New River Waterworks, examined:—

Q.—Were you consulted, as an engineer, on a plan for supplying Paris with water?

A.—Yes.

Q.—In the plan you have proposed, did it not form a part that the tenants' communication-pipes should be provided and laid down by the Company as an essential part of the works of distribution?

A.—Yes, I considered it most desirable that it should do so.

Q.—Will you state the advantages to the tenant or the public that were proposed from that part of the plans over the common method, leaving every uninformed occupier or owner to the necessity of employing a separate plumber to complete, as he might, that part of the general machinery?

A.—In the first place it would effect a considerable saving of capital; in the next place it would be done on principle, and in a superior manner. The trading plumber has no motive to carry out improvements—two lengths of pipe may be put where one would serve. As an example of the improvement proposed to be introduced in detail, I had intended to introduce lead pipes, with screw joints, similar to those used in wrought-iron pipes. The cost of these joints was not above a penny; they would have superseded completely the plumber's joint, and neither the plumber nor his irons, fire, ladle, nor labour were necessary, and an expense of 3s. 6d. per joint was saved. In various respects we should have economised the machinery for distribution.

Q.—This portion of the machinery being laid down by the Company, was it proposed to charge at once the expense of this outlay upon the owners or occupiers, or to charge for it a rental?

A.—It was proposed to charge interest on the extra amount of outlay as a rental.

Q.—Then these tenants' communication-pipes would have been under the same general care as the mains or iron pipes of distribution?

A.—Yes, that was my view; and my opinion has always been that, as public traders, that which is best for the public customer is ultimately the best for the Company by whom they are supplied.

Q.—What would be the extent of probable advantage to the public in respect to the saving of repairs?

A.—Very great: one public officer would have been appointed to attend to the laying on of all houses, as also to all the repairs. Under ordinary circumstances, when an accident occurs within or without the building, the tenant has to think how it is to be repaired, and has to consider how he is to pay for it, and who is to be sent for; the plumber, when he arrives, makes the repairs in his own way, which is without any reference to any general system. Two-thirds of the labour, on the occasion of any accident, is in the journeys which would be rendered unnecessary under a general system, by which, on such an occurrence, the inconvenience may be remedied at once. The advantage of having the tenants' communication-pipes placed under one general system, would have been, that they would have been so laid down at first as to have avoided many of the incidental injuries which they are liable to from frost and accidental circumstances, as well as being placed where they could readily be repaired.

Q.—In the case of a company undertaking to lay down the pipes, would not the repair of them form part of the general charge, and be added to the rent?

A.—Yes; frequently an accident occurs towards the end of the tenant's term of occupation in the premises, and the cost of repairing it may be equal to his quarter's rent. Being a tenant-at-will, or near the termination of his lease, he says, "I may be turned out shortly; it is not worth my while to undertake it;" and it is left undone, if within his premises.

Q.—Increased dilapidation must be the consequence?

A.—Of course, that naturally follows.

Q.—In that plan, then, you assumed as a principle that the tenants must be relieved of the immediate outlay, and the expense be spread over a period, and collected as a rent?

A.—Yes, certainly. This was the more necessary in Paris, where the dwellings are extensively occupied in flats, as distinct tenements. Each flat would be held for various periods, some of the nature of tenancies at will, some of them of the nature of leasehold, and under every description of interest and period of occupation. Of course, the parties having short intervals would not undertake the immediate expense of the outlay for the permanent improvement, nor would the persons in the lower apartments pay for the repairs in any other part of the building necessary for the supply of any upper apartment.

Q.—Did the plan of comprehending the tenants' communication-pipes and the whole machinery under one general system, offer any advantages in respect to economy and sufficiency in laying down the iron pipes?

A.—In a new town there would often be much public economy in laying pipes on both sides, instead of in the centre of the streets; there would be the saving of lead pipes, the saving of repairs to these lead pipes, the avoidance of the inconvenience and expense of breaking up the roads for that purpose—the saving of the inconvenience to the tenants in the event of frost, from there being less of their smaller pipes exposed. In a street of 60 feet wide, the saving of lead pipe would be about 20 feet to each tenant; that is, if the street is built upon each side; there would be 40 feet of leaden pipe saved in a house frontage of say 20 feet; therefore, 20 feet of iron extra would avoid the use of 40 feet of lead.

Q.—In carrying the water up the higher houses, would you not have introduced iron pipes?

A.—We should have introduced iron where we could. At that time, when lead was very dear, I contemplated the use of tinned copper pipes.

Q.—The Commissioners have received evidence as to the public wants, and especially of the wants of the poorest classes of the population, and as to the practical operation of an extended system of supplies in different towns, from which it seems to be desirable:—That the system of supply for the poorer classes of houses by common cocks or tanks for several tenements should be superseded by an extended system of supply carried into every separate tenement; that the system of periodical or intermitted supply should be generally extended to one of constant supply at all times, night and day, and kept on at high pressure, as in several towns and places, so as to supersede the necessity of having, and keeping in good condition, water-butts or tanks; so as to be used also early in the morning for cleansing and watering the streets, and at nights to be in immediate readiness on the application of a hose, to be thrown over the houses in the event of a fire. Assuming it to be desirable and necessary to meet the public wants in these respects, and carry out such a measure, do you think that the requisite supply could be rendered by the New River Company?

A.—I have no means at present of judging of the extent as to quantity such a mode of supply might require. The population within the district is nearly 900,000 individuals. But there could be no difficulty whatever in increasing, at a comparatively inconsiderable distributing expense, the supply of water through the existing works, perhaps even to an extent beyond that which might be required, provided the Company were empowered to take that quantity out of the river Lea or from the Thames.

Captain Davies, manager of the Exchange Telegraph Company, gave evidence as follows:—

Q.—You have paid special attention to the use of telegraphy for quickening the action of persons and things for the extinction of fires in the United States. Can you inform us of what is done there?

A.—I am unable from recollection to give you accurate particulars of the system in general adoption in the United States, but since the introduction in 1872 of the District Telegraph Company at New York, fire alarms are given with much greater promptitude. The plan is to place a small automatic telegraph instrument, that a child may use, in every house, thus affording means, by simply pressing a stud, of giving the alarm of fire or thieves, and the power to call a messenger at any moment, and all this at a very small cost per annum. The system is now becoming generally adopted in New York and Brooklyn, and has been found to work very satisfactorily, and will doubtless extend throughout the States. It is the intention of the inventor, and others interested in the patent, to establish a company to utilise this valuable invention in England, the idea being to divide the metropolis into districts, which shall have offices centrally situated, with a radius of three minutes' walk to any one point, these offices being connected with every subscriber's house, and again with every brigade station, water company, police-station, and turncock's residence;—the officers to have telegraph clerks, police, and messengers always in attendance, both day and night, so that in the event of an alarm from any subscriber's house, not more than three minutes could elapse before assistance would be rendered.

Q.—Assuming a constant supply to be on everywhere, and all the great pumping stations in combination, under one system; and this water supply, to be in complete condition, with hydrants in every street, in constant use for street and road washing, and therefore in constant readiness. It is stated that on the average a fire brigade engine may be brought to the spot in about ten minutes. What would be the action of your machinery on such a system?

A.—I am unable to state the time now taken to get an engine to a fire, as it entirely depends upon distance and the means at hand for giving the alarm to the various brigade stations. With the instrument used by the District Telegraph Company of New York, and recently introduced and patented in England, no time whatever need be lost—in fact, it may not only be known immediately at every brigade station in the metropolis, but every water company and every turncock would be advised of it at the same moment, and trained men with fire extincteurs could be on the spot from the company's station within three minutes of the alarm being given, and by this it is confidently hoped that many fires may be stayed at an early stage, and much property be saved thereby.

Q.—But may not your telegraph machinery, from its infrequent use during the long intervals between fires be apt to get out of order?

A.—The machinery is so simple, and would be in such constant use for other purposes than fire or thieves, that it would be impossible for it to get out of order. In some houses, more especially houses of business, it would be in constant requisition for calling messenger boys, cabs, &c. The wires connecting houses with the company's offices would be run under the eaves of the houses and dropped in wherever necessary. The instruments could be placed anywhere—behind the street door, at the head of a bed, or could be placed in every room if required. On the introduction of the system into New York, the burglars thought they could render it useless by cutting the wires, but the first attempt was the last, as the act was at once indicated at the office, and the police were directed to the exact spot thereby, when the offenders were caught. I have numerous extracts from American papers, showing instances where the system has been of service, and the last advices from New York speak of it in the highest terms.

The following extracts are taken from evidence before the House of Commons Committee on the Metropolis Water Bill No. 2 (1871):—

Mr. Robert Rawlinson, C.B.

645. Is not the constant service of the very first importance with reference to that subject?—Yes, no doubt it is; where you have the water at a sufficient pressure to act directly from the mains without the intervention of a fire engine, or where you are dependent upon fire engines, having the water constantly in the mains is an enormous advantage.

646. Are you able to speak with regard to the present condition of the fire service in London?—No; I only know that a great portion of the apparatus for the fire service is a disgrace to London. The old fire plug is positively disgraceful.

647. And not kept in proper order, I suppose?—It is a plug driven into the main by main force, and which has to be drawn as you see them drawn during frosty weather, and a stand pipe inserted to enable people to

get their supply. The same thing occurs in thousands of cases all over London. There is no proper fire hydrant; there is simply an old plug.

648. It is a very ancient and crude mode of managing matters, which rather indicates a want of progress in that particular direction?—Yes, I assume that they have not cared to alter it on account of the great expense of putting in fresh valves.

Mr. J. F. Bateman, F.R.S.

948. As regards the provision against fire, are the arrangements now upon the intermittent system such as you think reasonable and fair towards a large metropolis like this?—No.

949. Will you point out to the Committee in what you think they are deficient?—I think for protection against fire the water ought to be on at all times. There is this difficulty, that the water companies are the parties now to provide by nothing more than wooden plugs of the worst possible description, the arrangements for getting water from the pipe, an antiquated thing which has for 30 years nearly been done away with in the country, where, having provided water in their pipes, they give power to the public to take water from them for the extinction of fires. In the hands of a Corporation the interests of the whole of the public are so much in their hands that they generally go to a great expense in providing larger mains with reference to the extinction of fires, and therefore the two classes of works have to be considered somewhat differently. In the hands of a company they merely give permission to take the water from their pipes without any reference to the water, whether it is sufficient or not. But if protection against fire is to be regarded, then the mains through which the water is to be discharged ought to be larger; not more than a certain number of fire-cocks ought to be placed on pipes of limited dimensions, and the pressure should be such, and the arrangements such, as to throw the water without the assistance of fire engines to the height of ordinary buildings—in fact, over the top of the highest buildings, if the pressure is sufficient. That has been the case in Manchester and in Glasgow and elsewhere; in fact, the introduction of a better system of supply in Manchester has reduced the loss by fire on the value of goods, where fires have taken place, from 21 per cent. to less than 7 per cent. The loss before the introduction of the constant system of pressure at Manchester, that is, of the property where fires took place, was more than 21 per cent. of the value of the property, and it has gradually reduced, until now it is less than 7 per cent. of the value of the property attacked by fire.

950. You attribute that mainly to the facilities which you now have for getting water quickly at a high pressure sufficient to reach the highest houses?—Yes, that is so; it is mainly attributable to that.

951. Have they done away with the system of fire engines at Manchester?—Not entirely, because fire engines answer as omnibuses to carry the apparatus of the firemen, and they are occasionally required when fires occur at present where the pressure is not greater than what can conveniently be applied under ordinary circumstances: but to a very great extent fire engines are discontinued, excepting as omnibuses.

952. That system does not obtain in London of getting an immediate supply at high pressure?—No, it does not.

953. In your judgment, is it part of the constant service that it should embrace the idea of an efficient supply of water against fire?—Yes, it is; they cannot introduce, under the intermittent system, the same system of fire-cocks which they can under the constant system.

954. Will you explain to the committee what changes will be required to meet your view upon that subject?—I would require the abolition of every wooden plug and the substitution of a fire-cock or hydrant, and if what I believe the best kind of that apparatus is used, which is also the cheapest, it would cost about probably 30s. the fire-cock over the whole of London.

955. There is, I think, in existence a fire-cock of the description you have given us in use in various parts in the country?—Yes, hundreds; I do not know whether I might not say thousands. I might, indeed, say that hundreds of thousands are now in use in all towns; almost, if not every one, with which I am connected, and in very many others.

956. Therefore it is not a mere theory; the implement itself is accessible, and it is rather a question of expense in altering the arrangements?—Yes; they have been in constant use for 23 years, ever since 1848.

957. I believe it is a patent with which your name is connected?—It is a patent called Bateman's and Moore's Patent. It was the invention of an old assistant of mine, Mr. Moore; I approved of it, and, for his sake, I allowed my name to be used in taking out a patent for his benefit. It has not paid much, but it is, and has been, a very successful patent, in its usefulness.

958. Perhaps you do not know all the good you have done to the public. I have been told that the price has been reduced to one guinea?—The patent has long since been out, and I have no interest in it whatever, except to recommend it as a good thing.

960. I dare say you would say that the present plugs ought to be changed, even if you do not introduce the constant supply?—That I certainly should; I think they are a disgrace to the mechanical skill of the age, and they have been abandoned by me certainly as a most disgraceful thing, which I never would endure for the last 30 years; and I never put one in in my life, and I have been a waterworks engineer for 30 years.

961. There are certain ancient things to which people often cling, whose only objection to modern things is the cost of them?—Yes; they are about equivalent to the wooden pipes which existed before 1810.

986. What is your objection to the word plug?—Plug is a word meaning the piece of wood, which is used for the purpose of being forced into the upright outlet from the main pipe which conveys the water, and it just plugs the hole up, and every time that the water has to be drawn from the main that plug has to be loosened one way or another, not by way of a screw, but loosened by a lever, and it flies out, with the chance of hitting the man on the head, and when the water flows the men have to poke about with a long standpipe, almost always getting wet through before they can get it into the plug, and that is then driven down and fastened with pegs, and as soon as that is fastened, they attach the hose to the standpipe.

987. The apparatus, in your opinion, is not effective for the purpose?—It is a disgrace to a mechanical age that any such thing should exist; there are many improvements which have been introduced during the last 25 or 30 years which are much superior.

Mr. Joseph Quick, C.E.

2327. Have any local authorities applied to you for permission to substitute hydrants for fire-plugs?—They have not.

2328. You have, I suppose, from time to time, complaints of some failure of water at fires?—We have, from the absence of the turncock.

2329. How it is accounted for when there has been any defect?—It is from the absence of the turncock. The brigade will not allow anyone to call the turncock; the police do not seem to appoint anyone to call him, and the consequence is that it is left to chance.

2330. Have the water companies made to the fire authorities any proposal to obviate the risk of the absence of the turncocks?—They have offered to place a man at the disposel of each fire station and to pay him if they would allow him to lodge there, so that when a call is made at a fire-station the man should go at once to the turncock, and he would be on the spot.

2331. That was to be at the expense of the companies, was it not?—Yes.

2332. What was the answer to that?—That they could not entertain such a proposition; and in addition the water companies pay any number of people who call the turncocks.

2333. But if the authorities had complied with your proposal of having a turncock at the expense of the companies, resident at each station, no difficulty could have arisen about it?—I think so.

2334. You gave evidence, I think, before the Committee of the House of Commons on Fires in the Metropolis some years ago?—I did.

2335. Was that in 1862?—Yes, it was in 1862 when that proposition was made.

2336. I see here is a passage from the Report of that Committee, which probably you are acquainted with. The committee say that "They would refer to the evidence given by Mr. Quick, the engineer of the Southwark Water Company and the Grand Junction Water Company, on this subject, from whose evidence your committee have satisfied themselves that the complaints are due more to the non-application of the water than to any deficiency of supply when the turncocks have arrived on the spot;" and they saw afterwards that "some more stringent regulation or arrangement appears to be desirable to secure the immediate attendance of the firecock men by a special arrangement under some responsible policeman, or other person charged with such duty, to give the earliest notices of fires to the turncocks, which might be effected by electric telegraph communication, in connection with such new general system as may be be formed;" that is, a new general fire system; then they say, "Wherever constant supyly is introduced it will be necessary for hydrants to be substituted for the present fire-plugs, and it should be made compulsory on the Fire Brigade authorities to provide and fix hydrants on the company's pipes before the water is constantly left on in any service;" do you concur in that opinion now that it would be necessary or desirable to have hydrants put on?—I think it would be absolutely necessary.

2337. Where mains are charged, they might already have been put on?—Yes, wherever the main is constantly charged, they might have been put on.

2338. All your mains, of course, are constantly charged?—All the principal mains are.

2427. You said that hydrants would be a great improvement in the streets; they will follow, I fancy, as a matter of necessity upon the introducton of the constant supply?—They will, there is no doubt.

2428. In so far as fire-plugs are concerned, we shall get rid of those useless, and, I may say, dangerous things?—Yes.

2429. And then, as an immediate result of the introduction of a constant system, we shall have hydrants throughout the metropolis?—You will so.

2430. That, in your opinion, would be a decided advantage?—I think it would.

A committee has been formed at Munich for the erection of a monument to Baron Liebig. An appeal for contributions will be published shortly.

A thin seam of coal has been discovered at Epworth, in Lincolnshire. The coal, which is of good quality, was met with about sixty yards from the surface.

The United States' signal office has begun the publication of a brief monthly review of the weather, in which special attention is given to the storms that visit the United States.

The declared value of telegraphic wire and apparatus connected therewith exported in the last three months was £106,227; in the corresponding period of the previous year it was only £29,859.

ANNUAL INTERNATIONAL EXHIBITIONS.

The number of visitors admitted on Thursday, 8th inst., was as follows:—Season tickets, 216; on payment of 1s., 2,917; total, 3,133. On Friday, season tickets, 250; on payment of 1s., 3,072; total, 3,322. On Saturday, season tickets, 357; on payment of 1s., 4,758; total, 5,115.

The number of visitors admitted to the Exhibition during the week ending Saturday, May 10th, was as follows:—Season tickets, 1,474; on payment of 2s. 6d., 1,305; on payment of 1s., 15,709; total, 18,488.

The number admitted on Monday was, season tickets, 240; on payment of 1s., 2,900; total, 3,140. On Tuesday, season tickets, 195; on payment of 1s., 3,191; total, 3,386. On Wednesday, season tickets, 315; on payment of 2s. 6d., 1,624; total, 1,939.

THE QUEEN AT KENSINGTON.

Her Majesty the Queen, accompanied by the Princess Christian and the Princess Beatrice, visited the International Exhibition at Kensington, on Friday morning last, at a quarter past ten o'clock. The Queen was received by some of the old members of the Commission of 1851 and several of the members of the present Exhibition Executive Committee. Among them were the Marquis of Ripon, Earl Carnarvon, Sir William Hall, C.B., Sir Francis Sandford, Major-General Scott, C.B., Dr. Lyon Playfair, the Right Hon. Hugh Childers, Major Donnelly, Mr. Henry Cole, C.B., Major Du Cane, Captain Clayton, Lieut. H. Cole, Mr. Fowler, Mr. Kelk, Mr. Charles Lucas, Mr. T. Lucas, Mr. T. Fairbairn, &c. Her Majesty alighted at the door of the School of Cookery, the entrance to which was decorated with the prize roses exhibited a- the late Show of the Royal Horticultural Society The Hon. F. Leveson Gower, Chairman of the Com. mittee of the School of Cookery, and the other members of the Committee, with Mr. E. J. Craigie, Deputy-Commissioner, conducted the Queen and Princesses to chairs in the school. Mr. Buckmaster, the Lecturer of the School, then made the following observations, during which an *omelette aux fines herbes* was prepared:—

"May it please your Majesty,—The specimen of cooking which is now to be presented takes only four or five minutes, and is within the reach of the poorest of your Majesty's subjects. The materials cost 3½d., and they furnish a wholesome nourishing dish, acceptable for two persons. The omelette is seldom properly cooked even in France, which gives it its name. It is never found in the homes of the poor of this country, and in the houses of the rich it is often very badly cooked. The ordinary frying-pan and spoon found in every house will answer perfectly well. There is no occasion, as you are told in cookery books, for an omelette-pan and spoon. We wish to show in this school not only the best and most economic methods of domestic cooking, but the various uses to which kitchen utensils may be fairly applied without injury. To prepare a plain omelette, see that the frying-pan is thoroughly clean—for cleanliness brings with it habits of domestic order, which are among the first and best methods of happiness in every household, nor is it without its influence on the moral character, for virtue and dirt can never dwell comfortably together. Place in the frying-pan about one ounce of butter. We use gas-stoves, and duplicate all our operations, so that the public may have a better opportunity of seeing; but what we do at these gas-stoves we can equally well do at an ordinary kitchen fire-place. Break three eggs separately to see they are fresh, beat them up with a little chopped parsley and a pinch of pepper and salt. The eggs should not be beaten too much, or the white of them separates, and you produce a watery mixture which destroys the flavour and appearance of the omelette. Now that the butter is melted, pour into the frying-pan the omelette mixture and stir till it begins to set or thicken; shake the pan occasionally, and fold over the omelette neatly into an oval shape, and when it is of a golden colour turn quickly into a dish. To be able to prepare a plain omelette is to be able to prepare every kind of omelette. If you require a cheese omelette, introduce into the omelette mixture about a dessert-spoonful of grated Parmesan cheese with a little pepper and salt, and sometimes a few grains of cayenne pepper. In a sweet omelette no pepper or salt, but a little, and grated, sugar; and just before the omelette is folded in the pan distribute evenly over a little jam. If a bacon omelette, a few pieces of previously cooked bacon, cut into small dice, and so on for various kinds of omelettes. In preparing an omelette, remember five things—a clean pan, the mixture must not be too much beaten, the omelette must not be too large, three eggs are better than six eggs, which make two omelettes; they should not be too much cooked; they should be eaten immediately, or they become tough and more like a pancake. To make simple food wholesome and palatable by cooking was a duty imposed on man from the very earliest period of his civilisation. An abundant supply of food and the proper preparation of it by cooking are matters intimately connected with the physical well-being and happiness of your Majesty's subjects, and, from a long and close connection with the working classes, on their behalf I may be permitted to say that the interest which your Majesty has shown in the School of Popular Cookery will be gratefully appreciated by all classes of your Majesty's subjects."

This demonstration occupied just four minutes, and the Queen and the Princesses each tasted the omelette, which Her Majesty pronounced to be very good.

The Royal party then proceeded to the camp cooking apparatus of the German soldiers, to whom the Queen was pleased to address a few observations in German. The Royal route was continued through the ancient silks, which the Queen examined, and then on to the improved cabs for London traffic, offered in competition for the Society of Arts prizes. Her Majesty passed along the gallery containing the apparatus for saving life at sea, and expressed her deep interest in the collection. At this point the little children of Mr. Paul offered bouquets of roses, which were graciously accepted. The Queen, passing through the large collection of ancient tobacco pipes, in the examination of which a few minutes were spent, then ascended the stairs of the Picture Gallery, containing the works of Phillip and Creswick, which have been brought together to illustrate the career of those distinguished artists. At the entrance, the Queen was received by the committee of noblemen and gentlemen who had promoted the formation of this collection. The Queen passed along the whole of this portion of the Exhibition, examining the pictures in detail, and somewhat unexpectedly entered the gallery containing the works sent by officers of the army and navy. Upon leaving the picture galleries, Lord Ripon presented to Her Majesty the Japanese Commissioners, who have just arrived in England with a large collection of objects for the Exhibition. Her Majesty took her departure about eleven o'clock.

PICTURES AT THE INTERNATIONAL EXHIBITION.

But few sections of the International Exhibition equal the picture galleries in steady power of attraction. It is unnecessary to go far in search of a reason for this popularity of the pictorial department. The longer a good picture is looked at, the better it is liked; it therefore has an immense advantage over the most subtle piece of mechanism, or the most curious process, inasmuch as, once thoroughly understood, these latter must infallibly cease to interest the spectator. Curiosity, satisfied by a thorough inspection, refuses to lend a charm to subsequent study, and the most beautiful engine in the world is hardly deemed worthy of a second examination by the ordinary spectator. But good pictures, like good music, improve on acquaintance, and, in fact, require some study before they can be thoroughly appreciated.

It was a happy idea to hang the works of two great English painters—John Phillip, R.A., and Thomas Creswick, R.A.—in the same gallery. Perhaps it was hardly fair to put the work of Creswick in juxta-position with the stronger subjects and more masculine style of Phillip, but the result to the spectator is inexpressibly gratifying, as the rich greenery of English landscape relieves, in the most pleasing manner, the eye fatigued with the hot glare of arid Spain. The calm beauty of "A place to Remember" and "The nearest way in Summer time" is rendered doubly attractive by the neighbourhood of the bull-ring and the dramatic intensity of "The Spanish Wake." Many of Phillip's more ambitious efforts have failed in achieving the complete success of the "Letter Writer" (lent by Her Majesty). The ancient scribe is seated at his writing-table, and presents a richly embroidered back to the spectator. Juan Morales, escribano, is occupied in inditing an epistle for a love-lorn damsel seated at his left hand, and the penman is evidently in difficulties. He is scratching his grey poll, in the vain endeavour to soften the ardent language of the damsel to the tone deemed necessary by his matured wisdom. With true Spanish patience, numerous customers are awaiting their turn, and some of these are armed with formidable missives requiring elucidation at the hands of Senor Morales. A striking peculiarity of this famous picture is the intense brightness of the sunshine. The figures are literally "struck up against the blinding wall," and assist the northern spectator in realising the truth of the Poet Laureate's powerful line. "The early career of Murillo" is a great picture. The boy-artist is sketching in the street, and the striking figure of a Morisco girl, who has evidently been serving as a model, is the most prominent feature of the picture. Much interest is excited in the crowd by the proceedings of the youthful artist, whose labours are being honoured with a critical inspection. An intensely ugly muleteer is surveying the scene with supreme contempt, and is meanwhile utilising the time by munching vigorously at a huge lump of bread. Perhaps the least satisfactory figure is that of Murillo himself, whose sentimental aspect fails to convey the idea of the great realistic painter.

Of almost equal interest is the "Gloria," a sort of Spanish wake. In a little improvised chapel lies the body of a dead child, with the agonised mother huddled up on the ground beside it, in speechless misery. A kindly-looking woman and a sympathiser of the rougher sex are vainly endeavouring to distract the attention of the bereaved woman from her loss, and are evidently entreating her to join the festive crowd for a little season. A gay body of dancers fills the centre of the picture, but tears are streaming down the cheeks of the dark-eyed girl who is playing on a guitar. The ghastly contrast between the despair of the stricken family and the thoughtless mirth of the guests, is sustained with great dramatic power, and the painful interest of the subject is intensified by its admirable treatment. The two lottery pictures, "Buying the Tickets," and "Reading the Numbers," are full of those subtle touches of human nature which never fail to invest the most ordinary subject with interest. In one of these a burly *padre* is stowing away in his pocketbook the ticket he has just purchased, and is so absorbed in this engrossing occupation as to be utterly oblivious of the devout girl who is fervently kissing his garment. In reading the numbers, a laughing, bright-eyed boy is offering a light to a disappointed speculator, of cut-throat aspect. In all Phillip's work these pretty bits of bye-play are to be observed, and especially in "Life Among the Gipsies," wherein our old friend the British tourist, in checked suit and wide-awake hat, cuts no very dignified figure." "A Chat round the Brasero" is full of character. An elderly priest has evidently just told a diverting anecdote with great effect upon his auditory. One buxom damsel is convulsed with laughter, a gipsy-like woman is enjoying the joke in calmer fashion, while an ancient dame barely condescends to smile. "The House of Commons, 1860," shows the late Lord Palmerston addressing the House, while Mr. Disraeli, calmly biding his time, is meditating a brilliant attack.

We have already observed that in some cases Creswick's pictures suffer by comparison with their neighbours, but no contrast can deprive "A Place to Remember" of its pellucid charm. "A Squally Day," "Crossing the Stream," and "The Windings of a Rocky Stream," are also fine examples of a great master of the art of rendering English landscape. It is, however, evident that Creswick's happiest efforts are those in which he depicts nature in her calm and smiling moods.

Most of our readers will be glad to renew acquaintance with Mr. Leighton's grand picture, "Hercules Wrestling with Death for the Body of Alcestis," exhibited in the Royal Academy two years ago. The figure of Hercules in this magnificent work is a study in itself, and the contrast between the intense vitality of the hero and the pale figure of the dead Alcestis invests the picture with an undying charm.

Belgium, Bavaria, Denmark, Norway, and Holland contribute liberally to the art treasures of the International Exhibition. Mr. Van Sérius sends "Undine" and "Elaine," both remarkable for exceeding purity of style and a singularly mournful beauty. It is gratifying to find that high art is not so dead, after all, as might be imagined by a visitor to the Royal Academy this season.

In landscape, Belgium is very strong. Roffaien sends a capital picture of "The Village of Meyringen and the Wetterhorn, Switzerland." The artist has selected a charming spot, and has depicted it with unerring fidelity. No Alpine traveller will fail to recognise the tender shades of green which give such a charm to the valley of a hundred cascades. De Schampheleer, also, takes high honours. In looking at his "Road from Loosdreckt to Hilversum, Holland," it is impossible to avoid comparing it with a somewhat similar subject, wondrously painted by Hobbema. M. De Schampheleer, however, has water on both sides of his road, and thus has an advantage over the old master, who severely restricted himself to a mere high road. As a specimen of the art of investing the prosiest and most common-place of landscapes with a poetical atmosphere, M. De Schampheleer's picture is deserving of the highest praise. From Saxony comes a picture of "Verona," by T. Choulant. The architectural part is excellent, and gives a truthful representation of the famous old city of the Montagues. Capulets, and Scaligers.

France has but few representatives, but among them is a giant—Meissonier. It has been well remarked of this great artist that his works are not small, but large pictures looked at through the wrong end of the glass. In breadth and boldness he is approached by very few living artists, let their canvas be of what size it may. "The Connoisseurs" is a gem, but even that is outshone by "The Confidence." These specimens of the great Frenchman are, by themselves, worthy of a visit to the International Exhibition.

It is gratifying to find that the prominence accorded to the Fine Arts has added a most interesting feature to the Exhibition, one that will, year by year, become more important. The public spirit of owners of pictures has been productive of the happiest results, and the excellent fashion of lending valuable works of art to Exhibitions reflects the greatest credit upon the taste and patriotism of modern patrons of Art.

Mr. Henry Hughes, of Liverpool, is introducing a new method of laying tramways. He uses a newly-devised light iron rail, imbedded in cement, and claims to secure greater economy in laying down and in other ways. The inventor's cement is stated to have frequently borne the weight of fifteen tons on a thickness of three inches, and to have successfully resisted constant wear and tear for six years.

EXHIBITIONS.

VIENNA EXHIBITION.

A meeting of Her Majesty's Commissioners was held at the Vienna Offices of the Royal Commission yesterday, under the Presidency of His Royal Highness the Prince of Wales, K.G. There were present, Sir Andrew Buchanan, G.C.B., Her Majesty's Ambassador at the Court of Vienna; H.S.H. Count Gleichen, R.N.; the Earl Cowper, K.G.; Sir Anthony de Rothschild, Bart.; Sir Richard Wallace, Bart, M.P.; Mr. Henry A. Brassey, M.P.; and Mr. P. Cunliffe Owen, secretary.

The correspondent of the *Daily Telegraph* sends an account of the banquet to the British exhibitors, which took place on Tuesday last. He says:—The banquet given to-day by the Royal Commission to the British exhibitors and a few Austrians of distinction, at the Blumensaal or Horticultural Hall of the Exhibition, passed off most successfully. The room was gaily decorated with British and Austrian flags, an excellent orchestra was in attendance, and a sumptuous *menu* provided. Lord Cowper presided, while Sir Richard Wallace, Mr. Henry Brassey, and Sir Anthony Rothschild acted as vice-chairmen, each sitting at the head of a long table. Amongst the distinguished guests were Baron Schwarz-Senborn, the chief director of the Exhibition, Baron Gagern, and Chevaliers Engert, Hasenauer, and Gabrielli.

The same correspondent adds:—Terrible wind and rain storms have raged here for the last forty-eight hours, converting the grounds of the Exhibition into slushy morasses. The number of visitors has fallen off seriously.

This morning (Wednesday) a tremendous gust of wind burst the glass frontage of the west portal of the Machinery Hall with a great crash. Fortunately nobody was seriously hurt. Steam pipes will be fitted up by the end of the week in our section, but the other departments will probably not be able to obtain steam power before the end of June.

But few strangers are arriving at Vienna, and the overwhelming smash on the Bourse has cast a deep gloom over the city.

The correspondent of the *Scotsman* states that the catalogue of the Exhibition was printed on a Walter Press, at the office of *Die Presse*, in Vienna. The printing was begun on the 23rd of April, and on the 29th the first edition of 10,000 copies, each containing 32½ sheets, was in the hands of the bookbinder. On the 1st of May a copy was presented to the Emperor, and copies were afterwards sold in the building to the general public. These excellent results are due to Herr Ludwig Lott, of *Die Presse*, and his coadjutors, in whose hands the Walter machine has proved a great success, and who says that ten times as many copies could have been printed in the time if they had been required. *Die Presse* has two machines of the same size as those used in the *Times* office. They are the first machines of the kind used on the Continent, and the catalogue of the Exhibition is said to be the first book ever printed from continuous web paper.

It is stated that several artisans are to be sent from Manchester to report upon their respective trades as represented in the Exhibition.

The four bronze Sea-Horses made for the new fountain at the southern extremity of the Luxembourg Garden at Paris, which had been lying there ready to be set up, have been sent to the Exhibition.

The *Engineer* gives the following useful remarks upon the various routes to Vienna. They are also illustrated by a sketch map, showing very plainly the different lines of railway:—

The journey is probably performed in the shortest time by the Paris, Strasburg, and Munich route, though by way of Cologne and Nuremburg the time is not much longer. A fast train runs from Paris *viâ* Strasburg to Vienna in 37 hours, giving an hour and a-half at Strasburg—from 9 to 10·30 a.m.—for breakfast. The fare for this journey from London, *viâ* Calais, Paris, Strasburg, and Munich, is £10 0s. 6d. for a first-class single ticket, available for a month, and for return tickets, available for 45 days, the prices are £15 8s. 6d. and £11 11s. first and second-class respectively. These fares are charged alike by the South-Eastern and London and Chatham and Dover railways.

The journey by way of Calais, Brussels, Cologne, and Passau, occupies from 48 to 50 hours, and tickets are issued by the South-Eastern Railway Company at £8 11s. 3d. and £7 3s. 6d. for the single journey in first and mixed first and second classes respectively. These tickets are available for 30 days, but the return tickets over the same route are only available for the same time at a cost of £13 0s. 6d. and £9 10s. first and second classes respectively. By way of Ostend there is a reduction in the single fares of 4s. 6d., and in the return fares of 6s. 6d. and 7s. respectively.

The London, Chatham, and Dover Railway Company issue single tickets at the same rates as the South-Eastern, but at present we have no information as to their return fares. By way of Cassel and Leipsic—a journey of about sixty-three hours—the return fares are a trifle higher by second-class and lower by first-class than by the Passau route.

The Brighton Railway Company issue return tickets *viâ* Newhaven and Dieppe to Paris, not shown in the map, and thence by Strasburg and Munich, at £13 7s. and £9 15s. first and second classes, and available for one month. They also issue return or circular tickets by way of Switzerland or North Italy, available for six weeks and two months each, at £14 and £15 7s. 6d. first-class and £10 5s. and £11 7s. 6d. second-class respectively.

The Great Eastern Railway affords another route, which would prove a pleasant one to many, in that it gives an opportunity to see something of Holland, a country not so much visited, perhaps, as its interest would warrant. This line consists of rail to Harwich, a sea passage to Rotterdam, and thence to Cologne by Dusseldorf, crossing the Rhine by a floating pontoon. A sea passage may be taken from Harwich to Antwerp, if preferred. We have no information as to the fares by this route; we understand they are not yet fixed.

The last and longest route is to Hamburg by steam from London, thence by rail *via* Berlin and Dresden. This journey would occupy about ninety hours.

The General Steam Navigation Company will issue single tickets as far as Berlin at £4 15s. 3d. first, and £3 7s. 5d. second class. The whole journey costs about £6 10s. for a first-class ticket.

There is a special facility at the disposal of exhibitors and their representative assistants, of which these may not be aware. Messrs. Cook, as agents for the Royal Commission of the British section, have made arrangements by which *bona fide* exhibitors, or their *bona fide* representatives, may have tickets, first, second, or third class to Vienna and back at a single fare, available for return until the close of the Exhibition. The application for these tickets must be formally addressed to the Secretary of the Royal Commission, 41, Parliament-street, S.W.

Exhibition at Aberdeen.—It is proposed to have an exhibition of arts and manufactures in the new public buildings of Aberdeen.

THE CLOTH TRADE AND TECHNICAL EDUCATION.

On Friday last the Clothworkers Company held a conference in their Corporate-hall, Mincing-lane, to consider the best means to be adopted by them for the promotion of technical education in connection with the cloth trade at the principal centres of that industry. The Master of the Guild (Mr. John Bazley White) occupied the chair on the occasion, and there were present, among others, Lord Frederick Cavendish, M.P.; Mr. Whitwell, M.P.; Mr. Morris, President of the Halifax Chamber of Commerce; Mr. O. Nussey, and Mr. Alderman Barran, both of Leeds; Mr. Howell, Director of Contracts to the War Office, and a member of the Company; Major-General Eardley-Wilmot, Chairman of the Council of the Society of Arts; Mr. P. Le Neve Foster, M.A., Secretary to the Society of Arts; Major Donnelly, R.E.; Mr. Stanton, of Stroud; Mr. O. Roberts, Clerk of the Company, and others. Mr. C. J. Bloxam, Chairman of the Trusts and General Purposes Committee of the Company, after giving an account of the Guild of Clothworkers since its establishment in 1480, invited the counsel of the meeting on the subject of technical education, adding that the Company would be ready to entertain and foster to the extent of the means at their disposal any proposition by which the cloth trade might be promoted. The Company, he said, thought it essential to the trade of the country, especially the cloth trade, that we should instruct our artisans to to become skilled workmen, and so enable us to compete with foreigners. Mr. Morris, of Halifax, observed that the ground for technical education was very much prepared by the general elementary education now given, and he believed the Company could not do better than direct their attention to the nucleus of an institution in course of formation at Leeds. Mr. Nussey, of Leeds, referred to the Yorkshire College of Science, and suggested that a teacher in the manufacture of textile fabrics, and in drawing and designing patterns, might be added to the institution. Mr. Alderman Barran, of Leeds, thought there would be great difficulty in giving medals to workmen, and in founding a scholarship. It would be impossible to give prizes for the best textile fabrics. The best designs, he said, were those that sold the best and wore the best. In France and Germany manufacturers were educated gentlemen, and he thought the trade should not be solely pursued with the object of accumulating wealth. If the Clothworkers' Company could see their way to found a chair, or to assist the Yorkshire College, the influence of their example might be great. Mr. Stanton, a cloth manufacturer, of Stroud, dwelt on the necessity of adopting measures to enable the trade to hold its own against foreign competition. Lord F. Cavendish, M.P., admitted that the idea of artisans generally attending a college was Utopian, but he was of opinion with many in Yorkshire that much practical instruction might be imparted in the evenings, to those who required a higher education, through mechanics' institutions. The more immediate object, he submitted, was to give to their manufacturers and managers in the great factories that instruction which their foreign competitors obtained in the Polytechnic Schools on the Continent, and to that end he thought a complete knowledge of mechanics, chemistry, and mathematics was essential. As to founding scholarships, he did not think artisans could afford time to compete for them; but prizes might be offered for competition in mechanics' institutions, and the Clothworkers' Company might do good in founding such prizes. The discussion was continued by Mr. Howell, Director of Contracts to the War-office, Major-General Eardley-Wilmot, Major Donnelly, and Mr. Whitwell, M.P., the last-named of whom spoke in favour of an itinerant chair, with an eminent man at its head, to teach physics and chemistry in the most important clothing districts in the country. Eventually, it was understood that the committee would recommend the council of the company to found a professorship of textile fabrics, and some scholarships to be thrown open to young men connected with the trade in the various centres of the industry.

CORRESPONDENCE.

PIECE-WORK SENTENCES FOR PRISONERS.

Sir,—Those persons who feel an interest in the progress of prison discipline and the prevention of crime, must have derived much satisfaction from the special favour with which the advocacy of a greatly-increased resort to remunerative and reformatory industry in gaols was received by the Prison Congress which assembled last year in the Middle Temple Hall, London, and also by the more recent meeting of visiting justices held at the London residence of the Earl of Dudley.

As a magistrate I have often had occasion to observe that our existing system of imprisonment (notwithstanding the efficiency of prison officers as a class, and the introduction of various improvements in the discipline) fails, to a large extent, in effecting the reformation or deterrence of criminals. The very numerous recommittals of inveterate offenders for a succession of short terms is a common experience in all gaols, and in itself constitutes a strong proof of the necessity for a better system of sentences. Then, again, some of the occupations in gaol are not merely very wasteful (by rendering idle and vicious offenders a dead weight upon the heavily-burdened, honest taxpayers), but even disqualify the prisoner from earning a livelihood on his discharge. Thus, a printer, by being kept merely picking oakum, may, on his liberation, find that he has lost the dexterity of finger and quickness of eye needful for resuming his trade.

Further, the importance of making prisons, and, indeed, many other public institutions, so far as practicable, self-supporting, should claim more attention, by reason of the growing tendency to accumulate needless expensive organizations. For example, even in the operation of the new School Board, we find that the valuable provision for compelling parents to pay for the education of their children, so far as practicable, has become both difficult and costly in its enforcement, so as to involve a burden on the rates which should, on special grounds, be avoided.

When filling the office of Sheriff of London and Middlesex, several years ago, I was especially led to conclude that very great advantage would result to the public, and to offenders, by the adoption of labour sentences—a given quantity of hard but profitable labour—in lieu of mere sentences of detention for a certain time, as at present, irrespective of the work done by the prisoner, or of any satisfactory proof of his reformation. The proposal was suggested to Earl Grey by the late Archbishop Whately, as long ago as 1832. It was also strongly advocated by Captain Maconochie, and by the late Mr. Charles Pearson and others, and has indeed been partially recognised and adopted in the English and Irish convict prisons, under the name of the "mark system," by which a remission of about one-fourth of the length of time sentences may be earned by hard work and good behaviour. So far as it has been thus adopted, it has been attended by excellent results. Nevertheless, the principle continues to be ignored and neglected in the large number of country and borough gaols (about 220) in Great Britain and Ireland.

The neglect of so valuable a principle arises mainly from apprehended difficulties in its application to the different classes of prisoners. For example, it has been objected, How can you apportion quantity or labour sentences amongst the large number of criminals who are ignorant of any trade at all? Or how can you fairly distribute any fixed amount of piece-work amongst persons, some of whom are physically incapable of performing it?

These difficulties may obviated in the following manner.

Let a commission of experienced prison officers and magistrates, assisted by a few practical tradesmen, ascertain, by a series of careful observations, the average equivalents of ordinary prison labour of various kinds to a time sentence of one year. Thus it would be found how many dozen pairs of boots or shoes a shoemaker will usually make in that period; how many suits or garments a tailor will in general make; how many yards of land an ordinary agricultural labourer can dig or cultivate; how many feet of weaving a factory hand can accomplish, &c.

These averages of piece-work will then afford a fair approximate basis for substituting so many units of hard and profitable labour for so many months of time sentence. And instead of sentencing idle and vicious rogues to three, six, or twelve months' gaol detention, as at present, they will be sentenced to perform 1,000, 2,000, or 5,000, hard-labour units, as the case may be, these units representing so many articles to be mauufactured, or so much land to be tilled. Inasmuch as the qualifications and abilities of prisoners (both as to physical strength and technical knowledge) vary greatly, the exact apportionment of the equivalents of the labour units to each particular case and occupation should be regulated locally by the visiting justices and the prison governor, who would be guided by the observations for the general approximate basis already mentioned. And as a further and effectual check against any important error of estimation each labour sentence might be accompanied by a maximum and minimum limit as to time, or, at least, the former. For example, if a man was sentenced to perform 1,500 labour units, calculated for, say, six months' occupation, it might be provided that his confinement should not exceed nine months, even if the work were not done by that period. This limitation would effectually guard against any special abuse of the right of private judgment to be necessarily allowed to the local gaol authorities.

Besides this spur to active exertion and good behaviour afforded by a labour system, it may also be rendered of great immediate efficacy by making some portion of the quality or quantity of the prisoners' diet dependent, from day to day, upon the amount of his industry. By this means the lowest class of minds, unaccustomed to look forward to ulterior or distant advantage, would be made sensible of the present value of increased labour. And the stimulus thereby afforded would be of a similar kind to that which must induce them to work in ordinary life. For we should, in fact, endeavour to force a man to become in prison what we wish to make him when he comes out it, and to learn at least something of the Scriptural precept, "If any will not work, neither should he eat."

The advantages of this substitution of labour sentences instead of time sentences would be great and manifold.

1. It would largely stimulate the industrial habits and the intelligence of the prisoner.

2. It would effect a great saving to the honest ratepayer, who ought not, as at present, to be doubly victimized by the thief—first by plunder, and then by his maintenance in gaol.

3. It would increase the ability of the prisoners to support themselves reputably after their discharge, and so keep them off the rates in future.

4. By holding out a constant ground of hope, through the opportunity of shortening the duration of imprisonment by dint of special exertion, it would render the administration of discipline much easier to the prison officers, whilst greatly aiding the reformation of the offender.

5. By means of a small per centage of profit, on the results of his labour, being granted to the prisoner, his interest in the work would be effectually secured, and he might also be enabled to leave the gaol, in many cases, free from dependence upon the charity of Discharged Prisoners Aid Societies, or benevolent individuals. Even to a prisoner, self-help is the best help.

6. By rendering the exact time of discharging prisoners uncertain beforehand, it would obviate their being waited for outside the gaol by vicious comrades, who, at present, often succeed in leading them back to evil.

7. In some cases, at least, the profit of the prisoner's labour would not only recoup all expenses of his punishment to the public, but might be available for some contribution towards the restitution of private parties injured by his offences.

And, in short, this system would be found (far more than the existing plan) to combine the chief elements of punishment and prevention, namely, Deterrence, Reformation, and Restitution.—I am, &c.

A. Angus Croll.

Granard Lodge, Roehampton.

OBITUARY.

The Earl of Zetland.—The death of the Earl of Zetland took place on the 6th inst., after a long illness. His lordship was born on the 5th of February, 1795, and was therefore in his 79th year. He was educated at Harrow, and was married in 1828 to Sophia Jane, second daughter of Sir Hedworth Williamson, Bart. There was no issue, and her ladyship died in 1865. His lordship represented Richmond in Parliament from the year 1818 to 1830, and from 1835 to 1839. He was also member for the city of York from 1830 to 1832, and from 1833 to 1835. He was Grand Master of the Freemasons of England for a great number of years, and vacated in favour of the Marquis of Ripon about two years ago. The noble earl was Provincial Grand Master for the North and East Ridings of Yorkshire, and was also Lord Lieutenant of the North Riding until a few weeks ago, when he was succeeded by the Marquis of Ripon. His lordship was appointed Knight of the Thistle under Lord Palmerston's Government, and last year he was made Knight of the Garter. Lord Zetland became a member of this Society in 1853.

NOTES ON BOOKS.

Round the Table: Hints on Cookery (*London, Horace Cox*, 1873).—Visitors to the School of Cookery at the International Exhibition may be glad to hear of a book by whose aid they may carry on the study suggested by the lectures. Such a book is this. Instruction of a very simple and practical style is given about a great variety of dishes, and the directions for all of them are at once complete and intelligible. The object of the book is precisely the same as that of the originators of the School of Cookery at the Exhibition—to show how, without extravagance or waste, but by careful and economical application of materials, the food of our middle-classes may be palatably and wholesomely prepared. There are, it is true, instructions for elaborate dishes, but nearly the whole of the book is taken up with descriptions of simple dishes suitable for an ordinary household. It is because it is likely to be a very useful adjunct to the South Kensington lectures that the book is noticed in these columns.

GENERAL NOTES.

New Gas.—The New Gas Company announce the satisfactory introduction of their system into the city of Chichester. This undertaking was started at the beginning of the present year, to purchase certain improvements for the manufacture of gas for lighting and heating purposes, known as Ruck's patents, and among the advantages anticipated, according to the prospectus, one of the most important will be the generation of steam for steam-vessels at a greatly reduced cost. The city was first lighted by the new process on Friday last.

Railway Wheels of Paper.—It is stated in an American paper, that Hudson, U.S., is to be selected as the location for a new manufacturing enterprise to be known as the "Paper Car Wheel Company." Messrs. R. N. Allen and Co., of Brandon, Vermont, are the patentees of a new car wheel made of compressed paper, which is alleged to possess great superiority over iron or wood. These wheels have been in use on a Pullman palace car long enough to prove them, and it has been decided to establish a large manufactory at some favourable point. Hudson was chosen, and the machine works of R. H. Mitchell and Co. have been secured, with adjacent property, for the location of the new works.

Utilisation of Coal Dust.—A new building material is found in coal dust. The mixture is composed of one-sixth cement and five-sixths coal dust. In the Waverley hydropathic establishment at Melrose the experiment was tried. A series of thick sheet iron plates are stiffened at the edges with angle iron, the plates being attached to uprights of T-iron, and being kept in the proper position by pins, the plates are fixed so as to be readily raised as the building progresses. After the requisite proportions of mine dust and cement have been mixed together, and the whole thoroughly saturated with water, the mixture is flung in between the plates, and large pieces of slag or stone bedded in it; thereafter another bed of concrete, which fills the interstices between the large pieces and thoroughly fixes them; another layer of stones or slag is then added, and so on, till the space between the plates all round the building is filled. After being allowed to stand for a night, the concrete will be hard enough to allow of the plates being lifted in the morning. The chief feature is its extreme simplicity. When gravel can be obtained, it is of course better, but the slag refuse of furnaces and useless stones can be readily utilised in this manner, and make better houses than brick.—*American Builder.*

Alexandra Palace.—The opening of the Alexandra Palace and Park on Saturday, the 24th instant, will be an event of much importance, as adding a new place of elevating amusement and recreation to the metropolis, and especially as providing for residents in the great and rapidly-growing northern suburbs an establishment offering similar attractions to those so long enjoyed at the Crystal Palace by their southern brethren. The natural beauty of the Alexandra Park, heightened as it is by judicious and tasteful planting, would alone suffice to atract myriads of visitors, and the extent of the grounds (which embrace 220 acres) renders them a valuable addition to the existing lungs of London. The Palace, which crowns the summit of Muswell Hill, erected by Messrs. Kelk and Lucas from the designs of Messrs. Meeson and Johnson, architects, is an exceedingly elegant and substantial structure. The great organ by Mr. Willis, built under the superintendence of Sir Michael Costa, is one of the largest and finest instruments in the kingdom. A first-rate orchestra has been formed by Mr. Weist Hill, the conductor of the company's music, and an efficient choir of 300 voices will assist in the oratorios and other great performances which are to be given in the Palace. A theatre of the best description, the stage of which is as large as that of Drury Lane, occupies one of the transepts, and in another is a concert-hall, which will seat 3,000 visitors. On the opening day there will be a grand international flower show, at which £1,200 will be given in prizes; and at 3 p.m. a grand vocal and instrumental concert will take place in the centre transept, under the direction of Sir Michael Costa. The band and chorus will number upwards of 1,000. A series of opera concerts in May, June, and July are announced, and among the attractions of the season will be holiday festivals, ballad concerts, a horse show, a cat show, horse races, cricket matches, an archery fete, a Scotch fete, pigeon races, an international fruit show, rose and rhododendron shows, &c. Messrs. Bertram and Roberts are to supply refreshments. A branch railway, to be opened on the 24th inst., will place the Palace in direct communication with all stations on the Great Northern, Metropolitan, and London, Chatham, and Dover Railways.

Sydney School of Arts.—The Sydney Mechanics' School of Arts is prospering. The library has been well used during the year. It has been proposed that a working man's college should be formed in connection with the institution. It is not anticipated that at present any large proportion of these colonial artisans will devote their evening leisure to study, but the number is expected to increase each generation.

Photographic Printing.—A simple mode of photographic printing has been devised by M. Marion, of Paris, which would be very useful in preparing lecture diagrams. It consists in impregnating paper with ferro-prussiate, which renders it sensitive to light. The drawing, which is made on tracing paper, is laid upon the sensitive paper as a negative, and exposed to light, after which the sensitive paper is washed in water. The copy is then found to be produced on it in white line on a blue ground, which may be changed to black, the drawing still remaining white, by using a tannin solution.

Telegraph Poles.—In the discussion on this subject brought forward at the Society of Telegraph Engineers on February 26th last, Mr. Latimer Clarke in the chair, experience seemed to be on the side of using a screw for screwing the pole into the ground, and of employing a base-plate in connection with a wrought-iron tapering pole. Major Webber described a pole in which the point of fixture was close to the ground; whereas, in a pole described by Mr. Siemens, the point of fixture was on the base-plate. Mr. Siemens differed from Major Webber in laying more stress upon the use of a base-plate; his pole was two feet eight inches in the ground, and Major Webber's was six feet. Mr. Siemens pointed out that the construction of telegraph poles depended on definite principles. Mr. Latimer Clarke approved of the modified views of the base-plate advocated by Major Webber, including some remarks about the strength which the pole required at the lower part. A pole should be stronger laterally than in the longitudinal direction of the line. The best form of pole seemed to be one very much like Mr. Siemens', consisting of a long cast-iron base with a wrought-iron taper top, but with a tube strengthened by a rib on each side.

NOTICES.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

THE LIBRARY.

The following works have been presented to the Library:—

Proceedings of the Literary and Philosophical Society of Liverpool. No. 26, with index to Vols. 1 to 25. Presented to the Society.

Report on the Caoutchouc of Commerce. By James Collins. Presented by the Author.

Practical Notes on the Egyptian Mode of Cotton Cultivation. By Thomas Login, C.E. Presented by the Author.

Results of Five Years' Meteorological Observations for Hobart Town. Compiled by Francis Abbott, F.R.A.S.

British Rainfall, 1872. On the Distribution of Rain over the British Isles during the year 1872. Compiled by G. J. Symons, F.M.S.

ORDINARY MEETINGS.

Wednesday evenings, at eight o'clock. The following meetings have been arranged:—

May 21.—"On Recent Processes for the Production of Gas for Illuminating Purposes." By Thomas Wills, Esq.

CANTOR LECTURES.

The Third Course of Cantor Lectures for the present session is "On Wines; their Production, Treatment, and Use," by J. L. W. Thudichum, Esq., M.D. The Course consists of six lectures, the fifth of which will be given on Monday evening, the 19th of May, and the last of the course on the Monday evening succeeding.

Lecture V.

The wines of France compared to those of Spain and Portugal. The Gironde, its vineyards, wines, and varieties of wines. The Bourgogne and its productions. Belgian appreciation, and sweetness of Burgundy wine. The wine requires the procédé. The Champagne; peculiarities of viticulture. Chemical treatment of effervescent wine to ensure its soundness. Absurd notion of some writers on champagne; of the same on second wines and sugar-water wines; exposure of the sycophancy.

Lecture VI.

The wines of Germany; Riessling a type of bouquetted wines. Classification of the wines of the world, as determined by quality, quantity, value in the market of highest and lowest qualities. Active ingredients of wine. Use of chemical analysis. Use of wine to the healthy, whether old or young; wine, under which condition preferable to all other alcoholic liquids. Wine should be a beverage, not a dram. Use of wine to the delicate and sick. Selection and prices of wine. Proposed modification of the import duties, to adjust them to the climatic difficulties of Spain and Portugal.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...SOCIETY OF ARTS, 8. Cantor Lectures Dr. Thudichum, "On Wines; their Production, Treatment, and Use."
Social Science Association, 8. Captain Rogers, "On the Destruction of Human Life and Property in India by Noxious Wild Animals."
Institution of Surveyors, 8. Discussion on Mr. W. Menzie's Paper, "Arterial Drainage Works, Water Supply, and Sewage Drainage Works, executed at Windsor, between the years 1867 and 1873," and Mr. W. Hope's Paper on "Sewage Farming."
Royal United Service Institute, 8½. Captain J. P. Morgan, "On Rotation, and the Rifling of Heavy Guns."
British Architects, 8.
Asiatic, 3 Annual Meeting.
London Institution, 4.

Tues....Victoria Institute, 8 (At the House of the Society of Arts.) Anniversary Meeting. Address by the Rev Dr. Boultbee.
Statistical. 7¾. 1. Mr. F. H. Janson, "On the Statistics of Legislation." 2 Mr. George Warde Norman, "On the Cause of the Sub-division of Land in France."
Pathological, 8.
Anthropological Institute, 8. Mr. Hyde Clarke, "On Comparative Grammar of Hieroglyphic and Caucasian."
Zoological, 8½. 1. Sir Victor Brooke, "On African Buffaloes." 2. Lord Arthur Russell, "Remarks on Varieties of the Carp." 3 Mr. St. George Mivart, "On Lepilemur cheirgaleus, and on the Zoological rank of the *Lemuroida*."
Civil Engineers, 8. 1. Discussion on "The Delta of the Danube," and (time permitting) 2. Mr. John Robinson, "On Modern Locomotives, designed with a view to Economy, Durability, and Facility of Repair."
Royal Institution, 3. Mr. J. H. Parker, "Early Roman History and Architecture."

Wed....SOCIETY OF ARTS, 8. Mr. T. Wills, "On Recent Processes for the Production of Gas for Illuminating Purposes."
Pharmaceutical, 11. Annual Meeting.

Thurs...Antiquaries, 8½.
Royal Institution, 3. Professor Tyndall, "On Light."
Society for Encouragement of Fine Arts, 8. Mr. George Browning, "The Art Treasures of Italy."

Fri......Royal Institution, 9. Mr. Spottiswoode, "Spectra of Polarised Light."
Quekett Club 8.

Sat......Botanic, 3¾.
Royal Institution, 3. Mr. J. Morley, "The Historical Method."
Linnæan, 3. Annual Meeting.

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FRIDAY, MAY 23, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

INDIAN COMMITTEE.

A conference was held on Friday evening, 9th instant, Lord William Hay, F.R.G.S., in the chair.

The Paper read was :—

INDIAN HARBOURS.

By Lieut-General Sir Arthur Cotton, R.E.

Before proceeding to speak of particular harbours, or sites for harbours, in India, it may be well for me to state the principles upon which I form my opinions respecting them.

When first we arrive at a country beyond seas, of course the question is, where nature has provided a shelter for ships, however imperfect, difficult of approach, or in other respects inconvenient it may be, provided it is tolerably near to the place we wish to reach with persons or goods.

But when we have established ourselves there in such a way as to allow of our considering what we want in the way of a harbour to suit a trade of vast extent, the case is entirely altered. The question is then not what partial and imperfect shelter we can find for a ship ready provided for us, but where is the site for such a shelter that will suit the approaches to it on the one side from the tract of country we have to trade with, and on the other from the countries from which our ships will principally approach. Just as when we first occupy a country, we look for such lines of communication as are, in however imperfect a manner, practicable; but when we have extensively established ourselves in it, we do not look for such lines as have some imperfect natural facilities, but for such as—at, it may be, great expense—can be made most complete, and most fully suit the multiplied wants of the community.

1st. When we made common roads in England we looked for low saddles in the hill ranges to carry the roads over them, however circuitous or otherwise inconvenient these lines might be in many respects. But now our population and wealth have increased, we do not look for a low, out-of-the-way saddle, but take a direct line to the place we are going to, and run a tunnel through the hill, because with a large traffic the interest on the expense of such works is a less expense upon it than the extra expense of the circuitous route. Thus, if six million of tons are imported and exported in the Indian trade, one shilling a ton is the interest at 5 per cent. on £6,000,000, so that if an expenditure of that sum would provide us with harbours, which from diminished insurance, pilotage, port dues, cost of internal transit, &c., would save more than a shilling a ton on the present trade, without taking into consideration the certain vast increase of trade in future years, it might be worth while to provide entirely new and additional harbours in other places, besides improving existing ports. When we consider the expenses connected with the present harbours or absence of harbours, it gives us a sound standard by which to form our judgment of what it may be wise to expend on such works. Suppose, for instance, insurance, pilotage, and other port expenses of Calcutta are five rupees a ton on three million tons—this is the interest of 30 millions. And this is merely the question of money returns; the saving of life by harbour improvements is to be considered besides.

2nd. We have to keep in view that we now know how to make harbours anywhere. We are not tied down to spots where there is naturally some kind of shelter for ships. We know that a simple line of blocks of stone will provide shelter anywhere, and that if blasted or artificial blocks of 30 tons are used, they will stand any seas in India, and further, that it is less expense to use large blocks than small ones; and we have this prodigious advantage in making harbours for ourselves, that we should, of course, not add unnecessary dangers to them, such as are found in every natural harbour.

Thus, for instance, if a simple line of stone is made at Madras, parallel with the beach, it would form a harbour incalculably superior to Calcutta or Bombay, being perfectly open to access without a single danger of any kind whatever, and with perfect safety to the vessels when at anchor under it. How many vessels are lost both outside and inside Calcutta and Bombay harbours?

3rd. We have to keep in view the Suez Canal. This work, by bringing India well within steaming distance of Europe and America, has essentially altered the face of this question. Whatever is done in the way of harbours must have reference to the facilities of reaching the Red Sea from them.

4th. The harbour question is essentially connected with the cost of internal transit, and also with the comparative cost of ocean and internal transit. If the latter greatly exceeds the former, then it is of importance to have harbours where the internal transit will be shortened as much as possible, even though at the cost of increased insurance or post expenses; but if the internal transit can be reduced to that of ocean carriage, or near it, then the harbour may be at the extreme point of the land. And this is another thing that has, of late, essentially altered the question of the best sites for harbours. We now know that by means of steam and water combined, that is by steam-boat canals, with boats of 200 or 300 tons, the inland transit can be reduced almost, or quite, to that of the ocean, that is $\frac{1}{30}$d. per ton per mile, for long distances.

5th. That by far the greater part of the coast of India is exposed to the storms of the south-west monsoon, for four months in the year; only a small extent, viz., the east coast, from Masulipatam to Cape Comorin, being subject to stormy monsoons from the north-east.

One main point, therefore, is to consider what sites for harbours will be least affected by the south-west monsoon, and most accessible during these months.

I, therefore, in dealing with this subject, keep in view these points :—

1st. That we are not tied down to natural harbours.

2nd. That we can make harbours anywhere.

3rd. That we must do everything in this way with reference to the Red Sea route.

4th. That we can now have internal transit as cheap as ocean transit, or nearly so.

5th. That, excepting a small extent of coast subject to the north-east monsoon, the stormy season and winds are from the south-west.

6th. We have to keep in view the hurricanes, which are frequent throughout the Indian seas north of 10 deg. latitude, while south of that latitude they do not occur.

Now, with these points in view, let us run over the country which we want to supply and to draw from, as respects its natural facilities and difficulties.

The first point is that the slope of the country is almost wholly to the west, the exceptions being the valley of the Indus, sloping to the south, and that of the Burhampootra to the east, meeting the main slope and that of the Irrawady to the south.

At present five-sixths of the population occupies those tracts that slope to the west, and this is, therefore, the natural direction of the traffic. The whole of the western side of the country has a barrier of steep hills, of about 2,000 feet high—a very serious obstacle to cheap transit, though one which can certainly be in a great measure overcome. There are, however, four breaches in that barrier, viz., the valleys of the Nerbudda and Taptee, in the north of the peninsula; that of the Caulee, terminating in the new harbour of Carwar, in the centre, which, however, is a less perfect one, and that of the Ponanee in the south.

These all offer natural facilities for leading traffic to the west coast. The basin of the Burhampootra is entirely shut in, excepting to the eastward, but what that line of traffic may become is beyond all calculation, because the line of land carriage between it and the Yangtse is only 250 miles, and perhaps part of this may be converted to water communication. With this short line of land, which seems now well ascertained to have no very high range of hills across it laying open the whole river system of China to that of India, and thus uniting the two greatest masses of population in the world, there can be no doubt that eventually a traffic of as great an extent as any in the world will be brought into existence. The foreign traffic may follow either of the two lines, that is, by the Burhampootra to Calcutta and the southern ports of India, of which I have yet to speak, or by the splendid navigation of the Irawaddy to Rangoon.

In considering the subject of Indian harbours we must therefore keep in view this tapping of China on its South-West. The basin of the Irrawaddy naturally drains into the harbour of Rangoon, and it might, from the extraordinary fertility of the country, produce a vast foreign trade, but from the very small population, only three or four millions, it must be for a long time a comparatively small traffic, till it is the outlet for part of the China trade.

The basin of the Indus has two outlets, either to the south along its slope, or to the east along the valley of the Ganges, from which it is divided only by an almost perfect plain, in which a steam-boat canal is already far advanced. But by far the most important point in this basin is, that it is the natural outlet of all Central Asia, the trade with which will certainly become one of great extent, though it will be kept within bounds by the enormous cost of land carriage beyond the valley of the Indus, owing to the great distances and the vast heights which must be passed over. These will effectually and completely prevent the trade ever coming down to those things which form the great mass of traffic, such as grain, building materials, &c. It must always be confined to manufactures and other articles of considerable value. As respects value of goods, therefore, the line will certainly become one of considerable importance, but as respects quantity, it must always be one of comparatively moderate traffic. It is thus evidently essential that in considering the subject of harbours we keep before us distinctly the different tracts of country and their populations, their productions and demands, for which we have to provide outlets.

With respect to entirely new harbours, I may point out that the cost is far from great, now we know how to make them. A very moderate section of large blocks of stone is sufficient. In seven fathoms a section of 400 or 500 square yards, or 500 to 600 tons per lineal yard, is sufficient; and in India, at any place where stone is to be obtained near, three or four rupees a ton, or £150 to £200 a lineal yard of breakwater, will probably cover all expenses; so that a breakwater of 2,000 yards, costing from £300,000 to £400,000, or from £15,000 to £20,000 per annum, would make a perfect harbour. A charge of only from 2d. to 2½d. on one million tons entering, and the same leaving a port, would be a very small tax upon shipping, compared with the insurance, pilotage, port dues, and boat expenses in many natural harbours. For instance, supposing the insurance from England to Calcutta is 2 per cent. on goods value £100 a ton, and that of this one-third is due to the dangers of the Sandheads and the Hooghly, or 13s. per ton, how small is the expense of a new harbour in comparison, if it saved that insurance; and even on export goods of £20 a ton value, a saving in the insurance of only one-quarter per cent. would be 1s. a ton, perhaps five times the interest payable for a new harbour, and this is besides any saving in pilotage and other port dues.

I give these rough calculations to show what a great question it is whether we are to be content with natural harbours, or whether we ought to add new ones. Perhaps the insurance, pilotage, &c., paid for the present harbours in India, is one or one-and-a-half million a year on the present trade only. Keeping these things in view, let us run over the principal harbours or sites for harbours in India.

Beginning with Rangoon, we have a good harbour, but with a dangerous entrance, and exposed to the full force of the south-west monsoon and considerable dangers in the river. But it seems to be the necessary outlet for all the basin of the Irrawaddy, and eventually for a portion of the trade of China; the former, though considerable, cannot for many years become very great, but the latter might expand to great dimensions, though the principal part of the trade from China would naturally rather be drawn to the capital. Calcutta, the land carriage between the Irrawaddy and the Burhampootra being only 100 miles, with an ascent of about 1,500 feet crossing it. The question here seems to be whether a better harbour could be formed near the mouth of the main Irrawaddy, or whether Rangoon must be accepted as the only possible port, with its unimproveable entrance; but in that case, the great work that should be executed is a steamboat canal from the head of the delta of the Irrawaddy direct to Rangoon, to avoid the long navigation of the Panlang Creek.

The harbours in Chittagong can never be the outlet of a very great traffic, as there is only a narrow strip of country, effectually cut off from the interior by a lofty range of mountains.

We next come to Calcutta, which has grown up to be the outlet of an enormous traffic, in spite of terrible objections, involving an expense of perhaps a million a year in insurance, &c., with great loss of life. An immense trade of this kind, once established, must, I conceive, be accepted as irremediable in a great measure, whatever it costs, and we must make the best we can of it by such local improvements as it is capable of. But we must never lose sight of the fact that a port at the head of a deep bay facing the south-west monsoon, and within the range of frequent hurricanes, is a most terrible evil, and that if 20 millions would transfer its trade to a safer point, it would be a cheap bargain.

On the east coast of the peninsula we have a safe harbour at False Point, now beginning to be used as the outlet of the Mahanuddee and Orissa. But this is a port of very small importance, being merely a temporary one, till the steamboat canals are completed to Calcutta, when almost the whole trade will pass inland to that port.

The next port is Coconada, the outlet of the Godavery and its delta, as well as of a considerable part of the valley of the Kistna, in consequence of the canal of Ellore connecting the two rivers. This is an excellent harbour, very accessible and perfectly safe, no vessel having ever been lost in it; but it is within the range of hurricanes, and it has the drawback of the anchorage being about three miles from the town. The expense of shipping and landing is not, however, very great. This objection could, I am of opinion, be entirely removed by dredging, and some works at no excessive expense. Even as it is, it is one of the cheapest ports in the world, calculating all its expenses of insurance, &c. It must, of necessity, be the outlet of a principal portion of the great basin of the Godavery. The trade has greatly increased since the improvement of the delta, from about £80,000 to about 1¼ million; and the river being now open to near Mahadeopoor, 220 miles, a regular traffic has been established so far.

The works on the river have now been stopped, but when resumed a very small expenditure will open a great additional country, and eventually Cocanada must be the outlet of a tract now inhabited by about 10 millions, and with great resources. This is therefore one of the ports which urgently require attention and outlay.

The next port of Masulipatam has the great objection of shallow water for four miles, in an open, exposed bay; and it cannot be the outlet of a very extensive tract of country, though at the mouth of the Kistnah, because that river is incapable of improvement for navigation. The only thing that could open this part of the country is a steamboat canal of 220 miles from the capital, Hyderabad, but it would be an expensive line, with a rise of 1,800 feet. This port, therefore, I consider not worth improving, if it were capable of it.

Madras, being now an established city of considerable trade, and the outlet of some 15 millions of people, must be made the best of. It has the great objection of being within the range of hurricanes, and is at present a perfectly open roadstead, but the latter objection can be entirely removed at no excessive expense. A line of breakwater, parallel with the shore, in seven fathoms, would make it not only a perfectly safe harbour, and perfectly accessible, but would make it by far the best harbour in India, inasmuch as there would not be the smallest danger to shipping, either outside of it or inside. This work can be executed cheaply and easily, as there is rock on the coast within twenty miles of it, with partial shelter for vessels, which could easily be made into an effective temporary harbour.

A breakwater could be constructed here of large blocks, for £150 to £200 a lineal yard; or, for £300,000 to £400,000. When the different systems of steam-boat navigation on the Toombuddra, Kistna, and Godavery are connected, and such a work is carried also into the interior, to the south-west, a very large tract of country will be effectively connected with this port; and the trade would certainly greatly increase with a safe port.

The present tonnage is about 400,000 tons, and the value of the trade about five and-a-half millions. At a cost of £500,000 the charge per cent. on the present trade would be only about 10d. I may state here that, having had much to do with works on this coast, at Madras and elsewhere, which has given me practical knowledge of the movements of the sand on the beach, I am satisfied that there is no objection to such a breakwater, though I need not state here particularly how it would affect the line of beach, further than by saying that in preventing the surf it would stop the current of sand which naturally flows continually from south to north along the shore, and cause an accumulation south of the breakwater, at the same time producing a cutting into the beach north of it, but where the land consists of unoccupied sand drifts. I may here only say that the accumulation of the sand on the shore of the breakwater would not be such as to interfere with the complete practicability and efficiency of the harbour.

The next site for a harbour is near the Paumban pass or Channel. There is there an extensive and perfectly sheltered sheet of water on the south side of Point Ramen, where the land is very narrow, and could be cut through at a very moderate expense, and there is nothing to prevent a complete ship canal being made.

As to the advisableness of opening this harbour by cutting through Point Ramen, and so making this the highway to Madras and Calcutta from the Red Sea, instead of going round Ceylon, I have not the least doubt. The charge per ton for it would be quite insignificant. This matter has already been brought before the authorities, but the use of this harbour as a port depends wholly upon the internal communications. At present there is no communication that would be of any use in connection with this port, nothing but common roads, even if those. The completion of the coast canal alone would make this an important port. Unless a large tract of country could be drained to this point by lines of transit at 1-20d. per ton, this port could not be made use of extensively.

The next port is Tuticorin, which can never be an important one, as it is the natural outlet of a very small tract of country, unless the coast canal is continued to it, and then the question will be between it and the sites I next proceed to speak of.

After long consideration of this subject—the best site for a port from which the produce of India can be shipped for Europe—I conclude that Cape Comorin, or its immediate neighbourhood, is the place. There is a harbour, formed by the shelter of small islands, some fifteen miles west of Cape Comorin, where vessels have lately loaded, called Colachul, in the Travancore state, and perhaps this could be made into an extensive first-class harbour. But certainly hereabouts a breakwater could be constructed at a moderate cost, as there is rock at hand. There are a number of advantages in this site. It must be premised that both the west and east coast canals should be extended to it, the latter connecting all the great systems of navigation which are now under construction on the Toombuddra, Kistna, Godavery, and Mahanuddee, with those in the valley of the Ganges, the Rajhmahal, Soane, Grand Ganges, Delhi, and Sutlej works, up to the Punjaub. Lord Dalhousie thoroughly comprehended this subject of cheap transit, and ordered that the East Coast Canal should be completed. The advantages then of this site are these:—

1st. There is a most remarkable advantage in the site itself, in this respect, that it is, no doubt, the one point in all India that has least stormy weather. It is not within the limits of hurricanes, and there is hardly any rain during the south-west monsoon, a most remarkable fact. The monsoon divides at some distance to the south-west, one part striking the west coast farther north, and the other the high land of Ceylon, leaving Cape Comorin in a comparative calm. What little rain falls here is almost all in the north-east monsoon. In this respect, therefore, this site is greatly superior to all others, but especially to Calcutta and Bombay. The risk of ships approaching and leaving an artificial harbour here would be the least of any port in the world. The saving of insurance, &c., here, compared with the present harbours, would be very great. If it were only one-fourth per cent. on cargo of the value of £50 a ton, or 2s. 6d., it would be on a million tons £126,000 a-year, the interest of two and a half millions.

2nd. It is the point nearest the limit of the south-west monsoon, so that a ship steering about 350 miles south would be clear of the monsoon, and could run her westing in smooth water, to where she would make a fair wind of it to Aden. It is thus the nearest, that is, the most accessible point of India from the Red Sea in the stormy season.

3rd. There is not one serious difficulty in the way of a steam-boat canal from Loodianna to this, a distance of 2,700 miles; and by the Godavery river and the Toombuddra it would be open to Nagpoor and Bellary, and by the Burhampootra to the confines of China; and if, as I have suggested, the land line of 250 miles is opened to the Yangtse, the whole interior water communications of that country would be opened to it. Thus, almost the whole interior of India and China might be opened to this point, at a cost of transit not very different from that of ocean; probably less, if insurance is allowed for.

If we take the cost of freight to Calcutta at £2, and allow half of this to be due to port delays and charges, it leaves £1 per ton for the cost of 8,000 miles of ocean navigation, or $\frac{1}{30}$d. per ton per mile. And it is now certain that on long lines of steam-boat canal, fitted for vessels of 200 or 300 tons, the cost of inland transit in India would not much exceed that; even in America, with a much less value of money, the cost of working the Erie Canal, by steam, 350 miles long, is estimated at only $\frac{1}{35}$d. per ton per mile. Thus the whole of India and Central China could be drawn to this point, at a cost certainly less than the difference of insurance, &c., between it and any other port. With respect to the hurricanes, I should allow that one has been felt as far south as Tutucorin, in lat. 9°, and perhaps it even extended to Cape Comorin in 8°, but of this I am not informed, and certainly the occurrence of a hurricane south of 10°, is almost unprecedented, while in the bay of Bengal one occurs every year; and that is a most serious point in the question of harbours. I thus consider this point of a harbour near Cape Comorin by far the most important in the whole question of Indian harbours.

The next sites for harbours are Narrakul, and Alipee on the coast of Travancore, where occurs the strange phenomenon of an absolutely quiet anchorage, without any visible shelter, due, I am informed, solely to the disturbance of the mud outside, by which the water is so thickened that the waves subside before they reach the shore. These, however, can never be important ports, because they are only the outlets of a very small tract of country shut in by the Western Ghauts.

The next point is Ponany, opposite the great breach in the Western Ghauts; and here, undoubtedly, might be the main outlet of India, as the inland navigation could be brought down to that point. But it would have to pass over a height of 1,200 feet, requiring a lockage of 2,400 feet, which, though not a very serious objection, as the cost both of providing and working it would be very moderate, yet it seems to me to turn the scale in favour of Cape Comorin. My reasons for preferring the latter, stated together, are these:—

1st. The absence of hurricanes at Cape Comorin.

2nd. The fine weather there during the south-western monsoon.

3rd. Its being furthest to the southward, and so nearer the southern limits of the south-west monsoon.

4th. The avoiding of 2,400 feet of lockage.

With respect to the construction of a harbour here, it can, of course, be formed, as anywhere else, by a simple line of large blocks of stone parallel with the shore.

Proceeding north we come to the harbour of Carwar, near Sedashegur, well situated near the break in the Ghauts, formed by the river Caulee. This port has been occupied, and some trade has sprung up in it, and it is now the source of a great controversy whether there shall be a railway made from it into the interior or not.

If cheap transit were established with the interior, it would certainly become the seat of a very considerable traffic; but with a railway the cost of transit must be an effectual hindrance to a really large traffic. It is capable of being made an excellent harbour, but to go to any great expence, without providing cheap internal transit, would be a complete mistake.

The great mistake that has already been made about this was its transfer to the Bombay Presidency, by which the influence of Bombay was brought to bear against its being utilised; for, of course, its success chiefly depended upon its diverting so much of the product of the interior from Bombay, and this is the cause of the opposition that is now made to its use. Had it remained under the Madras Presidency it would have had no rival to contend with. I will only say that I have examined part of the line from this port, and have had an account of the remainder from a gentlemen competent to report on it, and there is nothing to prevent a steamboat canal (but with inclined planes at one place, similar to that on the Monkland Canal) being constructed, and which might be extended westward to join the canals of the Madras Irrigation Company in Bellary, by which it would be connected with the east coast and so with the whole system of water-carriage throughout India. It has the advantage of Bombay in being farther south, and so more to windward in the south-west monsoon.

There are two other points, Vingorla and Viziadroog, where lights should be placed and harbours formed between this and Bombay, as valuable harbours of refuge, but which could never be the seat of a great trade, on account of the great barrier between them and the interior.

I must speak of Bombay as the established seat of an immense trade, notwithstanding the great objections to it—viz., 1st. Its situation so far to leeward, with the south-west monsoon blowing with all its fury into the mouth of the harbour. 2nd. Its being within the range of hurricanes, and its enormous size, owing to which combined, great destruction of shipping takes place even within the harbour. 3rd. Its being cut off from the interior by the Ghauts. 4th. Great inconvenience in landing and shipping, owing also to its great extent. The first obstacle is, of course, irremediable, and always causes a great loss both in insurance and in the increased expense of sea transit. The second can be in a great measure remedied by the same work as is required on the open coast—viz., a breakwater, and considering the enormous value of the trade, and the great facilities for such a work, it is wonderful that no such work has been constructed.

Of the £90,000,000 total foreign trade of India more than one-third, or 700,000 tons, belongs to Bombay, so that a single shilling a ton on that, besides all the Indian trade, would give an annual income of £35,000, representing a capital at 5 per cent. of £700,000, and with the same charge on the Indian trade, probably a million, which is certainly much more than could be expended in making the harbour both safe and convenient.

With respect to the third objection, this also is irremediable. An immense sum has been spent on railways for this purpose, but no railways can remedy it. The receipts on the Peninsular Railway were, in 1871, £1,360,000, or per mile on 1,600 miles, £850, which, at an average charge of 1½d. per ton, gives an average traffic of 140,000 tons, not a fifth part of what is required, and what it would be, if there were water carriage at $\frac{1}{20}$d., instead of land-carriage at 1½d. Though therefore Bombay is well worth being made as perfect a harbour as possible, it never can become the outlet of the immense trade of India, when the country is really opened up by cheap transit, and its resources and activity immeasurably increased by a complete system of internal transit. We have to look forward and to provide for, and to create a traffic, not of a million tons, but of ten million tons.

Compare the traffic on the Godavery Canal to Cocanada, the outlet of only about three millions of people, and far from any great city, 160,000 tons a year, with that of the lines of railway leading to one of the greatest ports and a seat of government, averaging 140,000 tons, and thus judge how completely the whole question of harbours is bound up with that of internal transit. If Bombay were accessible to all India by transit at $\frac{1}{20}$d. a ton a mile, its trade would certainly soon be five millions of tons instead of one.

We next come to the harbours in Guzerat. This is, perhaps, the most remarkable point in the whole past history of harbours. I have not visited the harbours of Poshetra and Seraya myself, but we have the very highest authority on this point, that of Captain Taylor, late of the Indian Navy, that they are in every respect first-rate natural harbours—safe of approach, perfectly secure, and with ample depth of water; in fact, the only unexceptionable harbours of India, and better situated as respects the south-western monsoon than Bombay, thus in every way superior to it. But the most curious fact connected with these harbours in the Gulf of Cutch is that they utterly stultify the vast expense that has been incurred in Kurrachee. These harbours are just as well situated for receiving the traffic of the Indus and Central Asia as Kurrachee, and here are ready-made harbours, against one with an insufficient depth of water at the entrance, after spending on it up to the present time £480,000. There is nothing whatever to prevent the completion of a steamboat canal through the whole valley of the Indus, terminating in the very harbour of Poshetra. I must especially call attention to this point. No money can make Kurrachee what these harbours on the east side of the Indus are. I don't know exactly the state of the Indus canals, but I believe considerable progress has been made with them; and nothing but a perfect water communication can give full effect to the endeavours to open up the trade of the Punjaub and Central Asia. Land carriage of 800 miles, from Kurrachee to Attock, with a charge of 2d. a ton, or in all £7 a ton, three or four times the freight from the port to England, will be an effectual bar to a large portion of the traffic that there would otherwise be between Central Asia and England. It is upon this that the whole trade will depend; if we add 800 miles of land carriage to the heavy cost of transit from the interior to Attock, it will probably turn the scale in favour of a western course by land to the Caspian and Russia. The railway from Kurrachee to the Indus was a false start, which has set us all wrong with respect to the Central Asian trade. A steamboat canal could have been cut for one-fifth of the cost of the railway, and the river boats could have gone straight into Kurachee, instead of having to face, as they now have to do, the open sea to get there. What is now wanted, is a complete steamboat canal, of 1,000 miles, from the heart of the Punjab to this harbour of Poshetra, in the Gulf of Cutch, by which the Central Asian traffic can be brought to the ship for 4s., a nominal cost. Such a canal could be cut at present for at most £3,000 a mile, causing a charge of £240 a year, or 1-16d. per ton per mile on a million tons, if the interest were not paid, as it would be, by the irrigation. No wise selection of harbours, and no expense in improving them, will avail to enable India to compete with Russia and America while it is burthened with the cost of land carriage. There is at this moment nothing in the world between England and America in the matter of supplying England with wheat, for instance, but the point of cost of inland transit. The sole reason why wheat reaches England from the Western States, and not from the Upper Provinces of India, is that the former has the Erie and St. Lawrence Canals, and the latter has only land carriage, or very defective water carriage. I repeat, therefore, that the whole question of harbours hangs upon this, of the cost of internal transit.

We now come to Kurrachee, upon which I have already spoken in connection with the Kattywar harbours. Like the Sind Railway, I have no doubt that a complete mistake has been made. The shallow entrance is a serious objection to it, and so far as I can judge from the reports, it seems certain that no money can quite remove this objection. It is at present only 15½ft. at low water in the monsoon. But whatever has been spent on this work cannot possibly afford a reason for not making use of the perfect natural harbours on the other side of the Indus, nor can our having thrown away two millions on the Sind Railway be a reason for our saddling ourselves with a permanent enormous charge for land carriage of 800 miles for the whole of the Central Asian and Punjaub trade—or rather, for that part of it which will exist in spite of such a heavy charge, for by far the greater part of what there ought to be would be prevented by such a charge.

We have thus taken a view of the various harbours and sites for harbours round the coast of India, from the Gulf of Martaban to Kurrachee in connection with the principal tracts of country to be reached, with the natural and artificial means of connecting the tracts with the harbours, and with the lines of communication by sea from the harbours to Europe. I would now add some remarks on particular points. First, it must be most particularly kept in view that we have to provide for an immense development of trade. Even with the small beginning already made in the way of the material improvement of India, in the communications, irrigation, agricultural improvements, education, &c., a great development, both of Indian produce and native demand for foreign productions, has begun, and will rapidly increase, but what has yet been done is comparatively quite trifling. If six hundred millions have been expended on the material improvement of Great Britain, containing 100,000 square miles and thirty million inhabitants, from one to two thousand millions will be required fully to improve India, containing 1,300,000 square miles and two hundred and forty millions of people, and the latter increasing with great rapidity. If we take one district as an instance—that of Godavery, which had only half-a-million expended on it, in irrigation and navigation, with a million of people inhabiting it, we find an increase of trade from about £80,000 to £1,200,000, or fifteen fold—we see at once what a general improvement of the whole country would effect in the way of trade. At this rate even, the trade of India ought to be, in proportion for its whole population, £250,000,000, instead of, as I believe it is, about a hundred and fifty millions including both foreign and local traffic.

We cannot easily conceive what the effect of stimulating this enormous mass of population will be in internal and external commerce. Even in the present inert state of the population the increase of both would be enormous, if the whole country were supplied, like America, with cheap transit, even from that one improvement only. For want of this, nine-tenths of the traffic that would exist is effectually suppressed. With this certain enormous development of traffic before us we are in little danger of spending too much on improving present and constructing new harbours.

This is what I consider the principal defect in almost all our discussions about Indian material improvements. We do not realise what is before us, what will be the effect of arousing 240 millions of people from a state of torpor and inactivity. We are continually making our calculations, based upon the present state of things. Thus, in Godavery, we had not long finished the canals before the traffic often choked them. I have seen a lock worked without a moment's intermission, from morning to night, and a crowd of boats still waiting at dark, and a continual line of rafts for miles together on the canal, and this while the navigation only extended 180 miles from the port. If the whole Godavery had been opened to the populous and fertile country of Hyderabad, Nagpoor, Berar, and the valley of the Nerbudda, the works in the delta would have been utterly inadequate, and duplicate locks must have been added. They have now commenced building new enlarged locks, of 150 × 20 ft., in all the main lines of canal, even before the Upper Godavery navigation works are carried into the populous country.

2. With respect to the construction of harbours. We now know how to make them. It is now discovered that to break blocks of stone into little pieces, at a great expense, in order to render them unfit to resist the blow of the sea without an enormous section is a great mistake, and that we have only to make a line of large blocks, with a very moderate section, to resist the effects of the waves. I have lately seen a report, planning a breakwater exactly on the section of the Plymouth one. Are we to throw away 60 years' experience, and go back to what we did when we had all to learn?

3. I will now go more into particulars with respect to the Madras breakwater. The great question is, what is the movement of the sand along the coast? As I have had long acquaintance with this matter, both at Madras and at Vizagapatam, I may here give some particulars about it. The sand is moved along the coast, not by the current, but by the surf in the south-west monsoon, which, striking the beach rather obliquely, takes it up at one point, and deposits it a little farther north; in this way a continual current of sand is kept flowing along to the northward. There is a very small action of the same kind in the north-east monsoon, in the opposite direction, but the continuance of the stormy weather in that monsoon is so short, and the seas raised are so moderate, that the movement to the south is insignificant. But the quantity of sand moved is not very great. When first I observed the effect of a stone groyne run out from the beach in collecting sand, I was astonished at the rapidity of its extension towards the end of the groyne, but I found its progress soon became extremely slow, and the reason is obvious. The quantity required to extend the accumulation is as the cube of the breadth of it. Thus if it extends thirty yards along the face of the groyne the first year, it will take about seven years to extend another thirty yards, and about twenty years for a third thirty yards, so that a very moderate extension of a groyne will keep it ahead of the sand.

Thus also with a breakwater parallel with the coast, of the effect of which we can now have no doubt, though such a work has not been tried. Its result will be to destroy the surf along the beach from a little north of its southern end, and consequently that carried along from the south end, where the surf continues, will accumulate and form an extensive bank south of the southern end of the breakwater; but if the breakwater is constructed in seven fathoms it would take probably some hundreds of years to approach the end of that work. At the same time, to the north of the work as the surf would continue to act on the beach, while no supply of sand would come from the southward, there would be a constant eating into the beach, and a deep cutting would be produced by degrees, unless the beach there were protected by stonework.

But north of Madras there is an extent of bare sand hill, and probably it would not be worth while to attempt to protect it, as the land is of no value. If, however, the breakwater did not extend to nearly opposite the northern end of the town, so as to protect the whole of the occupied land from the surf, this point would have to be considered, and arrangements made for the protection of the beach. Having now had thirty years' experience in this movement of the sand, there seems no room for doubt respecting its operation.

This is the only part of the question that we need to investigate; all the rest is as simple as possible. It is only to make a straight line, of a very moderate section, with large blocks of either concrete or blasted rock, whichever is cheapest (and I have no doubt the latter will be found so), of twenty to thirty tons weight, in order to make the most perfect harbour in India. The rock can be obtained in any quantity to the south and south-west of Madras, a distance of twelve or fifteen miles; and though there would be considerable expense arising from the frequent stoppage of the deposition, especially during the south-west monsoon, yet I am sure that with an able engineer, competent to plan the vessels and apparatus for the conveyance of large blocks, and with the use of large blasts of 10,000 to 20,000lbs. of powder, the cost per ton will be very moderate. But of course all will depend upon having an engineer who has the peculiar talents for organising such an operation, or will make use of men who have it—such a man, for instance, as Mr. Fouracres, formerly employed in the Godavery Delta Works, and now in the Soane Irrigation, and who has introduced such admirable apparatus for various operations there, would no doubt arrange for the execution of this work at half or a quarter of the expense that would be incurred by an engineer without that peculiar talent. That this work could be executed for £300,000 or £400,000 I have no doubt, and the interest of this would be a charge of only 4d. or 5d. a ton in a trade of a million tons.

4th. But the most important, and the fundamental point in this matter is the absolute necessity of a Marine Department. How strange it seems that this should not have been long ago established! At length an Agricultural Department has been organised, and how could anything approaching to an efficient management of that which occupies nine-tenths of the population of India be hoped for without a department which had nothing else to attend to, with a man at the head who had the peculiar turn and talents required for such a charge? And, surely, the very same line of argument that has led to this decision is equally applicable to the requirements of the ocean traffic of India. It is impossible that the subject of harbours, and all connected with them, can be either properly understood or properly cared for, without a man being set apart for it who shall have nothing else to attend to, and with a competent body of subordinates attached to him This is the grand point which I would beg especially to submit for the consideration of this Society, as one which assuredly falls within the limits of its most beneficial self-imposed duties.

I don't know of anything more important in which they could take the initiative. And, in connection with this, I cannot help referring to the abolition of the Indian navy; it seems to me to have been, perhaps, the greatest of all the mistakes that have been made in our management of India. By what process of reasoning the conclusion was arrived at, that the country must be put to the enormous expense of pensioning this whole service, as if it was a pest that must be got rid of at any cost, is entirely beyond my imagination. The loss of such a body of men, thoroughly acclimatised, content to pass their lives in the terrible climates of the Persian Gulf and Red Sea, thoroughly acquainted with every rock and sandbank, every wind and current, and every tribe of men in those seas, cannot be estimated; and this would now be found the greatest difficulty in forming a Marine Department. But if a search was made, no doubt many of those men would be forthcoming, and would be found quite fit for many of the requirements of such a department,—though it is a fact that many of the most valuable men of that service are now holding, in addition to the pensions paid to get rid of them, appointments of very great responsibility, and requiring the best qualifications, and these men of course cannot be recovered and restored to India.

The abolition of this service would seem to indicate such misapprehension of the importance of the marine affairs of India as to call for the interposition of the Society, as the body most able to press the question upon the consideration of the proper authorities. Till such a department is established, nothing but a series of neglects and mistakes can be expected. Local interests will decide the question *for* one place, as in the case of Kurrachee, and *against* another, as in that of Carwar, without a real and unbiassed investigation, and neglect the claims of harbours like those in the Gulf of Kutch, *in which nobody is personally interested.* I don't mean to say that in my judgment nothing should have been done to the harbour of Kurrachee, or that everything should be done to that of Carwar, but this I say, that in all the discussions respecting these ports, and in the entire absence of any notice of the excellent harbours of Kattywar, so complete in themselves, and so perfectly situated for the outlet of the trade of the Punjab and Central Asia, there is shown a palpable want of an independent tribunal which could take an enlarged view of the wants and resources of the country, and should be able to decide according to the requirements of the whole community, and not sacrifice them to the interests of small bodies. The question is not what the interests even of the vast body of Bombay merchants, native and European, demand, but what is best in these matters for the population of India and England.

I must add some remarks on the expenditure required for harbours. Ten millions would go a long way towards supplying India with extensive and effective harbour accommodation, and why should we be afraid of such an expenditure? The present debt of India is 110 millions, with interest of five millions a year, besides the railway charge, which, including interest on cost of land and debt, is now three and a half millions, representing in proportion a further debt of eighty millions, or, in all, 190 millions, with interest amounting to eight and a half millions, or one shilling per head of population per annum for 160 millions. If, to compare this with the debt of England, we allow for the difference in the value of money threefold, it gives three shillings a-head. The interest of the English debt is 26 millions, or sixteen shillings a head, five times as great; so that if we borrowed money to the extent of 760 millions for public works India would be only on a par with England as to debt; but with this essential difference that the capital would be spent, not on wars, but on remunerative works, which directly and indirectly would certainly return at least twenty per cent. if judiciously expended, and so, instead of being an additional burthen, it would be an immense increase of income. The demand, therefore, for a few millions for harbour improvements ought not to be considered an obstacle to that work, and the cost of a marine department is as nothing in the question.

I have shown that the saving of a single shilling a ton in insurance, port expenses, &c., even on the present small trade, would represent a capital of six and a-half millions. My views, therefore, on this subject lead me to urge the following as the leading points in this matter:—1st. The necessity for a separate marine department, with some person at the head of it who is capable in some measure of comprehending this extensive subject, and would be independent of local biases. 2nd, That we have to provide not for the present trade, but for an enormous future extension of it. 3rd. That the expenditure, both in improving present harbours and the construction of new ones, ought to be on a scale far beyond anything hitherto allowed. 4th. That the most complete and well-planned system of harbours will be utterly ineffective unless combined with cheap internal transit, and that this can only be effected by steamboat canals.

In this paper I have not touched upon the important point of harbours of refuge, which yet is an essential part of the subject, whether considered only with reference to saving of life, or also as a saving of money in the diminution of sea risks, but this would, of course, come under the consideration of a marine department.

DISCUSSION.

Captain Taylor said the question of harbours might be considered from three points of view; from the land side, from the sea side, and again, as the civil engineer who had to make the harbour looked at it. In the first place, produce must be brought down to the harbour; in the next, the ships must come for it; and, in the third place, the harbour must be there to accommodate both. Beginning where Sir Arthur Cotton had ended, with Kurrachee, it was absolutely necessary that something should have been done there. There were two excellent harbours in the Gulf of Cutch, Poshetra and Seraya, which were to some extent his own *protégés*, but he cheerfully allowed that Kurrachee ought to have the pre-eminence, because it was really the seaport of Scinde and the Punjaub. The ports in the Gulf of Cutch were first-rate natural harbours, but they belonged to a native state, and that seemed to prevent their adoption and improvement by the Government. No doubt they were the natural outlets for the cotton of Kattywar, and it was surely a great mistake to carry cotton by railway to Bombay for shipment, while the ports he had referred to were so much more accessible. It was the fashion to talk of Bombay as the finest harbour in India, but it was in fact too large to be safe, as was proved by the fact of innumerable vessels being lost in it during a cyclone. Kurrachee, though a small harbour, was perfectly safe, at any rate when a vesel got inside, and as it was now being improved, probably larger vessels would be able to get in. No doubt dredging would have to be kept up, but that seemed a necessity everywhere. Mr. Robertson, a civil engineer who was sent out to report on the harbours of India a year or two ago, spoke of making a harbour at the extreme south, at the Paumban Pass, and proposed to cut a canal through Rameserum Island, suggesting that ships would then be able to lie alongside the banks of the canal and there discharge their cargo; and he said it was rather remarkable that if this scheme was carried out, the canal would be the only point in the peninsula of India, not excepting Bombay, where a large vessel would be able to land and discharge her cargo without the intervention of cargo-boats. He (Captain Taylor) could only say, the more shame for Bombay; she assumed to be the commercial capital of India, and yet allowed her harbour to remain almost as nature made it. Sir Arthur said it could be rendered more safe by reducing the area by means of breakwaters, and this was no doubt correct. In fact, the best parts of the harbour had not been utilised. Coming down the coast to Carwar, it was another of his children, he might almost say, as he surveyed it and brought it into notice, and he quite agreed with Sir Arthur that it was a mistake to transfer it from Madras to Bombay. Of course at that time the Suez Canal could not have been anticipated (although a brother officer of his in the Indian navy did predict it fifteen years ago), but apart from this consideration, Carwar should have remained attached to Madras, which wanted a port, and would have done everything for it; but being transferred to Bombay the merchants there could not see how their interests would be furthered by anything done at Carwar; so there were continual squabbles going on, and the Carwar railway still remained in abeyance. He need not refer to Goa, or any Portuguese ports in India, because their best port was not equal to Carwar. Beypore had not been mentioned by Sir Arthur, but it was one of the greatest mistakes which had been made. There was a railway from Madras to it, but it was a wretched little place, and money never ought to have been spent upon it. It was well said that the railway began in a boat at Madras and ended in a canoe at Beypore; and as to getting any traffic there it was absurd. Next came Ponany, and there it was simply an engineering question. No doubt there was a remarkable saddle in the hills, abreast of it, and something might be done, but he should not like to recommend a breakwater there. Next came Colachul, in the Travancore State, where, again, was the drawback of its being in a native Principality, and therefore the Indian Government could not deal with it, otherwise it would be a very valuable place as a port, and a good deal might be made of it. He had pointed that out to Mr. Ballard, the British Resident in Travancore, and since then some British ships had gone there, and, it was said, they sailed amongst the rocks and anchored to leeward in perfect safety; but, unfortunately, the place had never been surveyed, and captains had to depend entirely upon native pilots. This was spoken of by Sir Arthur as Cape Comorin, though it was about twenty miles to the west. Cape Comorin was the most southern point in India, and Colachul was about twenty miles to the west. With regard to relative distances of places on the coast from Aden, in laying down tracks for vessels he found there was very little difference between Cape Comorin and Bombay, in the time occupied in reaching Aden. Cape Comorin might be, perhaps, 500 miles nearer, but taking the average direction of the south west monsoon on that coast it made very little difference whether you started from Comorin or Bombay in an ordinary vessel, certainly not more than a day or a day and a-half at the outside, and against that must be placed the transit of produce down to Cape Comorin for shipment. With regard to the Paumban Pass, that was a proposal of Sir Arthur's own many years ago. Mr. Robertson proposed to cut a canal through the island of Rameserum, while Sir James Elphinstone wanted to cut through Point Ramen, a little sharp point which jutted out from India towards Ceylon, and this proposal he should adopt, because if a canal were cut through it there would be a beautiful harbour ready on the south side. This was allowed by Mr. Robertson in his report, and if ships were brought alongside the canal so as to discharge their cargo at the quay, it would be discharged on the main land of India itself, whereas, if Mr. Robertson's canal were cut through Rameserum Island, it would be twelve miles away from India; he should, therefore, always give his voice in favour of Sir James Elphinstone's plan of cutting through Point Ramen, which opened into a very excellent harbour on the south side. There was another point to be considered, that the harbour on the south side was to the windward of Adam's Bridge, a chain of rocks and sand which ran across from India to Ceylon. Now Madras was to the leeward of it, and if you left Madras you must either go through the Paumban channel, or else make the whole circuit of Ceylon. This port being to the windward of Adam's Bridge was a great advantage, as the ship could start at once on her homeward voyage, as she would from Madras. She would have to pay canal dues for going through the canal, but if she passed round Ceylon she had to pay the penalty of passing through the monsoon, and the consequent wear and tear would perhaps more than counterbalance the saving of dues. At Madras it was a moot point whether a breakwater or an enclosed harbour would be best, but that he thought might be safely left to the decision of Government. The harbour of Coconada (or Coringa) was very muddy, but the mud constituted its protection, just as it protected the ports of Narrakul and Alipee, and it was extraordinary how in a gale of wind the mud was stirred up like treacle, so that by the lead you could hardly tell where the mud began and the water ended, it was so thick. It was always safe, though the port was constantly moving to the north, in consequence of the silt from the Godavery meeting the ocean current, which at the time of year when the greatest quantity came down, set to the north. Cuttack, or False Point, was precisely similar, and very little could be done in an engineering way, either at Coconada or Cuttack, and in consequence of the mud he had referred to, the cargoes would always have to be taken off in boats. He entirely agreed that mistakes had been made in the matter of railways, by encouraging them to the exclusion of canals, which would in many instances have been better adapted to the wants of the country. With regard to Kurrachee, there was water communication all down the Indus, coming within three miles of Kurrachee, so that if this short distance were got over there would be free water communication between the harbour and the whole delta of the Indus. He thought there was no doubt, therefore, that the outlay required for this purpose would be repaid. At present the river boats had to face the open sea before they could get to Kurrachee. He had seen a plan for a railway to run right down the west coast from Bombay to Cape Comorin, and then up the east coast to Calcutta. Considering that such a route would have to cross a river about as large as the Thames about every ten miles, he thought that if there were enthusiasts about canals, there were also remarkable enthusiasts about railroads! As Sir Arthur had stated, nature had provided water communication three-fourths of the way from Bombay to Cape Comorin, and he thought an enlightened Government might easily find a way to complete the distance, and the same from Cape Comorin to Calcutta. It only required a few short spaces to be cut here and there, and then the communication would be completed. But there was another question still. Who wanted the harbours? Whilst endeavouring to excite interest in the harbour of Madras he spoke to some shipowners here on the subject; but he ascertained, indirectly, from one of the largest shipowners, that if there were to be port dues, however trifling, the shipowners did not want harbours, because they insured their ships. The shipowner was different from the owner of the cargo, and the latter had to provide for landing it, so that shipowners did not want harbours. No doubt sailors wanted harbours, although, in the *Nautical Magazine* of last month, he read an article arguing that if harbours were improved, and ships made so safe that there would be very little risk of loss, seamen would lose their pluck, and there would be no more bold British seamen left! Merchants also would be glad of harbour accommodation, because they liked to get their goods away as cheaply as possible, but unless the goods could be brought down cheaply to the harbour, they would not be used after all.

Mr. Andrew Cassels thought that Bombay had been rather hardly treated, both by Sir Arthur Cotton and Captain Taylor. He had lived there a good many years, and had a good deal to do with trade there, but had certainly not been aware of its being so dangerous a port as was now represented. No doubt accidents had occurred there from cyclones, but a great deal more damage had been done at Calcutta, far away from the sea, from the same cause. Bombay had become the centre of an enormous trade, and it hardly would have been so if the harbour had been so dangerous as Captain Taylor had described. Again, Sir Arthur Cotton seemed to think that Bombay was jealous of Carwar, and that it was a mistake on the part of the Madras Government to hand over that port to Bombay. He could assure that meeting that in the minds of the Bombay merchants there was not a particle of such poor jealousy; but they said this—make it what you please, Carwar will never be anything but a subordinate port to Bombay. The greatest market was the one which would always draw cotton from all parts of the country. From Bombay there were steamers starting continually for England, the Continent, Russia, and all parts of the world, and the same facilities could hardly be expected at Carwar, in fact, at the present time, cotton was being carried from the neighbourhood of Madras to Bombay, instead of being shipped at Madras itself, because the owners believed that at the larger market they would have a better chance of getting a good price for their produce. Kurrachee had been spoken of rather slightingly, and he confessed that until the last few days he had held much the same opinion, and thought a great deal of money had been thrown into the sea there. But very recently he had met with a Bombay merchant, lately returned from that district, who told him that the works at Kurrachee had been admirably well executed, and that it had really become a promising port. He thought such evidence could not be slighted. He had followed Sir Arthur with the greatest interest in his paper, and had learnt a great deal from it, and thoroughly agreed with him that India required a marine department. He believed that if half a million a year, for ten years, were spent on the harbours of India, it would be money well laid out, and that the dues, in one shape or another, would go very far towards paying the interest on any outlay of that kind. Although Bombay had no canals to bring produce to it, yet the railways converged there from all parts, and, as far as he knew, it was one of the finest ports in the world—one of the finest situations for trade, and he should be very much surprised if it did not become, in a still greater degree than it was at present, the commercial capital of India.

Mr. Hale said it seemed evident from the paper that certain material wants of India were much neglected. But unless it were known what proportion of the insurance was due to the dangers of the harbours themselves, it was impossible to speculate as to whether the outlay for improving them would be at all recouped by a reduction in insurances.

Mr. Saunders desired to bear his testimony to the importance of the concluding portion of the paper, referring to the loss of the Indian marine service. When India was transferred to the Crown, it was thought that one Admiralty was enough for one empire, but it must have been forgotten that the duties of the hydrographic office of the Admiralty especially related to the supplying of surveys and charts for the use of the Imperial navy, and that it was quite useless to expect any attention to be paid to the necessities of India. What had occurred since was amply sufficient to show that the Admiralty organisation was totally inadequate for the purpose. Its objects were too wide, and its immediate purposes too specific to admit of its giving to India the special attention which its great importance demanded. The interests of 200 millions of people, with something like 500 harbours, on which depended an immense maritime trade, deserved special attention from its own Government. It had been found in the case of our colonies, that especial marine surveying officers had to be appointed to meet their wants, the Admiralty not by any means meeting them. Since India came under the government of the Crown an organisation of periodical steamers had been introduced between India and Europe, bringing the produce of an immense country, reaching from Bagdad on the one side to the China seas on the other, and the interest of such a commerce as that, developing so rapidly as it did, demanded that more attention should be paid to the harbours than ever was paid by the old Court of Directors. Instead of that, no attention whatever was paid to the subject, notwithstanding it was so important in the interests of human life, which could not be covered entirely by insurance, without reference to commercial considerations. On the western coast it constantly occurred that vessels were lost off the ports, simply because there were no lights to enable them to make the port in a storm; and not long ago the newspapers contained a lamentable account of the loss of a large ship within about twelve miles of a port quite sufficient for her protection if she could only have made it, but there were no lights by which she could direct her course, and consequently she foundered. There was one difficulty about the case—that it was not a subject which landsmen could be expected to take very great interest in; and when it was last pressed upon the government of India, it was met by the appointment of a marine secretary, but all he could do was to register what occurred, and he had no power to do anything; no staff, nor any means of carrying out anything he desired. It was of the utmost importance that a surveying service should be instituted, and that careful registers should be made of the movements taking place on the coast of India, and this would afford abundant employment for the marine service if it were established on a thoroughly efficient scale. He hoped, therefore, that the Society would take the matter up and press it on to a settlement. He was afraid they would have no harbours without capital, and it seemed to him that the relation of capital to this subject had hardly received sufficient attention, except at the hands of Mr. Cassels. The experience of the Government with regard to the construction of harbours had been rather unfortunate in consequence of neglecting this consideration. They set to work to form a port, which they dignified by the name of Port Canning; a railway was made to it, and it was expected to be a great success, but at last it had to be definitely closed. The merchants of Calcutta remained where their capital was invested in warehouses and counting-houses, and would not abandon them in favour even of Mutlah, and the same occurred in other parts of the world. Table Bay was one of the worst harbours that could be imagined, and a little further to the northward there was a magnificent harbour, capable of accommodating all the fleets of the world. One would have thought that means would have been taken to promote the development of that harbour; but the merchants of the Cape were settled at Table Bay, where they had their warehouses and capital invested, and they all set their faces against this fine harbour to the northward, because they could not put their property on trucks and move it; so it was at Bombay. So long as the capital was concentrated there it would exercise a preponderating influence on the trade of the whole region surrounding it, and he was not at all surprised to hear that it drew a large amount of traffic, even from Madras. It had been said that some mistake had been made in the selection of Carwar as a port for the outlet of cotton, and there were mercantile interests at a place called Coomptah that did not at all approve of the movement of trade to Carwar. These things must be considered whenever the question of investment of Government funds arose. With regard to the Paumban Pass, it seemed a remarkable way of setting to work with reference to a gigantic operation like the improvement of harbours, instead of having a regular service, giving information of the changes taking place on the shores, and so having a foundation upon which to act, to send out a civil engineer to spend two years running up and down, confessedly without time to give that attention to each local interest which it demanded. It must be remembered that there were other great questions involved besides that of keeping out the sea. There was the question of how the ship was to get in and out, and these involved nautical considerations, and it seemed to him that to propose any operation of this kind without making nautical men responsible in the first place for what was wanted, and then leaving a civil engineer to execute it, was a very grave omission.

Sir Arthur Cotton, in reply, said the figures he had given were only a rough calculation to give an idea of what it might be worth while to spend on the improvement of a harbour. If the rate of insurance turned at all upon the dangers of the Indian Ocean and the sands in the Hooghly, it would be worth while to improve the harbour in order to reduce the rate of insurance. He had had some curious experience himself of Indian harbours. For instance, once he was running into the mouth of the harbour at Bombay, when the vessel missed the mouth of the harbour, had to turn round, and with an iron bound coast under their lee they had to pass through the first burst of the south-western monsoon—a more awful night he never passed. On another occasion, when entering the Madras Harbour, he could not make the captain believe the terrific rate at which the current was running; they missed the harbour by three miles, and were no less than 18 days getting in, the whole of the time being exposed to the force of the north-east monsoon. Again, when running into the harbour of Coconada, the captain, an experienced officer, said he knew perfectly well there was a hurricane in a certain direction, but they had the land under their lee, and there was no harbour of refuge within 200 or 300 miles, and he had to run right through the heart of the hurricane rather than go ashore. Once more, in going to the mouth of the harbour at Rangoon, they were run up high and dry on the middle sand, the ship lay over right on her side, and it was a narrow escape that all on board were not lost. Having had such practical experience of the harbours of India, he had been led to attend to the subject wherever he had been engineering on shore, and he quite agreed with Captain Taylor that there were three points to be considered at every harbour—the land side, the sea side, and the harbour itself. It was impossible that these matters could be fully and fairly discussed until there was an independent department with nothing else to attend to, which could investigate the whole question, and bring their skill to bear upon it independent of any personal or local bias.

The Chairman, in proposing a vote of thanks to Sir Arthur Cotton, said no one could have been better qualified to bring this important matter before them, and they must all agree with many of the propositions which he put forward. In the first place, it was of immense importance that a department should be established for the study of everything connected with harbour accommodation. He was not aware of the reasons which led the Government to abolish the Indian navy, but if what Mr. Saunders said was true, that nothing was being done in the direction of surveys since the abolition, it seemed a very serious responsibility to rest upon the Government of India. The next proposition was equally important, that the question of harbour accommodation was inseparable from that of internal transit. If a harbour was not the natural outlet of a large tract of productive country, it was simply wasting money to attempt to improve it, whereas a large expenditure might be wisely incurred, even on an indifferent harbour, which was the outlet to a large district. Following out the idea, Sir Arthur had recommended the formation of a harbour at the southern point of India, and if it would have the qualities he stated it was a very important matter, and well worthy the consideration of the Government. No doubt it ought to be connected with water carriage with all the rest of India, and in that case the whole produce would come in that direction, and would find a speedy road home by way of Aden and the Suez Canal. Three persons had been spoken of connected with the harbours, namely, the sailor, the landsman, and the harbour engineer. It appeared to him that there was a fourth also to be consulted equally important, namely, the Chancellor of the Exchequer. Whilst condemning the harbours of Calcutta, Madras, and Bombay, Sir Arthur was bound to admit that they all were places to which trade would find its way, and that something should be done to improve them; but, with regard to the Madras breakwater, he believed Mr. Robertson put the expenses at a million and a quarter, which was a very serious sum, especially as Captain Taylor stated, in one of his reports, that he believed that no breakwater would be of any use.

Captain Taylor said the evidence taken on the subject showed that when sailors were asked about it, they said that they would rather be outside the breakwater than in.

The Chairman said this showed how careful the Government must be in expending money on this class of works, on which there were so many diverse opinions. Again, with regard to the Paumban channel, there were three or four different routes recommended, and great care must be taken not to spend public money in any one but the best, though it was evident that an immense saving of time and distance would be secured by such a channel. With regard to the Kurrachee harbour, according to a report dated March, 1873, by Mr. Parkes, the engineer superintending the works, it had cost up to the present time £480,000, and the depth of water at the entrance was 20 feet at low water, and he was confident that that depth would be maintained. There was 25 feet at half tide, 26½ at high water, and 28½ at high water spring tide. He also stated that it would be always open from November to June inclusive. It would admit large troop ships, and this was an important consideration with regard to the defence of the northern frontier. As had been mentioned, with some harbours there was this difficulty, that they belonged to native States, and, therefore, the Indian Government could not very well deal with them, and he thought, therefore, that, practically, the duty of the English Government was to do what it could to improve the harbours already existing.

The vote of thanks having been carried unanimously, **Mr. Cassels** proposed a similar compliment to the Chairman, which was seconded by **General Vaughan**, and carried unanimously.

TWENTY-THIRD ORDINARY MEETING.

Wednesday, May 21st, 1873; Admiral the Right Hon. Lord Clarence Paget, K.C.B., Member of Council, in the chair.

The following Candidates were proposed for election as Members of the Society:—

Banner, Edward Gregson, 11, Billiter-square, E.C.
Cousins, Walter Cornelius Arthur, 11, Lawson-street, Great Dover-street, S.E.
De Losada, Don Norberto Rodriguez, K.C.I.C., 105, Regent-street, W.
Elmslie, E. W., 5, Great Winchester-street-buildings, E.C.
Lewis, William Thomas, Bute Mineral Estate-office, Aberdare.
Lloyd, Wilson, Darlaston.
McClelland, Andrew S., J.P., 140, St. Vincent-street, Glasgow.
Mann, Colonel R. I., R.E., of Jamaica, care of Messrs. Cox and Co., Craig's-court, S.W.
Milne, Samuel, Burton Joyce, near Nottingham.
Morrison, Henry M., Longsight, Manchester.
Norfolk, Richard, Beverley, Yorkshire.
Taylor, Rev. J. W. A., Headington, near Oxford.
Wedgwood, Joseph James, 19, St. George's-terrace, Queen's-gate, S.W.
White, Timothy, Charlotte-street, Blackfriars, S.E.

The following Candidates were balloted for and duly elected Members of the Society:—

Baker, William, 46, High-street, Sheffield.
Dick, Alexander, 110, Cannon-street, E.C.
Turner, Walter James, C.E., Town-hall-chambers, New Market-street, Bradford.
Watts, Joseph, Fulshaw-park, Wilmslow, Cheshire.
Whiteman, R. H., M.D., Hotham-house, Putney.

The paper read was—

ON SOME RECENT PROCESSES FOR THE MANUFACTURE OF GAS FOR ILLUMINATING PURPOSES.

By T. Wills, F.C.S.

During the last two years various causes have combined to make the time a very favourable one for the introduction of new schemes for the manufacture of gas. Amongst these causes the following may be mentioned:—First, the fear (although to a great extent perhaps groundless, yet, nevertheless, frequently expressed) that our supply of coal will be gradually lessening, and that, at no very distant date, it will become so curtailed as to increase its value to a formidable extent; second, the tendency of the coal market to push the price of coal up, to an extent out of all proportion to the necessity, has also created uneasiness; and third, partly in consequence of this, although it must also be said, partly on account of a wide-spread suspicion of mismanagement, gas companies have avowedly lately been occupying an exceedingly difficult position (a position immediately recognised and very soon taken advantage of by their *employés*), with no great prospect which could inspire hope for the future. Again, the great prosperity of the country, and the free circulation of money, coupled with a comparatively small number of safe and lucrative investments, have to a great degree been the motive power of many schemes, which, without their aid, would have had considerable difficulty in fighting their way into public notice. There is one other cause lending its tendency in this direction, which, though perhaps only entertained by a few, is yet continually growing in importance, and that is the belief that the present mode of gas manufacture is wasteful and unscientific, and only at the best a poor method of obtaining the desired result. To those who have not realised this fact, it is only necessary to point to the very small amount of the hydrogen and carbon contained in the coal which find their way into the gas; to the large number of bye-products obtained in the process—bye-products which, it must be remembered, although themselves valuable, and daily increasing in value, are produced and disposed of only because at present it is impossible to prevent their formation, and which should consequently occupy quite a secondary position; and to the existing imperfections in the apparatus used in the purification, storage, and distribution of the principal product.

The present paper takes into consideration two or three of the most important of these new processes. It is intended to examine them by the light of scientific facts, and to say very little about the commercial merits or demerits of any particular scheme or schemes, although it cannot be overlooked that the one has a very important bearing upon the other. To do even this satisfactorily, it will be necessary to review briefly the chemical and physical laws which are called into operation in the manufacture of gas, and also to give a short description of the apparatus at present employed for this purpose.

The organic origin of coal is, at this time, an undisputed fact; and we recognise, in the black carbonaceous mineral, the decayed and partially decomposed remains of a luxurious tropical vegetation, a vegetation as far excelling, in extent and rapidity of growth, the present growth of the tropics, as that does the more moderate growth of the temperate regions. This being so, in order to arrive at a correct knowledge of the nature and constitution of coal, we must go back to the stems, tissues, and foliage of the plants and trees, the growth and death of which has given us our coal measures.

The number of elements entering into the constitution of such vegetation is exceedingly limited—at the most four—yet the arrangement of these four is so complex that it is at times impossible to perceive in what manner they are united. This complexity of arrangement is peculiar to organic compounds, and as a rule stamps them as being the product of some vital energy or force.

Woody fibre, viz., that part of the plant or tree which gives to it its form and shape, we know contains the elements carbon, hydrogen, and oxygen, and we also know the amount of each which enters into its constitution, but the exact manner in which the three are united to each other is unknown. Now, when any complex organic body is left to itself to decay, in other words, to become oxidised, the tendency is for it to resolve itself into simpler compounds; and if the decomposition goes on to completion, the carbon and hydrogen will each unite with oxygen, to form the most stable compound which they possibly can with that body, viz., in the case of carbon, carbonic acid ($C O_2$), and of hydrogen, water (H_2O). If the fermentation or decay be arrested at some intermediate stage, then compounds will be formed less complicated than the original woody fibre, but still more or less removed from the final result, according to the stage at which the action was stopped. The decomposition of this woody fibre has proceeded to a considerable extent in coal, a portion of the carbon and a large portion of the hydrogen having gone off in the form of marsh gas (fire-damp), and a further portion of carbon, together with the oxygen, as carbonic acid, while a third portion of carbon has been separated in its elementary state. We are able to trace this action through several stages, which will be more distinctly seen from the following table, in which the amount of carbon is kept up to 100 in the several carbonaceous materials :—

	Carbon.	Hydrogen.	Oxygen.
Wood	100	12·18	83·07
Peat	100	9·85	55·67
Lignite	100	8·37	42·42
Bituminous coal	100	6·12	21·23
Anthracite	100	2·84	1·74

Here, not only are we able clearly to trace, by the analysis of these substances, the changes through which they have passed and are passing, but their physical appearance and structure fully confirms this evidence. Thus, in peat, the structure of woody fibre is recognisable at a glance; in lignite and bituminous coals this structure is not so clear, but still unmistakable; while in anthracite or stone coal nearly all trace of it is gone. This slow decomposition or fermentation may be regarded as a slow burning or combustion, viz., a union of the matter of the wood or coal with oxygen, and it is attended with the same result.

If, instead of slow fermentation and decay of the wood into coal taking place, the wood had been burned at once, practically the same result would have been obtained; the elements of the wood would seek to place themselves in a much simpler relationship to each other; the various changes would have been gone through more rapidly, but the final result would be identical with that of the previous case, viz., the production of water and carbonic acid. Here also there are many intermediate stages. Combustible gases are formed in abundance, together with tarry and oily matters, composed of carbon and hydrogen, and it is only by the further burning of these that the complete decomposition is obtained. What is true here of wood is also true of coal itself, if it be taken as the starting point, more particularly, however, of those coals which still contain a fair proportion of hydrogen and oxygen.

In each case the more intense the heat, the more rapidly does the decomposition proceed, or, in other words, the quicker does the combustion take place. Further, the more complicated the structure of any particular substance, the more readily will it be split up by the action of heat, provided that its constituents can exist in a number of simpler states, which in carbon compounds and organic substances is invariably the case. In the above instances it is supposed that the wood or coal is heated in air, but it is evident that we may prevent the access of air to the heated material, and by so doing we can arrest the decomposition of such material before the final stage of decomposition, as the only oxygen present will be that given off from the substance, which will in either case be insufficient for the complete combustion of the carbon and hydrogen. If the substances be heated under such circumstances, a number of compounds of carbon and hydrogen will be formed, simpler than the original wood or coal, but still having a considerable complexity of constitution.

This resolution of complex bodies to simple forms, under the influence of heat, out of contact with air, is termed destructive distillation, and is the process invariably employed in the manufacture of gas directly from coal. Thus it will be seen that the possibility of making such gas depends in the first place upon two things:—

1st. The great complexity of organic bodies, especially vegetable matter, and consequently coal.

2nd. The power which the elements constituting such substances possess, of forming a number of simpler bodies (some of them gaseous) when heated out of contact with air.

Although it is perfectly true that we cannot, in the process of destructive distillation, burn up our carbon and hydrogen into carbonic acid and water, for the want of the necessary oxygen, yet we may even go further than this, and reduce the carbon and hydrogen to their elementary condition, if the heat be only sufficiently intense, and it may be mentioned here that the reason why the experience of gas-engineers has always shown that a higher temperature gives a greater yield of gas per ton of coal, but gas of lower illuminating value, is to be found in this tendency of the carbon and hydrogen gradually to resolve themselves, under the influence of heat, into simpler and yet simpler products, until eventually a temperature is reached at which the greater portion of the carbon is deposited, and the hydrogen goes off in its elementary gaseous state.

The following Table, in which the proportion of hydrogen is maintained at 100, illustrates this point.

Table, showing the proportion of Hydrogen and Carbon in Coal Gas distilled at different temperatures.

Temperature.	Hydrogen.	Carbon.	Name of gas.
Dull red heat ...	100	614	Principally olefiant gas (C_2H_4.)
Red heat	100	580	
Bright red heat	100	472	Olefiant gas (C_2H_4) mixed with marsh gas ($C H_4$).
White heat	100	325	Marsh gas ($C H_4$.)
Continued white heat...	100	7	Nearly pure hydrogen, carbon deposited,

The number of well-known intermediate products obtained during the destructive distillation of coal is very large, and it is extremely probable that there are many that have as yet escaped observation. The subjoined table enumerates the principal of these products, as well as the physical condition in which they exist at ordinary temperatures. It seems scarcely necessary to say here, that these are true products, and in no wise educts, that is to say, they had no previous existence in the coal.

Gaseous.

Hydrogen
Marsh gas
Acetylene
Olefiant gas
Propylene
Butylene
Carbonic oxide
Carbonic acid
Nitrogen
Ammonia

Liquid.

Water
Benzole
Toluole
Cumol
Cymol
Aniline
Picoline
Bisulphide of carbon

Solid.

Paraffin
Naphthalin
Paranaphthalin
Pyrene
Chrysene

These products are here represented as isolated and existing by themselves, but, in reality, they are found mechanically mixed in the rough materials obtained during gas distillation; practically, the result of this distillation consists of only four products:—1st. The coke which remains upon the bed of the retort in which the coal is carbonised; 2nd. A light, watery fluid, which contains some of the more soluble gaseous substances dissolved in water; 3rd. A pitchy or tarry substance formed of the liquid and solid products, the lighter portion of which contains the liquid oils and naphtha; and finally, the gaseous bodies, together with which is always found more or less of the vapours of the more volatile liquids.

As the hydrocarbons become richer in carbon, and proportionately poorer in hydrogen, the tendency is for the substance to assume the liquid state; and if this excess continues to increase, eventually to become solid. Thus, olefiant gas is C_2H_4; benzole (a liquid), C_6H_6; while naphthalin (solid) is $C_{10}H_8$.

It is advisable here that we should look a little more closely into the physical condition of some of these bodies, as upon this depends the success, or want of success, which attends many of the new schemes.

The solid liquid and gaseous states of matter are not divided from each other by any sharp line of division, but gradually pass from one to the other by insensible gradations; this is evident to us in the case of solids and liquids, for we are acquainted with many bodies which cannot fairly be placed in either class, and to which the term viscous may appropriately be applied; not so evident, but still observable, is a state of matter bearing a relation to the liquid and gaseous states, such as viscous bodies do to liquids and solids; and, from such and other evidence, we regard gases as being the vapours of liquid bodies, more or less removed from the boiling points of such bodies.

A perfect gas would be defined as possessing the condition of perfect fluid elasticity, and presenting under a constant pressure a uniform rate of expansion for equal increments of heat, but it seems probable that this theoretical definition is never absolutely realised, for although we still speak of a few gases as perfect, and represent them therefore as fulfilling the above law, yet all analogy and previous experience would indicate that eventually even this statement will have to be modified. The term vapour was for a long period a term for a distinct class of gaseous substances, viz., those which could be made to assume the liquid condition; but, by the investigation of many experimenters, led by Faraday, this point is at present only a question of the adequateness of the means employed, and hence this term may now be used in a much wider sense, and may include all gases whatsoever, for that these are but the vapours of liquids possessing exceedingly low boiling points, appears to be distinctly proved. All liquids whatever, at all temperatures, give off certain quantities of vapour from their surfaces; the amount thus given off differing for different bodies and for different temperatures; if the liquid be enclosed in any vessel, the vapour will exert a certain pressure upon the sides of such vessel, and this pressure will vary with the temperature, being higher for higher temperatures, and lower for lower ones. This pressure is termed the tension of the vapour of that particular substance. This may be readily illustrated in the following manner:—If a small quantity of water be passed up into the vacuum existing at the top of an ordinary barometer, the mercurial column will immediately be depressed to a certain extent, which depression will be due to the vapour given off from the water at the particular temperature at which the observation is made, and its amount will represent the vapour tension of water. Now, if alcohol be used in a similar experiment, the depression will be much greater, and hence the vapour tension of alcohol is greater than that of water, and so on, every liquid giving a different result.

Now, if we take a case in which the amount of liquid passed to the top of the mercurial column is insufficient for the formation of that amount of vapour which the given space can take up, the whole of the liquid will then disappear, and the depression will appear to be due to the presence of a quantity of true gas, and this is borne out by the fact that a vapour in this state—unsaturated, as it is called—follows all the laws that the more permanent gases do. It will be found, for example, to vary in volume directly as the pressure, and further to increase or decrease in volume at a uniform rate on an increase or decrease of temperature. But now, on the other hand, let more of the liquid be passed up into the vacuous space than can possibly be required to fill it with vapour; in this case a quantity of the liquid will remain upon the surface of the mercury, and the superincumbent vapour is then said to be saturated, which indicates that as much vapour as can exist at that particular temperature will be found so existing in the given space; if, therefore, the temperature be now raised, a further quantity of the liquid will be converted into the gaseous condition; if lowered, a portion of the liquid already existing as gas will return to the liquid state; in the same way, if the pressure be lowered or raised, the same result will be observable. Thus it is seen that the vapour proceeding from every liquid substance possesses a fixed maximum tension for every particular temperature or pressure, which it cannot exceed under any circumstances.

It follows, also, that if we take the case of an unsaturated vapour, by either increasing the pressure or reducing the temperature, we shall eventually reach this point of maximum tension or saturation, after which any further increase of pressure, or decrease of temperature, will be attended with a condensation of the vapour into the liquid state; and, in fact, it has been by using either one of these processes, or both combined, that nearly the whole of the bodies existing as gases have been liquefied. Another point must be mentioned here. In the above illustrations the various liquids were supposed to be passed up into a vacuum, the vacuum existing above the mercury, in an ordinary barometer. Now, precisely the same results would have been obtained if this vacuous space had been filled by any gaseous body; the quantity of vapour given off by a liquid is absolutely independent of the medium into which it is so given off.

The importance of some of these facts, as regards the manufacture of gas for illuminating purposes, will be seen when it is considered that coal gas not only contains certain permanent gases, but also a large quantity of the vapours of volatile hydrocarbons, which contribute in no small degree to its luminosity; and these points will be referred to again, more particularly when speaking of carburetting air or gas.

A few words are necessary here to state a few facts regarding the luminosity of the flame of gaseous hydrocarbons.

It is still generally accepted that the luminosity of flame is due to the presence of intensely heated solid particles (although some powerful objections have been urged against such a belief). In the case of the combustion of all hydrocarbons, these solid particles are particles of carbon.

Now, a flame will be more or less luminous according to the greater or less number of such particles present, and to the temperature to which they are raised. The denser the hydrocarbon, the greater number of carbon particles will exist in a given space, and when its vapour is burned there will be a correspondingly greater number precipitated into the interior of a flame. Now, bearing these two points in mind, it will be manifestly advantageous to obtain for combustion such compounds of carbon and hydrogen in that proportion of the two which shall give us the greatest quantity of carbon to the smallest quantity of hydrogen, provided that the heat of the flame is maintained sufficiently high to raise the carbon particles to whiteness. This latter condition is quite as important as the former, for it is quite possible that a gas containing a considerable amount of the denser hydrocarbons shall, by reason of the comparatively low temperature of its flame, possess less illuminating power than a gas possessing a smaller quantity of such hydrocarbons, the temperature of the flame of which, however, is somewhat higher. It would appear to follow from this, that every effort ought to be made by the gasmaker to obtain a gas containing as large a proportion as possible of these more luminous compounds; but a glance at the following table, containing analyses of the gas supplied by several different companies, will show that, at any rate, this effort, if made, is not very successful, the greater bulk of the gas being composed of hydrogen, the flame of which is without any light-giving properties whatever, and marsh gas, a gas possessing the least light-giving power of any hydrocarbon, as it contains the smallest proportion of carbon to the largest of hydrogen.

Composition of Coal Gas Supplied by the Following Companies:—

	Great Central.	Imperial.	Chartered.
Illuminating hydrocarbons	3·56	3·67	3·53
Marsh gas	35·28	40·66	35·26
Hydrogen	51·24	41·15	51·80
Carbonic oxide	7·40	8·02	8·95
Carbonic acid	0·28	0·29	—
Nitrogen...............	1·80	5·01	0·38
Oxygen	0·44	1·20	0·08
	100·00	100·00	100·00

The result, as stated here, is even more unfavourable than it at first appears, for the above figures, representing the quantity of illuminating hydrocarbons, express not only those that are really gaseous bodies, but also the vapours of liquids held dissolved in the gas. There can be no question that a great advance in the manufacture of coal-gas would be made, if by any means, applied either to the primary distillation of the coal or to the gas after its production, whereby the amount of acetylene (C_2H_2) or of olefiant gas (C_2H_4) could be increased; for olefiant gas contains, in a given bulk, just twice as much carbon as marsh gas, and acetylene a still larger quantity. The value of this increase is not to be measured only by the increased quantity of carbon contained in a given bulk of gas, for a small portion of either of the above compounds, diffused through a non-illuminating gas, is much more than equivalent to a similar quantity of carbon combined in some less condensed compound. An illustration of this occurs in the case of marsh gas. If marsh gas, possessing, it will be remembered, only a small amount of luminosity, be decomposed, either by its passage through a heated tube, or by the electric spark, the carbon it contains will be deposited, while the amount of hydrogen set free will occupy double the volume of the original gas. Yet the flame of this nearly pure hydrogen will be found to possess a greater luminosity than the flame of the original marsh gas, although it has lost nearly the whole of its light-giving material, accounted for by the presence of a very small quantity of acetylene, produced during the decomposition. The light of a coal-gas flame is, without doubt, somewhat increased in a similar manner, for the reason that during the precipitation into the interior of the flame of the solid hydrocarbons—viz., during the decomposition, under the influence of the high temperature, of the flame of the gaseous bodies—small quantities of very much more highly condensed substances are formed, substances which probably would exist in the solid state if isolated at ordinary temperatures. Further than this, coal-gas, although practically a gaseous body at all temperatures, does, as has been said, act as a vehicle for holding in suspension, and carrying a certain quantity of the vapours of such bodies as benzole, toluole, napthalin, &c., which are to be found in the tar, with what practical success—success which is sufficiently certain as to be relied upon—we shall have to consider when speaking of the special carburation of gaseous bodies as a means of obtaining illuminating gas. It is, indeed, for this purpose that these remarks regarding the luminosity of flame have been introduced.

As there are three schemes, to which reference will be made, for the manufacture of gas, which deal with modifications of the existing apparatus employed, it will be desirable to give a general statement of that which is at present almost exclusively used.

The coal to be distilled is exposed, in quantities of about five hundred-weight at a time, to a comparatively high heat—a bright cherry-red heat is usually employed—in elongated tubular vessels of earthenware or iron, called "retorts," the shape of which varies slightly, some being that of a capital D, with its perpendicular stroke placed as a base, others circular, and others elliptical; ten feet long, twenty inches wide, and fourteen inches high, are about the proportional measurements. A number of such retorts are usually set in a furnace, and heated by one fire; in most large works double retorts are used, which are worked from both ends, as if they were two single ones. At the mouth, or mouths, is a flange, upon which a plate of metal—the lid—is capable of being secured strongly, and made tight with luting, if necessary; through these mouths the coal is introduced by means of long scoops or gutters, and the coke at the close of the operation withdrawn by the aid of rakes. Immediately upon the introduction of a charge of coal into a heated retort, carbonisation commences, and gas is evolved. This carbonisation occurs first with that portion of the coal which lies in contact with the sides and bed of the retort, and hence is more complete than that of the interior, which, however, undergoes destructive distillation, and furnishes gases and vapours of higher hydrocarbons. These coming into contact with the heated mass on the exterior, split up into simpler bodies, the great desideratum being to heat the coal to an equal extent all through at the same time. The gas is conducted from the retorts by perpendicular pipes, about five inches in diameter, which rise near the mouth, called stand-pipes; these pipes, which taper towards their upper extremities, are, above the furnace, bent twice at a right angle, and enter a larger pipe running horizontally over the centre of the retorts. This tube, which is called the "hydraulic main," is at all times half full of tar and oil, and the ends of the bent tubes are allowed to dip into this tar to the depth of two or three inches, for the purpose of cutting off all communication between the retort and the gas which has left it. This hydraulic main is fixed horizontally, the tar being drawn off from its extremities, and as the whole length of tube is kept at a fair heat—which heat should not be too strong—by reason of its contiguity to the furnace, the tar is usually in a liquid condition. It becomes essential that the gas should be submitted to a process of cooling, in order that those more condensible bodies which have been vaporised by the great heat may be deposited, owing to the great mobility of gaseous matter, and its possessing a high latent heat, this process becomes one of some little difficulty, and necessitates the exposure of the gas to a very large cooling surface. This is attained either by simply passing the gas through iron tubes of sufficient length, or through hollow iron columns, having an annular closed space through which the gas circulates. The extent of surface needed is sometimes very large, as much as ten square feet of cooling surface being often necessary for every cubic foot of gas passing per minute. If it were left for the evolution of the gas in the retorts to maintain a sufficient pressure to drive it through the various apparatus, considerable loss would result from leakage; and it is found further that the gas produced under pressure is not so good in illuminating power, a considerably greater quantity of carbon being deposited under such circumstances. Hence it is customary to employ what is called an exhauster, this being usually a rotary fan, acting the part of a rough air-pump. The use of this apparatus places the pressure entirely under control, and allows it to be reduced at the retorts to about half-an-inch of water.

After the gas leaves the condenser, it has to be submitted to the various processes of purification; but as these do not in any way bear upon the present subject, it will be sufficient to state that it is first washed or *scrubbed* by passage through a coke tower, over which water is allowed to trickle, to remove any residue of tar and also the ammonia which it contains. Thence it passes into a tank of milk or cream of lime, kept in continuous motion for the removal of carbonic acid and sulphuretted hydrogen, and lastly through a series of trays filled with dry lime and oxide of iron, for the removal of the residual sulphur existing in the form of sulphuretted hydrogen or bisulphide of carbon. The gas is then stored and distributed.

It was mentioned in an earlier portion of this paper, that if coal be distilled at a high temperature, a very large yield of gas can be obtained; this increased yield, however, will be coupled with a considerable diminution of illuminating power. The reason for this was then explained—in fact, the distillation of coal may be carried on at such a low temperature that the quantity of gas obtained is practically nothing, the whole of the products appearing in the solid or liquid state (a *prolonged* exposure of gaseous hydrocarbons to a low or even moderately high heat is attended with precisely similar results, viz., the formation of more complex substances), or conversely the heat may be so high as to completely decompose the whole of the hydrocarbons into their constituent elements. It is found advisable, in ordinary working, to take a mean of these results, and thus a fair yield of gas is obtained, together with a not inconsiderable amount of tar and oily matter. These latter products increase in direct proportion to a decrease of temperature, and a consequent decrease of gas—thus:

Table of amount of Gas and Tar obtained at Different Temperatures.

Temperature of Distillation.	Amount of Gas Obtained.	Amount of Tar.
		lbs.
Very low red heat	7,500	150
1,300° to 1,400° Fahr.	8,300	120
Bright red heat	9,500	70

There are three considerations which influence a gas engineer with regard to the temperature at which he shall distil the coal, and which sometimes compel him to use a heat higher than would otherwise be advantageous; these are, first, the time which can be afforded for the production of a given quantity of gas—a lower temperature means a more or less lengthened time of exposure for the same quantity of coal, and where, as is usual, the necessary plant is only just sufficient for the supply of the required quantity of gas, this prolongation of the process is impossible; second, the per-centage of fuel (coke) used in the furnaces for the distillation, this is likely to be greater for a greater interval of time; and, thirdly, the quality of the coke produced, for the demand for coke, and consequently its value is great, and it is therefore the principal bye-product in the gas manufacture, and its production in fair quantity, and of good quality becomes an important point in the economy of gas-making.

In 1871 a patent was taken out for "Improvements in the manufacture and purification of gas, and in certain parts of the apparatus employed therein," which, while mainly dependent upon the distillation of coal and other bodies at low temperatures, proposed to fulfil all that could be desired with regard to the second and third of the above considerations, and at the same time offered in compensation for the prolonged time occupied by the distillation a very considerably increased yield of gas of a much higher than usual illuminating power. This process is carried out by distilling the coal at a much lower temperature than usual—in the original scheme from 600° to 1,000° Fah. is mentioned, but in practice from 1,300° to 1,400° Fah. will probably be employed; at this temperature, from a ton of gas coal about 8,500 cubic feet of gas are obtained, together with a greater than ordinary yield of tar and oil; this tar is condensed, by special means employed for securing a greater rapidity in the process, and collected as free from water as possible, with a view to its being re-distilled in a separate and peculiar retort. The gas produced during the carbonisation of the coal is, as may be expected, a rich gas of high illuminating power, and after its production it is in all respects treated in the ordinary manner, and will therefore not require further special mention, unless it be in one particular, and that is its comparative freedom from what has been called the *residual* sulphur impurity; as this sulphur impurity consists almost entirely of the volatile bisulphide of carbon, which is recognised as a product of high temperatures, the occurrence of only a small portion of that body in gas distilled at as low a temperature as that used in this process is in no wise strange, although, doubtless, at the same time it is a favourable result. The special point of this invention consists in the submission of the oil and tar collected to separate destructive distillation at a low heat, whereby a certain quantity of those substances is vaporised, attended at the same time with the formation of another quantity of condensible products. These products are again distilled with a further partial decomposition, and this process is repeated until a given quantity of tar has been converted into vapour, and a certain amount of pitch. The means used for obtaining this result are as follows:—The tar and oil are allowed to flow into an iron pan, maintained at a temperature of about 700 or 800 deg. Fah.; in this apparatus the more volatile constituents are rapidly evaporated, and are conveyed into a hollow iron tank for the purpose of retaining any of the material mechanically carried over, thence through a retort filled with charcoal in small pieces, and heated to a temperature of about 1,000° Fah.; by the passage of the various vapours through this vessel they no doubt suffer decomposition, not brought about by any property of the ignited charcoal, but doubtless by the more thorough heating of the gas, the very large heating-surface afforded by the charcoal successfully bringing the particles of vaporous matter up to a sufficiently high temperature for decomposition; in this manner a quantity of gaseous matter is formed, notably hydrogen, carbonic acid, carbonic oxide (the oxygen being obtained by the splitting up of what water there is present), marsh gas, and a small quantity of illuminating hydrocarbons; the condensible products are treated again in the same manner as before mentioned. The gas obtained from the oil and tar is treated in the ordinary manner as regards purification, and is ultimately mixed with the gas originally obtained from the coal. The aggregate quantity thus produced is declared to be in excess of that usually obtainable from an equal quantity of coal, and possesses a considerably greater illuminating value.

This is the most recent of many processes for the distillation of coal tar and oil. Hitherto it has been found most economical to distil the substance from which gas is to be manufactured at once, that is, having only one stage in the process, for previous experience has shown that the production of a quantity of intermediate products, and their after distillation, has always been a wasteful mode of working, both as regards the result obtained and the expenditure of power and material in order to obtain it.

This new process has been submitted to the investigation of two eminent independent scientific men, both having a large acquaintance with the various processes of gas manufacture. The value of such investigation cannot well be over-estimated, and it would appear desirable that in all such cases similar investigations should be resorted to, for it rarely happens that an inventor is able to perceive the weak points of his own invention, and still more rarely is he able to grapple with and surmount them by the use of his own scientific knowledge, while at the same time it is not too much to say that many processes and schemes have been allowed to dwindle and die because the good and useful points which they contained have not been perceived amongst so many erroneous views and ideas. A searching and clear examination of any particular invention ought to be regarded as exceedingly valuable testimony.

The following are some of the more important points brought out by the examination of the above described process by Messrs. Keates and Odling. The experiments conducted by these gentlemen were made upon two scales, the first a manufacturing one, in which the process was in use for the manufacture of gas for the public consumption; and the second upon a much smaller one, in which, however, the various apparatus was necessarily under more perfect control, and hence some points were capable of clearer elucidation. The highest yield of gas obtained directly from the coal was 9,775 cubic feet, the temperature of distillation being between 1,300° and 1,400° Fahr. The quantity of oil and tar obtained from one ton of coal varied considerably with the nature of the coal used; thus, Silkstone coal gave 16·4 gallons of tar and oil per ton, Clay Cross Main 11·9 gallons, and Pelaw Main 13·9 gallons, or a mean of 14 gallons. The highest yield of gas which was obtained by the continued distillation and redistillation of the oily tar was 29 cubic feet per gallon. The mean lighting power of the gas produced from coal was 23·0 candles, and of that obtained from the tar 25·0 candles. The quantity of coke used to maintain the heat in the various parts of the apparatus was about 33 per cent. of that produced, and in the event of the distillation being repeated until complete separation into pitch and vaporisable matters takes place, this amount would be much exceeded. It must also be remembered that the time occupied in the distillation of the coal is just double that allowed when ordinary high heats are employed. The most successful experiment as yet made with this process has shown that from one ton of coal it is possible to produce 9,500 cubic feet of 23-candle gas by a careful regulation of the temperature, and from 14 gallons of oil (the mean produce of one ton of coal) 600 cubic feet of gas of an illuminating power equal to 25 candles. Against this result must be placed the considerably increased time occupied for the distillation, and the increased consumption of fuel. It would appear, therefore, from these figures that the second process of distilling the oil is of very little practical utility. The expense attending the production of an equal quantity of gas of a scarcely less illuminating power from coal being far less than that attending the distillation of the oil or tar. Indeed the experimenters themselves consider that the oil would be more valuable as a marketable article than as a material for the manufacture of gas. That this process is capable of yielding a larger amount of gas of high-illuminating power, and of a character as permanent as that of gas ordinarily produced from cannel coal, is, without doubt, satisfactorily proved; and the one point for the entertainment of gas engineers seems to be the relative simplicity and economy of producing coal-gas of a high illuminating power in the ordinary way by the distillation of a rich, and consequently more expensive coal, or of the adoption of this process of distilling an ordinary gas-coal at a low heat, with a correspondingly longer exposure.

Another arrangement has been patented which, to some extent, embodies the above idea, although with some considerable modifications; thus the processes of distillation and re-distillation are carried on simultaneously. The two heated tanks for the heating of the tar and oil of the previous invention are dispensed with, and heated iron pipes, in reality continuations of the retorts, placed parallel with them, and heated by the same fire, filled with some porous material, such as pumice or coke, are substituted. The tar formed, which is not so large in amount as that obtained in the ordinary manner, is thus further decomposed by its passage over the large heated surface, and the gas so produced helps to increase the ordinary yield. If coke be used for the porous material, it speedily becomes converted into a pitchy cinder in appearance, almost identical with the charcoal after its exposure in the previous process, and forms a very fair fuel for the heating fires. There is, however, a difference in this invention, which, although not claimed as part of the patent, yet forms an important point in it, and this is that a jet of superheated steam is driven into the retort, and brought into contact with the heated coal. During the carbonisation a portion of this steam undergoes decomposition in the presence of the red-hot coal; its oxygen uniting with the carbon to form carbonic oxide, and its hydrogen being liberated as gas, it was expected that this hydrogen would also unite with a portion of carbon to form some gaseous hydrocarbon, but this is not possible, as the highest temperature attainable in a retort of this description would be far too low to bring about such a direct union, but an indirect benefit may arise from this injection of steam, and that is, that the gases formed from the coal may be more quickly removed from the heated mass, and being at the same time somewhat diluted, the tendency to form more complex bodies will be partially destroyed, and, consequently, the production of the tar and oil will proportionately cease. The previous heating of the steam is no doubt necessary in order to prevent undue condensation, but its being heated to redness, as mentioned in the specification, would prove a difficult and probably unprofitable operation, and would certainly be impossible to accomplish by merely bringing it into contact with the heated sides of the retort. The result of introducing a jet of steam into the retort during the making of gas may be said to have been successful to the extent to which it has been tried, but the amount so introduced requires very careful regulation. A very full and complete trial was made by a number of eminent men some years ago upon a plan very nearly allied to this—viz., what was known by the name of "White's hydrocarbon process," in which steam was introduced into the retort with the heated coal, and the following points appear to have been satisfactorily proved:—

1. An increase in the produce of gas from a given weight of coal was obtained.

2. An increase in the illuminating power of the gas afforded by a given weight of coal.

3. The amount of tar and other oily products is considerably diminished.

It is a generally accepted fact that the quicker coal be carbonised in gas-making, provided it be done effectually, the more successful will be the operation. In the ordinary process this end is far from being reached, the carbonisation gradually proceeding from the exterior layer of coal directly in contact with the heated bed and sides of the retort towards the centre and more protected portions; and as a consequence of this, the heavier and more condensed, and in some respects more valuable gases, coming from the interior part of the fuel, have to pass over the more thoroughly carbonised and hotter outer portion, and will thus suffer a further decomposition before leaving the retort. Many plans have at various times been adopted to obviate this evil, such as exposing the coal in exceedingly thin layers, or forming the bed of the retort of a constantly moving stage, upon which a thin layer of coal in small pieces is constantly exposed to a uniform heat. Some of these methods have been successful, but have had in most cases to be abandoned on account of greater complication of machinery, and hence greater difficulty in continuous working. A plan—probably the simplest that has yet been introduced—has recently been brought forward, the principle of which is as follows:—The retort in this case is set in a vertical position, and through its centre revolves a broad and somewhat deep screw, put together in sections, the thread of which is placed at an angle of 45 deg., and which comes nearly into contact with the sides of the retort. Through a hopper at the top, coal is supplied, in pieces of small but regular size; the inclination of the thread of the screw impels the pieces against the heated sides, where comparatively rapid carbonisation takes place, and the rate of revolution of the screw is so regulated, that by the time the fuel has arrived at the bottom of the retort the process is complete, and coke of a somewhat inferior quality is discharged into a suitable receptacle. The yield of gas is greater by this means, and of higher illuminating power, the amount of tar being correspondingly less; the difficulties encountered appear, as in previous methods, to be chiefly mechanical, the great friction to be overcome by the working of the screw requiring considerable power, the wear and tear thus becoming also greater. Further, the exposure of the iron to such a continuous high temperature renders it extremely brittle, a quality enhanced no doubt by the presence of sulphur, which causes a superficial conversion of the iron into sulphide. That the process itself is to a great degree successful, will be seen from the following results:—

Coal Carbonised.	Quantity of gas obtained.	Illuminating power of gas.	Amount of tar.
1 ton.	11,040	16 candles.	8·5 gallons.
1 ton.	10,160	17 candles.	—
1 ton.	12,000	16 candles.	—

The fact of the existence of a large number of hydrocarbons of great volatility, the vapours of which, when ignited, burn with exceedingly luminous flames, has been a very great incentive with inventors to produce some scheme whereby these vapours might be used to confer luminosity upon a combustible non-luminous gas, or further, inflammability, coupled with luminosity, upon a non-combustible and negative gas. The Patent-office contains the record of many such schemes, which, for some reason or other, have failed to fulfil their originators' hopes and desires. Much misapprehension has arisen upon this matter. Too much has often been expected from such schemes; but, on the other hand, a large amount of unreasonable contempt has been poured out upon all projects of the kind, both extremes being avoidable by a short consideration of certain well-known physical laws. It should be remembered by the opposers of the possibility of there being any good in such ideas, that to a great extent, larger than is generally thought, the luminosity of coal gas itself is dependent upon the presence of the vapours of such volatile substances, which are held in a state of solution in the gas, but which still remain condensible bodies; and we shall see presently that the loss in illuminating power which coal gas undergoes on exposure to a low temperature, is really due to the condensation of such substances. These remarks apply to the principle of carburation, and not to any special means of applying that principle.

This idea of carburation is not by any means new, having been started almost at the same period that lighting by coal gas in the ordinary way was introduced; but it was not until the opening up and working of the American oil wells, by which a supply of very light petroleum oil or spirit was obtainable, that any scheme in this direction was found to have any chance of success. In 1862, a patent was taken out in France by a M. Mongruel, which proposed to pass air through an exceedingly light and inflammable spirit, the air thus becoming charged with a certain amount of a highly luminous hydrocarbon vapour, in such a quantity as to render the mixture inflammable, and to allow of its being burned as an ordinary combustible gas. This idea was introduced into England by a company known as the Photogenic Gas Company, which received some amount of support at the time, but, from some cause or other, did not prove a success.

The various inventions brought into notice since that time for the purpose of carburetting air and other gases have been based upon precisely the same principle, but have differed considerably in the apparatus employed. A general distinction may be made here—more for the sake of separate examination than from there being any fundamental difference between them—between those processes which propose to use air as the vehicle or medium for holding in solution the hydrocarbon vapour, and those in which a combustible but non-luminous gas acts in such a manner; in either case any remarks upon the quantity of vapour taken up, and its character when held in solution, will apply to both. Many erroneous statements have been made on this matter for the want of a little scientific knowledge; for instance, in some cases patentees themselves have declared that a union takes place, other than mechanical, between the gases of the air and the vapours of certain hydrocarbons, which result in the production of such gases as olefiant gas, or acetylene, an utter absurdity and impossibility which would be evident to any who would consider under what circumstances, and under what circumstances only, such gases are produced. A vapour of any hydrocarbon whatever will, whether it exist by itself or whether it be diffused through another gas or gases, always be such a vapour, and will invariably exhibit the properties characteristic of it; and, moreover, if diffused through a gas, will be found condensible once more to the liquid from which it was formed, if proper means be applied. An illustration occurs in the case of aqueous vapour, which always exists in greater or less quantity diffused through the air, but this vapour is still the vapour of water, exhibiting all its properties, and capable once more of assuming the liquid state on a sufficient reduction of temperature. Another view equally erroneous is, that a given bulk of air or gas will take up and hold in solution an almost indefinite quantity of vapour, and some extraordinary statements have been made as to the large amount of this quantity. Now, from what has been said in the earlier portion of this paper, it will be readily understood that this point is capable of experimental proof, and is not determined either by chance or accident. Every liquid body has a maximum tension of its vapour, and this point is as fixed for any particular substance as its specific gravity or its boiling point. If, therefore, a given space, filled either with air or other gas, contain a quantity of vapour at its maximum tension, that space will be saturated with such vapour, and it will be found impossible to cause it to hold ever so slight a quantity in excess of that already existing, as, however, this tension is lower for lower temperatures, a space that is saturated at a higher temperature will become over, or supersaturated as the temperature falls, and hence must deposit a quantity of vapour in the liquid state. When experiments are made with a view to test this result, the temperature of the *gas* should be the observed temperature and not the temperature of the vessel containing it, as the conducting power of a gas for heat is so bad that it takes a considerable time for any quantity of it to fall from a higher to a lower temperature. It will be seen, then, that the fixing of the maximum tension of the vapour from a liquid for different temperatures will give us an exceedingly good indication of the quantity of the vapour which may exist diffused through any space of air or other gas. A statement was made at the outset, which, for the sake of clearness, is repeated here, viz., that the medium in which the vapour is diffused has no effect whatever upon the quantity so diffused, a vacuum, or equal volumes of all gases, taking up the same quantity of the vapour of any liquid. The boiling point of a liquid is far more intimately connected with its vapour tension than its specific gravity; indeed the boiling point depends upon the vapour tension, for when this tension equals in amount the pressure of the atmosphere, a body is said to boil, and does at that point enter into ebullition. A great tendency has been shown by inventors to reduce the specific gravity of the hydrocarbons which they use, with a view to obtain bodies of very great volatility, and to some extent the boiling points of such bodies have been disregarded; probably this has not led them much astray, because, as it happens, the substances mostly used for these purposes, the light petroleum spirits, have low specific gravities and low boiling points, the two being reduced at the same time, but if almost any other class of hydrocarbons had been dealt with, the specific gravity would have proved no guide to the volatility of the the compound; thus, in the case of the following bodies, alcohol, benzole, and bisulphide of carbon, which have respectively the specific gravities 0·719, 0·85, and 1·272, the vapour tensions, and consequently the boiling points, follow just the contrary order, and the body possessing the greatest density is really the most volatile. The vapour tension of alcohol, at ordinary temperatures, viz., about 15 deg. C., is equal to the depression of the mercurial column to the extent of 30 mm, the boiling point of alcohol. being 79 deg. C.; the vapour tension of benzole, in the same manner, is 55, and the boiling point of the liquid 78 deg. C., and of bisulphide of carbon as high as 250, with a boiling point of 48 deg. C.; low specific gravity is, therefore, not always coupled with low boiling point and great volatility.

A law was enunciated by Dalton, which, though since proved to be only approximately true, nevertheless enables us obtain a rough idea of the vapour tension of any liquid if we know its boiling point, which was this:—"The vapours of different liquids have equal tensions at temperatures equally removed from their boiling points." Thus, the boiling point of alcohol being 79 deg., the vapour tension of alcohol at 50 deg. ought to be equal to the vapour tension of water (with a boiling point of 100 deg. C.) at 71 deg., which is approximately correct. Now, the boiling points of the light petroleum spirits used in the carburation of air are pretty well known, and some of them are expressed in the following table, together with the specific gravity of the spirit:—

BOILING POINTS OF LIGHT PETROLEUM SPIRIT OF DIFFERENT SPECIFIC GRAVITY.

Specific gravity.	Boiling point.
0·600	4 deg. C.
0·628	30 „
0·669	68 „
0·699	92 „
0·726	118 „
0·741	136 „
0·757	160 „

The spirit more commonly employed has a specific gravity of about 0·650, having a boiling point of 58 deg. C. In the following short table the vapour tension of this spirit has been calculated by the above approximate law, for several different but often experienced temperatures.

TABLE OF MAXIMUM VAPOUR TENSION OF PETROLEUM SPIRIT OF A SP. GR. ·650 AT DIFFERENT TEMPERATURES.

Temperature.		Vapour tension.
—10 deg. C.	(14 deg. F.)	43·5 mm.
0 „	(32 „)	81·0 „
+10 „	(50 „)	132·0 „
15 „	(60 „)	167·0 „
20 „	(68 „)	203·0 „
40 „	(104 „)	301·8 „

These vapour tensions, therefore, express the maximum proportionate quantities of the spirit which can exist dissolved in air, or other medium at those temperatures; thus the quantity of vapour dissolved at 15 deg. C. (60 deg. F.) or the temperature of a tolerably warm day, is just about double that which will be dissolved at 0 deg. C. (32 F.) or the freezing point of water; the reduction of the temperature from 15 deg. to 10 deg. C. (60 deg. to 50 deg. F.) is coupled with a loss of about one quarter of the amount of hydrocarbon vapour. These points are capable of direct experimental proof, and all claims and statements made by inventors may be brought with perfect justness to such results. We may perhaps state the above table in a still clearer way, by converting the figures representing the vapour tensions into the per-centage of vapour present in any bulk of gas at any particular temperature. It will then stand thus:—

TABLE OF PER-CENTAGE OF VAPOUR OF PETROLEUM SPIRIT OF A SP. GR. ·650, PRESENT IN AIR OR OTHER MEDIUM AT DIFFERENT TEMPERATURES.

Temperature.		Per-centage.
—10 deg. C.	(14 deg. F.)	5·7
0 „	(32 „)	10·7
10 „	(50 „)	17·5
15 „	(60 „)	22·0
20 „	(68 „)	27·0
40 „	(104 „)	39·0

Now, for an "air gas" scheme to be successful, the air must hold in solution a sufficient quantity of vapour at the lowest temperature to which it may possibly be exposed as shall confer upon it both inflammability and an adequate luminosity, and this really means that at a higher temperature it will hold in solution a much greater quantity than is necessary in order to obtain such a result. In many cases, doubtless, this is the case.

The quantity of vapour held in solution at any one time, no matter at what temperature the observation be made, will be found to be just that quantity which would be found sufficient to saturate the air or gas at the lowest temperature to which it has been exposed; hence any lowering of the temperature after carburation should be carefully avoided, as a loss would thereby be incurred of a quantity of vapour which would not be restored on the temperature becoming again higher; this, of course, applies only to the gas or air after it has left the *liquid* hydrocarbon, and is not in contact with it.

The liquid hydrocarbons, which at present are almost exclusively proposed to be employed for the purposes of carburation, are the light oils and spirit which form the first distillate in the preparation of paraffin oil from the crude American mineral oil. As this light spirit is too volatile and inflammable to be burned in any sort of lamp at present in use, and no other commercial application has been discovered, very large quantities of it are disposed of as an entirely waste product, obtainable at a merely nominal cost. Whether the difficulties of importation, or its taking its position as a marketable product, will materially affect the estimates at present put forward for the continuous acquirement of large quantities, will remain hereafter to be seen.

With regard to these "air gases," all that remains is to state wherein the various plans differ in their mode of carburetting the air. The first of these recent schemes purposes to drive minute streams of air through a layer of spirit of a specific gravity 0·670—this is accomplished by forcing air under pressure through a small tank of the liquid, having a false bottom of wire gauze; the passage of the air through the gauze divides it into innumerable fine streams, and causes it to come into close contact with the liquid material. The air, as it issues from the top of the tank, will thus be saturated with the hydrocarbon vapour. The depth of liquid through which the air passes is maintained constant by means of a somewhat ingenious float. It is further proposed, in this patent, to dissolve in the spirit a quantity of some more highly-condensed solid hydrocarbon; but it is open to very considerable doubt whether the effect of such addition could be very perceptible.

The illuminating power of this gas is very high, as high indeed as 30 candles, although this statement requires a slight qualification, as the lighting power of the flame is not expressed by it, but only the fact that if it were possible (which it is not) to burn the gas at the rate required by the photometric test, viz., five cubic feet per hour, this illuminating power would be obtained, it being a fact that a very much smaller amount of air-gas can be burned from the ordinary "London argand" burner, or from a batswing, to obtain the same size of flame than in the case of coal-gas; this effect is no doubt due to the greater density of "air gas." It may be mentioned here that these air-gases do not burn at all well under pressure, and hence are only suited to burners which afford exceedingly free passage to the issuing gas, such as argands, there being a tendency with burners of the batswing and fishtail class for the air and vapour to separate, possibly explainable by the more rapid transpiration of the lighter substance through a narrow opening. The gas produced by this particular scheme possesses, as might be expected, a very fair degree of permanency at ordinary temperatures, and is capable of transmission through comparatively long lengths of pipe with little deterioration in quality. As an experimental trial, one side of the nave of the Crystal Palace has been recently lighted in this manner, with what success the public journals have testified, the spirit used for this purpose having a somewhat lower specific gravity than that mentioned in the patent. It is further stated that one gallon of oil will carburet 800 cubic feet of air, the cost of this gallon of oil being two shillings.

A second plan for obtaining the same result is a modification of the above, the special features of which are, in the first place, the required current of air being maintained by clockwork, and, secondly, the substitution of a considerable length of cotton, wool on other absorbent substance, kept saturated with the liquid hydrocarbon, in the place of bubbling the air directly through the liquid. The spirit used and the results obtained are very much the same as in the former case. This scheme also is being illustrated upon a somewhat extended scale, the small town of Great Marlow being at present illuminated by its means.

Perhaps this latter has one slight advantage over the former. inasmuch as the bubbling of air through a volatile spirit will promote its evaporation, to such an extent that the temperature of the liquid will be reduced exceedingly low, in some cases as low as the freezing point, and consequently the temperature of the air will be very considerably reduced at the same time. Now any unnecessary reduction of temperature, either of liquid or air, should be carefully avoided, in order to keep in solution as much vapour as possible.

Yet a third plan has received some attention which possesses at least the advantage of simplicity, and this consists in using an ordinary gas-holder, with its tank, as a gas generator, to the exclusion of another apparatus. At the crown of this gas-holder is placed a valve, opening with ease inward, but closing the moment any pressure is applied to the holder. Underneath this valve are placed trays containing a shallow layer of a spirit, if anything, of somewhat lighter specific gravity than those used in other cases. As the gas-holder is mechanically raised, the entering air passes over the surface of the volatile hydrocarbon, becoming in this manner sufficiently charged to be immediately used as an illuminating gas, which may be consumed through most ordinary fittings. The illuminating power of the flame, expressed in the same manner as before, is from thirty to thirty-three candles. The spirit—of which one gallon, it is believed, will carburet 500 cubic feet—used in this process is said to be obtainable in an almost unlimited quantity, being driven off on the first heating of the crude product in the manufacture of American kerosene oil. At present this volatile distillate is allowed principally to evaporate into the atmosphere; but it is thought that with very little extra expense or trouble, it may readily be condensed and imported. This spirit evaporates with extreme rapidity, as might be expected from its low boiling-point; and the vapour proceeding from it, as from other petroleum spirits, is an exceedingly heavy one, almost as heavy, indeed, as the vapour of ether; hence, when mixed with air, it renders the mixture considerably heavier than an equal bulk of air, and this has been taken advantage of in the construction of what is certainly an ingenious arrangement, intended to be used as a portable gas lamp, or, in some cases, in place of the ordinary gaselier. A small reservoir communicating by a pipe with an ordinary gas burner, provided with a stopcock, is filled with shavings or wool, which material is saturated with the spirit. The air and vapour descend together through the pipe to the burner, and produce a flame apparently equal, in all respects, to ordinary gas, the air entering through a small hole at the top of the reservoir. It is stated that half-a-pint of oil will be sufficient to saturate an amount of material to supply a light for nine hours.

It has often been thought that of a necessity these very volatile liquids must be much more liable to explosion than those of higher boiling points; such, however, is not the case, not but that it is possible to cause them to explode, because the vapour of any combustible hydrocarbon, when mixed with that proportion of air which contains just sufficient oxygen to burn up the hydrogen and carbon, will burn throughout at once, producing thereby sudden expansion, which is nothing more than explosion; but the conditions necessary, in order to obtain this result, are more difficult in the case of these heavy vapours of very volatile bodies, as, just above the explosive point, the air and vapour simply inflame and burn, while just below it inflammation will not occur at all from the presence of too small a quantity of vapour. This is contrary to the case of hydrogen gas, which explodes with ease when mixed with air in very variable proportions. The fear has been expressed that possibly, even after the complete mixture of such a heavy vapour and air, that separation other than condensation to the liquid state might occur, that is to say, that a layer of heavy vapour might lie at the bottom and a layer of the lighter air at the top; but the law of the diffusion of gases which states that gases and vapours, whatever their differences in density, will become and remain completely mixed, invariably prevents such separation, just as in the atmosphere the heavier oxygen is not found at the bottom, and the lighter nitrogen at the top, but the two are found together in practically the same proportions from wherever a sample of air is obtained.

If comparisons be instituted between gases made in the ordinary manner and these air gases, they should be made under the same circumstances, and if this be done it will be found that coal-gas itself suffers, either on exposure to a low temperature or by long keeping—not in any way a surprising result, since it contains the vapours of benzole, toluole, &c., which are capable of being condensed to liquids. In this respect rich gases always suffer the most; thus on continued exposure to a temperature of 0 deg. C., or 32 deg. F., gas made from cannel coal loses much more of its illuminating power than gas made from ordinary coal.

The employment of a combustible gas as the vehicle for holding in solution, and carrying, vapours of volatile liquids, appears at first sight to be a more rational and probably a more successful method of applying the principle of carburation, for in the former cases not only has a sufficiency of vapour to be retained to confer luminosity upon the flame, but a further quantity must be present for the production of the flame itself, or we may express this difference by saying that in the one case the combustible gas is already manufactured, and requires only to be endowed with luminous properties by the hydrocarbon vapour; in the other the combustible gas has itself to be manufactured, and then, also, to acquire luminosity from the hydrocarbon vapour, and therefore it will be perfectly clear that a non-combustible gas will require to hold a larger quantity of vapour in solution than a combustible gas, in order to attain the same amount of lighting power. This statement does not, of course, deny the possibility of a non-combustible gas, such as air, acquiring and holding a sufficient amount of vapour, but all other things being equal, a combustible gas has a distinct advantage in this respect, and probably such a gas might be carburetted with a hydrocarbon liquid, having a lower boiling point, and hence less volatile than an incombustible gas, such as air. This advantage is also increased when air is employed, from the presence in it of one-fifth of its volume of oxygen which burns up, without other effect than increasing the heat of the flame, a proportionate quantity of vapour. The nature of the combustible gas used is not of any very great importance, and hence cheapness and economy in production become the chief guides for its manufacture. The possibility, without any great amount of trouble, of obtaining a quantity of hydrogen gas from water has always been a favourite theme with inventors, and many schemes for its practical utilisation have been introduced; but one hardly expected to recognise in a "new gas" our old friend this water-gas once more; such is, however, the case, and a patent has lately been obtained for the carburation of this gas with some light hydrocarbon liquid. The plan is being carried out upon a small scale, and will doubtless very soon be tried upon a more extended one. The amount of attention that has been at various times bestowed upon this subject may be gathered from the number of patents obtained for the production of this so-called water-gas. The first appears to have been granted to Michael Donovan in 1830, a second to George Lowe in 1831, a third to Gilbert Saunders in 1833, and two others to Mr. Floret and Jean Baptiste Molerat about the same time, and many others, all differing by some slight modifications, but all dependent upon the decomposition of steam by red hot coal, coke, or metal. This decomposition takes place with very great ease whenever steam is passed over such heated material. Hydrogen, carbonic oxide, and carbonic acid being produced, probably two different actions take place, as expressed by the following equations:—

$$H_2O + C = H_2 + C\,O$$
$$2\,H_2O + C = 2\,H_2 + C\,O_2$$

The amounts of hydrogen, carbonic oxide, and carbonic acid obtained are variable under different circumstances. An analysis of the gas obtained by passing steam over red-hot charcoal for some hours gave as a mean—

Carbonic acid	20 per cent.
Carbonic oxide............	20 „
Hydrogen................	60 „
	100

Any form of carbon is capable of effecting this decomposition. If a metal, such as iron, be present, it adds to the quantity of hydrogen obtained according to the following action:—

$$4\,H_2\,O + 3\,Fe = Fe_3\,O_4 + H_8$$

This mixture of gases is inflammable, and burns with a non-luminous but hot flame, the heat of which would be increased if the carbonic acid were previously removed, the flame of hydrogen gas having a temperature of 3,776 deg. Fah. This heat of the flame is an undoubted advantage when the gas is carburetted, as the particles of carbon are thereby heated to whiteness; but, on the other hand, the presence in the gas of a quantity of carbonic oxide is as great a disadvantage, on account of its injurious and exceedingly harmful character. Carbonic acid is an injurious gas, but its action upon the system is not that of an active poison, but rather that of preventing the necessary amount of oxygen from entering the lungs, and hence death from its effect will be death from suffocation. On the other hand, carbonic oxide is an active poison, and recovery from its effect is much more doubtful; indeed, it is calculated that 2 per cent. in any atmosphere would prove fatal, a result that should cause great caution in the use of a gas containing it in any quantity.

In this recent process it is proposed to use retorts of the ordinary description, set, as usual, in benches of five, seven, or nine. All, except the upper one of each set, are filled with some carbonaceous substance, usually coke, together with some scrap iron, or iron chairs, and heated up to a comparatively high temperature; steam—under pressure, generated from an ordinary boiler, and super-heated by its passage through pipes set in and heated by the same furnace as the retorts—is introduced into the back of each retort, and has to traverse its whole length, passing through the red-hot coke and issuing from the front. During this passage the above decompositions take place. The upper retort is of a larger size, and is also filled with coke, but no steam is introduced into it; the gases formed and the remaining undecomposed steam from the other retorts passing through it together, this remaining quantity of steam being thus decomposed; and from this point the gas is treated precisely in the ordinary manner, and stored in holders, it being, in all respects, a permanent gas. It is intended to utilise this gas by itself, as a heating gas; but its chief use is for illumination, and the necessary luminosity is obtained in the same manner as with air gas, the gas being caused to bubble through some light spirit, any reduction of temperature by the rapid evaporation being avoided by maintaining the vessel containing it at a constant temperature by means of a steam pipe. The illuminating power of the gas so obtained is equal to about sixteen or seventeen candles; and its permanent character is declared to be, and no doubt is, quite sufficient to render it of some practical utility. Let it, however, be borne in mind that no more union has taken place between the vapour of the hydrocarbon and the permanent gaseous mixture than in the case of the carburation of air, both gases taking up precisely the same quantity of vapour at the same temperature, and both being equally liable to be affected by changes of temperature, or other changes of circumstances. The whole of these carburetted gases are, of course, to a very large extent free from those impurities which are usually found in coal gas.

A suggested application of this principle of carburation, as an adjunct to the ordinary manufacture of gas, has many favourable points; for coal gas may most certainly be as successfully carburetted as either air or hydrogen and carbonic oxide, and it is quite possible to produce an exceedingly large yield of poor illuminating gas from coal, the luminosity of which might be brought up to the ordinary standard by partially carburetting the gas with some light hydrocarbon, the presence of a less quantity of vapour being requisite in a given bulk of gas, and hence a successful result would be more easily obtained, as the vapour would only have to raise the luminosity from a lower to a higher point, and not to do the whole work of illumination itself. A very large yield of gas from coal may be obtained by working at a high temperature, or at the ordinary temperature if a jet of steam be introduced into the retorts during the carbonisation, it having been found possible to obtain by this latter method as much as 52,000 cubic feet from a ton of coal of an illuminating power equal to four candles.

In the preceding remarks an endeavour has been made to state and examine the claims of each of the processes brought forward in a clear and impartial manner. The extravagant statements and impossible theories sometimes put forward often obtain credence and support because those hearing them have seldom the necessary knowledge of the rudiments of chemistry or physical science to combat or disprove them; and very often such statements themselves are made in ignorance, and not with intent to wilfully mislead, by those who would be glad to state the truth if it were presented to them in a clear and succinct manner. Most schemes of this nature are open to conclusive proof with regard to their value and practicability, and in some cases this proof will be entirely to their advantage, and should not be shunned by their promoters. The introduction of so many new inventions just now, with regard to the manufacture of gas, indicates a great want somewhere, and if such a want exists it cannot be long before it is met and satisfied. Whether any of these present schemes are tending toward this satisfaction it is premature to say; this much may, however, be said, that hasty condemnation upon insufficient evidence is as much to be lamented and avoided as exaggerated and untruthful statements.

All mention of the commercial success of any of the above inventions has been avoided, as it was not intended, at the outset, to make this paper anything but an examination from a scientific point of view of such inventions. Doubtless there are those who are able to form an excellent judgment upon such matters as comparative cost of material, plant, labour, &c.; and this part of the subject must at all times have an exceedingly important influence upon any expressed opinion as to the profitable nature of any such undertaking.

DISCUSSION.

After a few words from **Mr. Hale**,

Mr. H. P. Stephenson asked whether the hydrogen used was free from carbonic oxide or not. White's process (by which Stockton had at one time been lighted) was not the same as that by which the "new gas" was made, as his gas had been hydrogen, which derived its illuminating power from a mixture of boghead coal-gas, whereas in the "new gas" petroleum afforded the illuminating agent. The drawback to White's process was that the two gases would not mix thoroughly, and besides the process was a costly one. The light was also very uncertain, and varied considerably in power owing to this imperfect fusion of the gases, whereas this was by no means the case with the new gas. He believed the new gas would not burn in a flat flame burner, though it answered very well in an argand. Chichester was now lighted with a mixture of coal gas and this new gas, and, as he understood, the arrangement worked admirably. As to the poisonous qualities of carbonic oxide, Professor Frankland and Mr. Alexander Wright had some years since experimented upon the subject, and had found that carbonic oxide was no more destructive to animal life than an equal quantity of coal-gas. These experiments had been made in connection with Mr. Gillard's patent, in which a jet of hydrogen was thrown upon a ring of platinum, which became incandescent and gave a beautiful white light. It seemed to him that in the new gas neither the carbonic acid nor the carbonic oxide was got rid of. He should like to ask whether it was in its burnt or its unburnt state that the carbonic oxide was referred to as poisonous by Mr. Wills. Speaking as a director of the Crystal Palace District Gas Company, he would suggest that if any more experiments were made at the Palace with the new gas, the coal gas should be entirely cut off from the complicated system of mains there before the new gas was turned on.

Mr. M. H. Gore had had some practical commercial experience on the matter in hand. He had himself been connected with the introduction of air-gas into this country from America, under Longbottom's patent, in which dry air was driven through benzole. He had made some 400 or 500 experiments with the gas, but found it a failure. It would not travel. Some which he had once stored in a gasholder for four days did not deteriorate; but when it was transferred to another holder it was found that great loss ensued. Further experiments produced still further deterioration, and he came to the conclusion that the gas was useless for this reason. Still it could be employed under certain conditions. He had had to make gas, for instance, where there was no coal. In 1867 he was called upon to light the city of Mexico with gas, and it was found that coal was too dear for coal-gas to be employed. He consequently first tried a modification of White's process, mixing water-gas with gas produced from resin or tar, but there were many difficulties in the way; he could not obtain proper retorts; in fact, he had been obliged to use a retort of sheet-iron, and there were other practical difficulties. Finally, he found that he could not obtain the requisite illuminating power without getting rid of the carbonic oxide, a process which involved so much expense, that at length the project was abandoned as impracticable. He then fell back on the plan of making gas from wood and resin, and in this he succeeded, so that Mexico was now lighted by gas of that sort. In conclusion, he would urge that all interested in the subject should set their faces against the extravagant and misleading statements by which it was now the fashion to herald in all new schemes of the sort. Such a practice was nothing else than puffery of the worst description.

Mr. Howland then proceeded to exhibit and explain a new apparatus for manufacturing an air gas, the invention of Dr. Greenhough, of the United States. A small quantity of spirit was poured into a gas-holder, and the holder raised so as to admit atmospheric air. This air became saturated with the vapour, and a gas was the result, which burnt freely in an argand burner supplied by a tube. The spirit used was a by-product from the manufacture of kerosene oil, and resulted when the stills were first heated. It consequently was very cheap. The gas produced burnt much slower than coal-gas, and one gallon of the liquid (which could be obtained in London for a shilling) would make over 1,000 feet of gas.

Mr. Smartt inquired if there was any danger in the use of this process.

Mr. Howland said it was perfectly safe, and to prove this he lighted the vapour on the surface of the liquid, and also boiled some of the liquid over a lamp. As to conveying the gas, they had only attempted to do so for a short distance, but he saw no reason why it should not travel as far as was required.

Mr. Wills, in reply, said that he had been using pure hydrogen in the experiments they had seen. It was in connection with a project for driving superheated steam through the coal in a gas retort known as Muscamp's that White's hydrocarbon process had been referred to, and not in connection with any of the new processes for the carburation of gas. As to the poisonous qualities of carbonic oxide, he admitted that coal gas was poisonous, and would destroy animal life if present in sufficient amount, but a much smaller quantity of carbonic oxide would destroy life, and therein was the difference. Carbonic oxide, when burnt, became carbonic acid, so that it was, of course, in its unburnt state that he spoke of it. In conclusion, he would advise that no new scheme should be condemned on account of its novelty. For himself, he had endeavoured in the paper to give an impartial and accurate account of the various schemes he had described, and without offering any opinion, he would leave those present to draw their own conclusions.

The Chairman, in moving a vote of thanks to Mr. Wills, complimented him on his very exhaustive and elaborate paper, and observed that the large attendance present showed how great an interest was now taken in the subject. He would also remark on the extreme ease and simplicity with which Mr. Howland's apparatus worked; observing that it was one of those clever American contrivances which often took us over here by surprise at their ingenuity.

The vote of thanks was unanimously carried.

After the conclusion of the meeting, Mr. Elmslie exhibited some specimens of tins for holding preserved meats, &c. Round the upper edge of each tin a wire is inserted below the cover; the ends of the wire project sufficiently to allow of this being seized with a key or fork provided for the purpose, so that the wire may be drawn out, cutting off the cover of the tin as it comes. The invention appeared one of considerable simplicity and convenience.

Captain O'Hea wishes it to be made known that the cartridge referred to in his paper on "Improvements in Breech-Loading Rifles and Ammunition," read on the 14th instant, as the cartridge which gained the Government prize of £400, in the cartridge competition, is the Daw cartridge, the invention of Mr. G. Daw, of Threadneedle-street, London.

The Society of Biblical Archæology intend shortly to publish a series of translations of all the important Assyrian and Egyptian texts which exist in the various collections of England and the Continent.

ANNUAL INTERNATIONAL EXHIBITIONS.

The number of visitors admitted on Thursday, 15th inst., was as follows:—Season tickets, 210; on payment of 1s., 3,793; total, 4,003. On Friday, season tickets, 215; on payment of 1s., 3,115; total, 3,330. On Saturday, season tickets, 947; on payment of 1s., 5,265; total, 6,152.

The number of visitors admitted to the Exhibition during the week ending Saturday, May 17th, was as follows:—Season tickets, 2,122; on payment of 2s. 6d., 1,624; on payment of 1s., 18,264; total, 22,010.

The number admitted on Monday was, season tickets, 178; on payment of 1s., 2,645; total, 2,823. On Tuesday, season tickets, 202; on payment of 1s., 3,590; total, 3,792. On Wednesday, season tickets, 321; on payment of 2s. 6d., 1,701; total, 2,022.

It has been brought to the knowledge of the Committee for Carriages that an eminent firm of coachbuilders have sent to this year's London International Exhibition parties of workmen connected with the carriage trade to inspect the carriages, carriage-fittings, &c., which are exhibited. The firm referred to are understood to have defrayed the travelling expenses and admission fees of the workmen, and to have placed them under the guidance of an expert who had previously made himself acquainted with the special points of interest in this class of the Exhibition. The Committee for Carriages, being of opinion that the above-mentioned course might be adopted with advantage by other firms, brought the matter to the notice of her Majesty's Commissioners; and I am to state that the Commissioners are prepared to allow a reduction of 25 per cent. on parties of workmen of any number not less than fifty. The tickets for such parties should be applied for, by letter, about one week before the date of the proposed visit.

Her Majesty's Commissioners have been informed that Mr. C. S. Middleton, of 134, Walworth-road, S.E., has made himself acquainted with all the special points of this year's Exhibition. This gentleman would doubtless place his services, on reasonable terms, at the disposal of any firms who may wish to organise visits of their workmen to the London International Exhibition of this year.

Her Majesty's Commissioners are most desirous that the practical illustrations and processes of manufactures shown in each year's Exhibition should be made conducive to the advancement of Technical Instruction. Her Majesty's Commissioners venture to think that it comes within the especial functions of the companies of the city of London, who for centuries have been connected with the advancement of arts and manufactures, to consider what useful lessons may be afforded by the Exhibitions, and they invite their serious attention to the subject. Most if not all of the city companies are interested in education in various schools under their direction. It is proposed to hold a meeting of representatives of all the city companies in the Royal Albert Hall; to invite them to look at the industrial collections of the present year, and afterwards to form committees representing each of the companies interested.

The President of the Institution of Civil Engineers proposes holding the annual conversazione of the Institution in the western galleries of the London International Exhibition, on Tuesday the 27th instant.

Among the cooking stoves in which gas is employed, those manufactured by Messrs. S. Leoni and Co. (No. 4,726), are specially noticeable. Though it is certain that the advantages claimed for gas when used for cooking are not as great as its advocates would have us believe, there is no real doubt that, if properly used, it may be made more economical than coal. The chief gain is, that there is little or no heat wasted. The exact amount required can be obtained at once, without waiting for the fire to burn up; and when the work is done, the gas can be turned off, and there is no waste while the fire is burning out. Again, it is infinitely cleaner than coal, and the heat can be exactly regulated to the various processes of cooking. Against these advantages must be set the fact, that if used wastefully—as household servants would be apt to use it—it is certainly not cheaper than coal, as a given value of coal will produce a greater amount of heat than the same value of gas. In fact, the case may be summed up thus:—Gas, carefully and properly used, is cheaper than coal; wastefully, it is dearer. It is cleaner; for many purposes it is more convenient, and all cooking processes can be accomplished by it.

The earliest patent on the subject was taken out in 1831, by Robert Hicks; eighteen years later, in 1849, D. O. Edwards took out another patent, in which the gas was mixed with atmospheric air before combustion, and it is this principle of mixing the gas and the atmospheric air, so as to obtain heat, not light, upon which all gas stoves have been founded. The principle is, of course, merely that of the well-known Bunsen burner, with modifications.

In Leoni's apparatus one great desideratum has been attained, that of perfection of ventilation. All fumes and vapours are carried away along the flue, and one great drawback to the use of gas, as hitherto employed, is avoided. It is also arranged so as to be capable of cooking on the largest scale, as is shown by the results at the London Hospital, the kitchen reports of which state that an average saving in meat (as shown by the loss of weight in cooking) is about 20 to 25 per cent. as compared with the old system, and that an absolute saving of £500 in the butcher's bill for a year has been effected by the gas stove.

Among the experiments that have been made with one of Leoni's apparatus (a kitchener for family use) is the following:—Breakfast for five adults and three children—2 pints of coffee, 1 pint of tea, $\frac{1}{2}$ lb. of bacon, $\frac{1}{2}$lb. oatmeal for porridge, 6 rounds of toast; time, 20 minutes; consumption of gas, 12 feet (less than three farthings). Dinner for twelve adults and three children—6 lbs. leg of lamb (loss $1\frac{1}{4}$ lbs.), 4 lbs. sirloin beef (loss 10oz.), 5 lbs. potatoes, 6 large cauliflowers, 2 large fruit pies; time, $1\frac{1}{2}$ hours; consumption of gas, 48 feet ($2\frac{1}{2}$d.). This economy of fuel is mainly effected by the ingenious arrangement for reflecting and utilising the heat—arrangements which reflect special credit on the invention. A smaller apparatus is calculated to do all the cooking for a family of twelve persons, at a cost of 36s. per quarter, or $4\frac{3}{4}$d. per day, estimating the price of gas at 4s. per 1,000 cubic feet. These facts speak for themselves, and show how great improvements can be effected by careful scientific appliances, for it is economy in the use of fuel, not cheapness in the fuel itself, that is the chief advantage of these new stoves. Besides the larger cooking apparatus, Messrs. Leoni show some very convenient and handy appliances for cooking on a small scale. These might well be introduced into houses where the use of gas for general cooking purposes is impracticable from previously existing arrangements.

Among the scientific inventions at the Exhibition, one of the most interesting and beautiful is the process of glass engraving by means of the sand-blast. Though brought out some time since in the United States, it is only now that we in England have an opportunity of seeing this process at work. The machine is in Room V., and is numbered 4,886.

The main object of the inventor is to engrave ornamental and other devices upon plain and coloured glass, upon stone, and upon metallic surfaces, in an expeditious and economical manner, and with a sharpness which is unattainable by any other means. The invention, which applies chiefly to intaglio and flat relief engraving, is based on the fact that when glass, stone, or metal is subjected to the impact of a blast of sand, or equivalent hard granular substance, the detrition of the surface exposed to its action will be rapidly effected. Strangely enough, although the sand-blast acts with energy upon hard or brittle surfaces, it has little or no effect upon elastic and soft substances, such as india-rubber, wax, paper, and lace, and it is upon such substances, therefore, that the patentee relies for protecting those parts of the glass, stone, wood, or metal which are intended to be untouched by the sand-blast. The efficacy of the blast depends upon its velocity. The sand may be propelled either by steam, water, or air, but steam is in general preferred where high velocities are required.

The process is very simple. A bit of lace is spread over a piece of glass, the jet directed on it, and in a few seconds the surface of the glass unprotected by the lace is cut away and made into "ground glass," while the pattern of the lace is marked out in smooth, untouched glass. To produce glass "ground," or opaque, on one side, a sheet of glass is placed on rollers under a stream of sand driven through a long slit at right-angles to the plane of the glass, and as the whole surface of the glass passes under the jet it is all evenly ground or frosted. By using sheets of variously-coloured glass cemented together, and hollowed out to various depths, coloured designs may be produced, but the most beautiful effects are obtained by the employment of photographs on gelatine (like those used in the heliotype process), which are attached to the glass before its exposure to the jet. The sand cuts away the finest lines of the glass when it is uncovered, but leaves smooth the portions protected by the soft gelatine. There are now on view in the Exhibition some really exquisite specimens of pictures on glass produced by this means.

Another application of the process is for stone carving. By its use perforated stone work and tracery like that now existing in some of the old Indian temples is readily produced. The most intricate and delicate lace-work may be cut out of the hardest stone in a way that no mason's chisel could ever effect. Work like this might form an absolutely new feature in architectural decoration, as ornamental gratings of stone and marble might re-place those now made of iron. When, as in this case, a large quantity of material is to be removed, a steam jet, of from 40 to 50 lbs. pressure, is used, and the stencil is made of iron or rubber. This stencil gradually wears away, but much less rapidly than the stone. When a small quantity of material is to be worn away, or the surface merely depolished, as in ornamenting glass, a jet of air of from $\frac{1}{10}$lb. to 1 lb. pressure is preferred. With a steam jet using two horse-power of steam at 70 lbs. pressure, and one pint of sand, two cubic inches of granite, four cubic inches of marble, or ten cubic inches of sandstone, may be cut away per minute.

Besides the objects already mentioned, it is stated that the blast may be applied for cutting grooves in quarries and tunnels, for cleaning scale from metals, for cutting stone in lathes, and for effecting various other processes.

A Committee for the erection of a monument to Liebig has been constituted at Munich. Councillor von Neithammer is the chairman, Prof. Von Bischoff the vice-chairman, and professors Vollhard and Von Jolly are the secretaries. The King of Bavaria has subscribed 1,000 florins.

The *New York Semi-Weekly Times* says that in an old map, ordered by Parliament in 1771, and printed in a book of travels at that time, the petroleum deposits of Pennsylvania are all laid down and marked.

The amount of gas consumed by the city of New York alone each year is estimated to be not less than 4,000,000,000 feet.

EXHIBITIONS.

VIENNA EXHIBITION.

A meeting of Her Majesty's Commissioners was held on the 15th of May, at their offices in the Exhibition ground, under the presidency of his Royal Highness the Prince of Wales, K.G. There were present:—Sir Andrew Buchanan, G.C.B.; H.S.H. Count Gleichen, R.N.; Sir Anthony de Rothschild, Bart.; Sir Richard Wallace, Bart., M.P.; Mr. Henry A. Brassey, M.P.; and Mr. P. Cunliffe Owen, secretary.

On Saturday afternoon, in presence of the Prince of Wales, steam power was for the first time applied to the British machinery.

The following account of the British Commission House is taken from the Vienna correspondent of the *Daily Telegraph*:—The house, a one-storied, oblong square corrugated-iron building, containing eight rooms, offices lavatories, &c, has been lent to the Commission by Mr. Hemming, the building contractor, who has run up so many temporary constructions in the Exhibition grounds—amongst others the English and Italian restaurants, the Paget pavilion, &c. It stands upon a terrace, raised nearly three feet above the level of the garden ground surrounding it, which terrace, extending completely round the house, and paved with encaustic tiles of great beauty, both as regards pattern and colour, is the work of Messrs. Minton and Hollins, of Stoke-upon-Trent, and is adorned at short intervals with the most magnificent productions in pottery of that firm—huge vases of a deep glowing green, graceful urns tenderly tinted and delicately enriched with surface outgrowths of ornament, *faïences* of the quaintest design, but all quite lovely in colour. As you enter the house the first room to your right is that upon which the greatest decorative ingenuity has been expended by some of our first art industrials. It is the "Commission," or, by courtesy, the "Prince's Room," a well-proportioned apartment, about twenty feet by twelve, which, as well as the rooms adjoining it, has been entirely furnished and decorated by Messrs. Jackson and Graham, of London. Here may be seen, in all its pride, art furniture supplemented by art *tapisserie* and ceiling decoration, and set off by art ornaments and accessories. The room glows, but not garishly, with rich deep colour; there are no loud obtrusive hues—all are subdued in tone, cognate, and true to "Farbenharmonie." The carpet in this room—as indeed in every other throughout the building—is a contribution from the ateliers of Mr. John Lewis, of Halifax, and is a *chef-d'œuvre* in its way. Messrs. Winfield, of Birmingham, have supplied, at their own expense, the gorgeous sphinx chandeliers and candelabra; Simpson and Sons (Strand), a fireplace, of lustrous browns, greens, and yellows, with excellent panel-drawings on toned grounds; Trentham and Co. have fitted a handsome stove into the wonderful fireplace, affording an interesting contrast between modern utilitarianism and old-world decorativeness—a contrast free, however, from incongruity, by reason of the artistic character common to both its factors. The "Prince's Room" is further embellished by some exquisite ironwork flower-stands, reading-lamps, bookstands, and brackets sent in by Messrs. Barnard, Bishop, and Barnards, by Mr. Pillischer's elegant lamps, and by Messrs. Elkington's silver and bronze ornaments. To your left on entering, exactly opposite to the Prince's Room, and corresponding to it in size and shape, is a reading and reception room, for the use of the commissioners. This is also splendidly furnished by Messrs. Cooper and Holt, decorated by the Pavy Felted Paper Company with fluted tent-ceiling in gay colours and tasteful *tapisseries*, and contains, amongst other works of art upholstery and iron-work an inlaid dressing-table by Barnard and Bishop, of remarkable lightness and elegance. The two first named firms are also fitting and decorating the "Exhibitors' Club Room," a building constructed by Mr. Hemming, behind the Commission House, and for which the British exhibitors have to thank the private liberality of the Commissioners, who subscribed to pay for its erection, &c., out of their own pockets. The lavatories, &c., are the work of Mr. Jennings, and excite certainly as much, if not more, admiration amongst foreign visitors than any other part of the Commission House. An Imperial personage, who inspected them, observed to me on leaving the Prince's lavatory, every detail of which is really admirable, "It is in arrangements like these that the English are unapproachable by any other people—ils sont absolument sans rivaux à l'égard de tout ce qui concerne le confort et la propreté." The noble iron railing envisoning the whole of the Commissioner's miniature domain has been presented by the Coalbrook Dale Company. There are many more artistic and beautiful objects worthy of mention collected together within the iron walls of our cosy Commission House more than I can at this moment call to mind—but enough has been said to prove that it is in every respect worthy of the bright escutcheon that glitters over its portal. Its situation is most happily chosen; for, standing on its steps, you can see before you the British Department in the Industry Palace itself, and to your left the British Agricultural Annexe, whilst a few steps to the rear will bring you to the British section of the machinery hall, close to which, again, are the English workman's dwellings and boiler-houses. Our whole department, in fact, is, so to speak, in a ring fence, and the centre of the ring is the Commission House. It is to be hoped that the great exertions and patriotic free-handedness of the Commissioners, who have already subscribed for the completion of the British part of the show nearly three times the amount of the small public grant originally placed at their disposal, will be fittingly appreciated by the nation at large, and by British industrials in particular. As the Prince of Wales said, in his excellent speech of Saturday, addressed to the working men, "Nor time nor money have these gentlemen spared to further the achievement of England's share in the great work we are all engaged in." For the time England can but offer them her gratitude, but I hope she will not accept the sacrifice of their money.

In the space allotted to Mr. R. Minton Taylor, of Fenton, is shown a fine collection of plain, encaustic, and majolica slabs, and other similar objects. At each end of the wall-space there is a complete piece of wall-tiling, including dado, wall-space, and cornice. Both compositions are classic; that on the left hand is characterised by simplicity of design, while that on the right, composed mainly of majolica tiles in relief, is rich and ornate. Between the two are shown the principal members of a tile reredos, with large pictorial representations of the "Agnus Dei" and "The Pelican in her piety." Several sections are shown of an exceedingly rich and elaborate floor which Mr. Taylor is laying at Biddulph Grange, for Mr. Robert Heath, and there is also a specimen of a reproduction of a tiled floor of the thirteenth century. The exhibits have been produced under the art superintendence of Mr. G. Eyre.

Moscow Exhibition.—It is announced by Monsieur Saenger, the secretary to the above Exhibition, that the medals awarded to exhibitors will be supplied on payment of the cost of the metal, and that the prices will be as follows:—The grand gold medal, 170 roubles; the smaller gold medal, 80 roubles; the grand silver medal, 15 roubles; the smaller silver medal, 7 roubles; the bronze medal, 2 roubles. The rouble is equal to rather more than 3s. English money, but varies according to the rate of exchange.

PAPER OF JUTE.

The *Dundee Advertiser*, for May 14, was printed on paper made of jute, the first time such an experiment has been made. The paper, though thin and transparent, and of rather a yellow tinge, is by no means bad, and after a few more experiments it will doubtless be much improved in quality. The quantity of jute suitable for the purpose, and now in the market, is considerable, and at the present price of paper the utilisation of a material such as this would prove an immense boon. The paper on which the *Advertiser* was printed was made from old jute bagging, and it is said that the class of jute which will probably be found most suitable for paper-making, in respect of cost and production, is that known as "rejections," which can be bought in any quantity in Dundee at £9 10s. per ton. That, no doubt, is somewhat dearer than esparto, but while the outcome of paper from Esparto is only about 50 per cent., that from jute may be taken at 70 per cent., so that the yield more than compensates for the difference of price.

By way of encouraging the manufacture, the proprietors of the *Advertiser* offer the following two prizes:—1st. A premium of £50 for the best ream of paper made entirely from jute suitable for printing their journal, of its average size and weight, and of which the maker will undertake to supply 50 tons at a price not exceeding 4½d. per lb. 2nd. A premium of £100 for the best ream of paper made entirely of jute, suitable for printing their journal, of its average size and weight, and of which the maker will undertake to supply 100 tons at 4d. per lb.

INDUSTRIES IN THE PROVINCE OF MESSINA.

Common hard soap is manufactured in Messina, Milazzo, and Roccalumera, and is chiefly consumed in the towns and villages of the province. There are extensive wine factories at Milazzo and Lipari. The wine is shipped off to Naples, France, Germany, and the United States. Cream of tartar is manufactured in Messina, Roccalumera, St. Teresa, and Barcelona, and is exported to all parts of the world. The essence of lemons and oranges, and boiled and raw lemon juice, are made in Messina, Roccalumera, Spadafora, Barcelona, Patti, St. Agata, and at all places where the lemon is cultivated. These important productions are exported to all parts of the world. Flour and maccaroni are manufactured in Messina and Milazzo, and are principally consumed in the island. Sea biscuits are made at Milazzo for exportation. Starch is made and consumed in Messina. Tunny fisheries, on a large scale, are established at Milazzo, Oliveri, and Patti; the fish is salted in great quantities, and is sent in the interior, to the coast of Italy, the Adriatic, and Malta. There are several steam and other silk filatures in Messina, Patti, Itala, Roccalumera, Fiumedinisi, St. Teresa, Casalvecchio, Barcelona, Giojosa, Marea, St. Angelo, Cape Orlando and Naso; the silk produced is chiefly sent to France and Italy. Wool is obtained at the sheepfolds in Mistretta, St. Fratello, Capizzi, Caronea, Montalbano, and Francavilla, and is chiefly consumed in the island. In many of the mountain valleys a very coarse cloth is made, and is well adapted to the wants of the country people in the winter time. Straw hats, of a very common kind of straw, are also made in Messina. They are used by the lower classes, by the country people, fishermen, &c. There are several small tanneries in Messina, and two in Barcelona. The produce of the same is consumed in Sicily and at Naples. Gloves, in large quantities, are made in Messina, and are exported to the United States, France, and Germany. There are several quarries of variegated marble at Taormina, and there are deposits of lignites at Salico and Banso, in the neighbourhood of Messina. At Gesso there are mountains of good gypsum and alabaster. Lipari contains almost inexhaustible quarries of pumice-stone. At Patti there are thirteen earthenware factories working all the year round. They make several kinds of culinary vessels, which are shipped to every part of the island and to the coast of Barbary. Large quantities of casks are made at Messina for the Levant. Not much attention has hitherto been devoted in this province to improvement in the culture of land. The fertility of the soil cannot be disputed, and will doubtless be eventually developed.

CORRESPONDENCE.

THE NEW TAX ON KNOWLEDGE.

SIR,—We all like Mr. Stansfeld. Popular measures are always safe with him. He is the man to put our local taxation into the right groove. But last night, though he touches with merciful finger the sacred interests of Church and Chapel, he aimed his clenched fist at Mechanics' Institutions. Let me then ask all the host of their literary members at once to protest against his ill-judged proposal to lay a taxing hand on their Institutions.

While he calls aloud for National Education, cost what it may, he would remove the exemption hitherto willingly extended to our institutes.

If any bodies have forced on our governing classes to the acquisition and diffusion of useful knowledge, they have done it. What crime have they committed to be taxed when millions are voted for the very work which they have so successfully promoted?

They have welcomed every little cup to dip into their fountain of knowledge. More than this, they have caught the most unwilling among their enemies, and have taught them to talk so white out of the House that they could never with any grace talk black when National Education was the measure within the House. Let me, then, appeal to every literary member in the three realms, to tell his representatives that of all things, next to ignorance, taxation is the thing he likes the least.

I am, &c.,

JOHN BENNETT.

Cheapside, May 6, 1873.

GUN-COTTON v. GUNPOWDER.

SIR,—It does not appear at all probable that the manufacture of gun-cotton can ever be reduced to a simple manipulation, as is eminently the case with ordinary powder that requires no scientific knowledge, and can be made by anyone, better or worse, according to his ability, but still available for its intended purpose. On the contrary, the skill and science of the first-rate chemists of Europe and America have been devoted to the manufacture of gun-cotton, sometimes termed tri-nitro-cellulose, or pyroxilin, without having attained complete success. Even if ultimately successful, the process cannot be conducted without the constant supervision of high chemical science. There are so many details required in the preparation of the ingredients, in their composition, and drying, that it will be impossible always to avoid failure in some particular, resulting in disaster both to makers and users.

Perfect gun-cotton may possibly be much superior to ordinary powder, weight for weight, or bulk to bulk; but the difficulties in the manufacture, the cost, and danger, will more than over-balance any such valuable qualities, while the attainment of the hoped-for perfection in the manufacture has been, and is still, retarded by the number of patents relating to gun-cotton; for all new inventions require improvements, which can only be introduced by the patentee himself, to be secured, of course, by additional patents. They cannot be added by other parties without securing them, when both patents become useless unless combination take place.

For a similar cause the sewing machine remained nearly dormant for more than twenty years, and it is only of late that improvements have now rendered it a cheap household implement, a benefit of which the public have been for so many years deprived by the vagaries of patentees; but perfection is still remote, and will remain so as long as we persist in upholding exclusive laws. The breech-loading rifle is in precisely the same predicament, overloaded and smothered by innumerable patent rights.—I am, &c.,

Henry W. Reveley.

Reading.

GENERAL NOTES.

The Cornwall Polytechnic Society.—The Exhibition of this Society will be opened early in August, at Falmouth, and all articles for exhibition must be forwarded at least one week before the opening. Medals and prizes will be awarded for useful inventions or improvements, which must be explained by models or drawings and descriptions. The following special premiums will be awarded:—For the best model and best plan for improving the ventilation of mines, £10 and £5; a premium of £5, given by the *Mining Journal*, for the best paper containing an account of methods of mining practised elsewhere, applicable with advantage to Cornwall; for practical suggestions, with models or drawings, as to the motive power to be employed in driving boring machines in Cornish mines, including the method of conveying the power to the machine, £10 and £5; for models of steam stamps, three, two, and one guineas; for the best working plan of a mine in full work, £5 5s.; models or plans of a new safe contrivance for lowering or raising miners, two premiums of £5 5s. Prizes are to be given for good workmanship in models, &c., and sectional models of a Cornish engine and pump lifts or pit work will be rewarded. Prizes are also awarded in other sections. Full information may be obtained from the Secretary, Mr. J. H. Collins, F.G.S. Polytechnic Hall, Falmouth.

Chemical Respirator.—One of the most recent applications of Professor Tyndall's observations upon the power of cotton wool respirators to stop particles from entering the lungs is that of Messrs. Barton, who have patented a respirator for use by miners, firemen, and others who are forced to enter places filled with noxious vapours of any kind. This respirator consists of a metal case packed with cotton wool soaked in glycerine and pieces of charcoal; it is fitted to a helmet which is worn by the firemen or miners. Other inventions for the same purpose have depended on an external supply of air, driven in through pipes, as in a diving apparatus, but this requires no connection with any external apparatus, and has consequently a considerable advantage. It is stated that experiments made with it have proved entirely satisfactory.

Adulteration in France.—The Tribunal of Correctional Police, Paris, recently tried two men—Crépin, a concierge, and Shiemer, for a new kind of adulteration. They had invented a substitute for coffee, which they called "exotic grains," and manufactured from the dregs of the real article, purchased from *cafés*, mixed up into a paste with flour and water, shaped into berries, and then roasted. The composition was sold to grocers at 1f. 60c. per kilogram, and the books of the defendants showed that a ton and a half had been disposed of in the trade. They were condemned to six months' imprisonment. Twelve grocers were at the same time condemned to a month's detention for selling coffee mixed with this compound.

New Gas.—A company has been formed under the name of the "Home and Foreign Gas Licensing Company (Limited)," for the purpose of working "Parker's gas" patents. The process consists in utilising coal-dust, which being mixed with caustic lime, is distilled in pretty much the ordinary manner. Gas is also to be made from petroleum which has previously been absorbed by lime. The mixture is said to be perfectly safe to handle and transport. The process is reported to have been successfully tried at the Bewdly and Bromyard Gasworks.

NOTICES.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

CANTOR LECTURES.

The Third Course of Cantor Lectures for the present session is "On Wines; their Production, Treatment, and Use," by J. L. W. Thudichum, Esq., M.D. The Course consists of six lectures, the last of which will be given on Monday evening next, the 26th of May.

Lecture VI.

The wines of Germany; Riessling a type of bouquetted wines. Classification of the wines of the world, as determined by quality, quantity, value in the market of highest and lowest qualities. Active ingredients of wine. Use of chemical analysis. Use of wine to the healthy, whether old or young; wine, under which condition preferable to all other alcoholic liquids. Wine should be a beverage, not a dram. Use of wine to the delicate and sick. Selection and prices of wine. Proposed modification of the import duties, to adjust them to the climatic difficulties of Spain and Portugal.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...**SOCIETY OF ARTS, 8.** Cantor Lectures. Dr. Thudichum, "On Wines; their Production, Treatment, and Use."
Royal Geographical, 1. Annual Meeting.

Tues. ...Medical and Chirurgical, 8½.
Civil Engineers, 9. The President's Annual Conversazione at the Exhibition, South Kensington.
Royal Institution, 3. Mr. J. H. Parker, "Archæology of Rome."

Wed. ...Geological, 8. 1. Mr. J. Clifton Ward, "On the Glaciation of the Northern part of the Lake-district." 2. Mr. Frederic Drew, "Alluvial and Lacustrine Deposits and Glacial Records of the Upper Indus Basin." 3. Mr. W. T. Blanford, "On the Nature and probable Origin of the Superficial Deposits in the Valleys and Deserts of Central Persia." 4. Mr. James Buckman, "On the Cephalopoda-bed and the Oolite Sands of Dorset and part of Somerset."
Archæological Association, 8.

Thurs...Royal, 8½.
Antiquaries, 8½.
Philosophical Club, 6.
Royal Institution, 3. Professor Tyndall, "On Light."
Society for Encouragement of Fine Arts, 8. Mr. H. C. Selous, "Form and Motion."

Fri ......Royal Institution, 9. The Earl of Rosse, "On the Radiation of Heat from the Moon, the Law of its Absorption by our Atmosphere, and its Variation in Amount with her Phases."
Architectural Association, 7½. Mr. F. T. Dollman, "On Altars."

Sat......Royal United Service Institute, 3. Captain H Brackenbury, "The Tactics of the Three Arms as Modified to Meet the Requirements of the Present Day." (To be followed by a discussion.)
Royal Institution, 3. Mr. J. Morley, "The Historic Method."

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ALBERT GOLD MEDAL.

The medal has this year been awarded to Mons. Chevreul, Member of the Institute of France, and Director of the Gobelins and of the Jardin des Plantes at Paris, for his valuable researches in connection with Saponification, Dyeing, Agriculture, and Natural History, which, for more than half-a-century, have exercised a wide influence on the Industrial Arts of the World.

MUSICAL EDUCATION COMMITTEE.

The Committee met yesterday, the 29th instant, at Clarence House. Present—H. R. H. the Duke of Edinburgh (in the chair). Mr. H. Cole, C.B., Mr. A. S. Cole, Major Donnelly, R.E., Major-General F. Eardley-Wilmot, R.A., F.R.S., Lord Gerald Fitzgerald, Mr. C. J. Freake, Mr. Frank Morrison, Admiral the Right Hon. Lord Clarence Paget, K.C.B., Mr. J. F. Puttick, Mr. Samuel Redgrave, Lieut.-Col. A. Strange, F.R.S., with Mr. Le Neve Foster, Secretary.

The Committee took into consideration the report of the Sub-Committee as to the best means of raising funds for the erection of buildings suitable for a National Training School for Music, and agreed on a preliminary report, recommending the special steps necessary to be taken for at once establishing, on an independent basis, the National Training School for Music. They also authorised the preparation of plans for buildings and the necessary estimates.

PURCHASE OF RAILWAYS BY THE STATE.

A special meeting of the Society will take place, by order of the Council, on Friday, the 13th June, at 12 o'clock, when a paper will be read by William Galt, Esq., "On the Purchase of the Railways by the State." The Right Hon. the Earl of Derby will preside.

CONVERSAZIONE.

The Society's Conversazione will be held at the South Kensington Museum on Friday evening, the 28th June. Cards will be issued in a few days.

PROCEEDINGS OF THE SOCIETY.

COMMITTEE ON THE MEANS OF PROTECTING THE METROPOLIS AGAINST CONFLAGRATION.

The following evidence was given before the Committee by Mr. Samuel Sharp, Architect:—

Q.—You have paid special attention to the subject of fireproof construction?

A.—Yes; I have for some time.

Q.—What are the principles and plans you propose?

A.—I propose a construction of fire-brick, in which material I have had some practice in building coke-ovens, in which I used jointings of fire-clay, instead of jointings of mortar or cement. The following is a statement of the principle of the plan I propose:—I propose to make each room of a single warehouse intact, entirely self-contained, so that, should the goods in it ignite, it could be shut off from every other part of the warehouse; and even if all the goods in it were to be consumed, the fire could not communicate with any other part of the warehouse. I begin with a single room on that plan; that is a warehouse in itself and it is made perfectly fireproof by being built of fire-bricks joined with fire-clay, so that it becomes part of the brick itself. That idea forms the basis of the system, which could be amplified to any extent, either by additional stories or multiplying the rooms on each floor, care being taken in planning that proper communications should be made in the most simple and ready manner to each room by corridors, these corridors having only outside doors, excluding as much as possible the external air. There is no opening up to the external air in the warehouse at all—no opening from floor to floor. In going into each warehouse you would enter into a corridor first, and the only opening externally would be the windows. All the staircases should communicate only with the corridors, and be, whenever possible, outside the walls. The corridors would each form a perfectly fireproof gallery, giving by the outside staircases ready command over each room in the warehouse. I propose to divide each room by walls in bays, so as to separate the goods as much as possible, keeping in view the convenience of stowage (these bays in the larger warehouse might be divided by doors), so that if the goods in one bay ignited they would not affect the goods in the other bay before the fire was extinguished. All the rooms would be simple multiples of one room, and when you get to a larger scale you divide those by bays into so many compartments, with a tramway to take the goods out. I propose to construct all walls, roofs, and floors, of fire-clay bricks, and all doors and shutters of fire-clay blocks; each room to be vaulted, so that whether the warehouse should consist of simply one room on each floor, or complicate, it would be entirely vaulted throughout, so that by closing the doors and shutters each room, corridor, or the entire warehouse would be hermetically sealed and perfectly fireproof, either from without or within, as it is proposed to glaze (same as earthenware) the inside walls, arches, doors, and shutters, on both sides. That is as far as the construction of the building goes. The other part is the extinguishment of fire by water. I propose to lay tubes of fire-clay in the spandrels of the vaulting, with small jet tubes of pipes commanding each bay, room, or corridor of the whole warehouse, so that on the first sign of fire the water could be turned on to any part required. Should all the goods in one room be on fire, by closing the doors and shutters, and turning on the water and flooding the entire room, the fire would be put out without in the least endangering the other rooms of the warehouse. In this case water would be let to run down the walls themselves, and also, to prevent injury from adjoining premises being on fire, the water would be allowed to run down the outside walls in one continual flow. The outside walls, doors and shutters being of fire-clay, aided by this continual flow of water, the warehouse would be perfectly safe from all external fire, however furious. The floor of each room would be so laid as to carry off the water, by this system of pipes, down to the main sewer or sewers of the general drainage. The water to be obtained from water-works, if any; if not, a tower to be provided. I also propose to open and shut all doors and shutters, and work all cranes by water. The watchman to see all doors and shutters closed, and to have a full knowledge of the water-scheme, plan of all pipes, &c., so that he could at once lay on the water to any room or corridor; and to see that the system is in working order he should, whenever a room is empty, or at stated times, flood it, to see all is in working order, and also to cleanse the room.

Q.—The general idea is, that in this construction you exclude the use of iron?

A.—Entirely; that is the main principle; and I use fire-clay instead of the ordinary brick.

Q.—What do you get by the use of fire-clay instead of ordinary bricks?

A.—You get a perfectly fire-proof building.

Q.—If you apply sufficient heat to Stourbridge bricks, although you do not get through so quickly, yet, with an intense heat, you would get through that?

A.—That is impracticable. No fire that you could make in a warehouse, or adjoining to a warehouse, would be of that intensity to injure the fire-clay.

Q.—Then, as respects iron, it is stated that many fires have occurred, and that strings of iron have been seen hanging in a melted condition.

A.—Neither cast-iron nor wrought-iron will stand fire above a certain heat, but cast-iron stands better than wrought-iron, though neither is fire-proof. Cast-iron does not bend so soon, and it is a better thing for standing fire than wrought-iron.

Q.—At the fire which occurred at the City Flour-mills, some of the joists were of wrought iron, and the floors gave way?

A—In a general way they collapse and curl up. They lose their shape entirely, and iron roofs would bend about like serpents; but the rolled iron, which has been proved by trying it in furnaces, does not stand so much heat as cast-iron; of course it is strong, simply by being manipulated. Taking the ordinary run of things, rolled beams and cast-iron columns, with either concrete or brick arches, are, to a certain extent, fire-proof; you may say they are for general purposes; but when you come to a strong conflagration they are not at all. I am referring to such a one as we had in Tooley-street; no iron beams would stand that. I have built coke ovens myself of fire-brick, and it was my own idea to use the fire-clay. We took it out of the pit and made bricks of it, and then built ovens of it, and used the same clay instead of mortar. In the course of a certain time that got burnt, and it was a mass. I have known these ovens twelve years, and they are as good now as when they were built. Some have been built upwards of thirty years; I am speaking of some in the neighbourhood of Barnsley; and I have known the same kind of thing near Durham, at Bishop Auckland.

Q.—The most objectionable point seems the immense number of walls you are obliged to have.

A.—No doubt you occupy space, but the object is to make a fire-proof warehouse.

Q.—Have you built any warehouse upon this principle?

A.—No.

Q.—About what would be the cost?

A.—They would be fully double the ordinary cost.

Q.—It was stated by some of the cement manufacturers at Faversham that they had concrete made of half Portland cement and half sand, and they find that stand in their furnaces as well as the Stourbridge bricks.

A.—I have not seen the furnaces made of that, but it will stand to a considerable extent, and much more so than the ordinary brickwork. I should say that concrete made of Portland cement is the next thing to fireclay.

Q.—You propose to have fireclay pipes; do you think they will hold the water well?

A.—Yes, there is no fear of the pipes bearing the pressure.

Q.—In your experience you have done something in preparing plans for half-tile walls construction; do you think the same construction would be available in this case?

A.—I have no doubt their construction would make a fire-proof building.

Q.—One of the results is that you get a construction with about a quarter of the ordinary material.

A.—Yes, that is the calculation made. It would cheapen the construction to a certain extent, but the labour would be more in proportion. It would reduce the cost perhaps one-fifth.

Q.—Is this system capable of being warmed without danger?

A.—Yes; the whole warehouse could be warmed and kept dry without open stoves or fear of fire.

Q.—If a fire-proof construction is intended, you conclude that the fire-brick material is the thing to be used?

A.—The idea was to make a perfectly fire-proof warehouse without consideration of space, and I did not enter into that question at all at the time.

Q.—You have seen plans into which iron enters?

A.—Yes.

Q.—Will you look at this specification (handing same to witness)?

A.—That is perfectly right as far as it goes. There is nothing new in it. The only thing the patent is claimed for is putting the laths underneath iron instead of wood. There is no advantage in it.

Q.—You think yours, as containing no iron, has the advantage?

A.—I consider that the normal idea. It must be fire-proof. There are two things against it—namely, space for the walls and the extra cost. With respect to staircases, I should recommend, next to fireclay, concrete; and next to that, good hard wood.

Q.—You spoke of doors with firebricks; I suppose those are held in a frame.

A.—They would have to be hung by hinges. It is almost impossible to get rid of the iron, but they might be made to run on very hard wood, that would not be as inflammable as iron. I am speaking of good sound old oak. Plaster is the best non-conductor. If you cover each ceiling it will stand an immense amount of heat.

Q.—What would you use for your stairs?

A.—I would use concrete if it were necessary to go to the expense.

Q.—It is stated, in some evidence, that the fire really advances rapidly up the wooden staircases, and that the wood is the great conductor.

A.—That is so when made in the ordinary way, they are made so loose. If you examine the construction of an ordinary wooden staircase, it seems made to burn. No doubt a building such as I propose would be a very good fire-proof building, and it is merely a calculation of money.

Note.—By an oversight, an extract from some evidence of the late Mr. Mylne, the engineer to the New River Water Company, was inserted as if it were a recent examination of a living witness.

A fire has been raging underground in Holborn, South Shields, over an area of 300 square yards, amongst the pan-ash and small coal, beneath valuable properties, several of which have fallen.

The project of a railroad to carry coal direct from the mines of Pennsylvania to new England is agitated.

ANNUAL INTERNATIONAL EXHIBITIONS.

The Council, having been informed that her Majesty's Commissioners do not intend to publish Reports on the different departments of the Exhibition of the present year, and looking to the great importance to Arts, Manufactures, and Commerce that these annual displays should not pass away without some record, have decided to undertake that duty, and for this purpose have engaged the services of gentlemen specially skilled in the subjects of the several sections, to prepare such Reports for publication in the Society's *Journal.* The Council, however, desire it to be understood that, in publishing these reports, they do not necessarily adopt all the views expressed in them, which must be taken as those of the writers only.

The two following reports are the first that have been issued. The remainder will appear as soon as they are complete.

REPORT ON ANCIENT OBJECTS.

By C. Drury Fortnum, Esq., F.S.A.

For the first time since the establishment of Annual International Exhibitions, Her Majesty's Commissioners have this year determined on devoting some portion of the building to a display of Ancient Objects, in the same categories as those selected for illustration in the general show. Last season, indeed, the unrivalled collection of ancient jewellery, so liberally lent by its various owners, was to be seen in the South Kensington Museum, to which institution it is not improbable that persons might be more disposed to entrust such costly belongings; but it only illustrated one section of the classes selected for the Exhibition of that year,—inkstands, writing materials, and other matters having no representatives of former ages.

Now, through the liberality of many possessors, a very interesting series of instruments for the uses of tobacco, of drinking vessels, and some other objects for table use, adapted to the preparation and partaking of stimulating or of soothing liquids, and the serving of condiments, have been got together and arranged in the north-eastern end of the building.

First among these contributions is Mr. Bragge's matchless and exhaustive collection, illustrative of the uses of tobacco in all ages and all countries since its first introduction. Beginning our survey at the northern end, turning to the left, we see, in the wall cases, all contrivances of the Northern and Central American Indians for the use of the narcotic weed. Here are tomahawk pipes, canoe pipes, pipes of stone from the Red River, of bone, of wood, &c. On the other side of the door is an equally complete array of similar utensils from Central and Southern Africa, some of enormous size, in clay, helmet-shaped, and in stone. Mark also the "sheisha," the under bowl of which is filled with new milk, when prepared for smoking.

Passing down the cases on the window side we find a series of German and French pipes, in porcelain, some cleverly painted, crowned by large developments of the instrument, adorned with coats of arms, and of a capacity sufficient to satisfy a town. Tobacco-stoppers, formed as legs, arms, &c., of the same material. A case contains hookah bottles, for drawing the smoke through rose or other scented waters, of various materials. Persian faience and enamel; others similarly mammiform in hard Chinese porcelain, probably made for the Persian market. Oddly enough, these bottles are described by M. Jacquemart * as for drinking water. He calls them *gargoulettes,* referring to an Oriental miniature by one Kabir, in which their use for that purpose is represented, the water being poured by young maidens into the hands of the thirsty one, who drinks from them as from a cup. Some bottles are of Bidaree ware, others of Wedgwood; and the "chillum," of Northern India, in varied earthenware. Hookah burners also, with multiple bowls, for smoking various prepared substances at the same time.

Near at hand is another case, containing hobble-bobbles and narghilis, a more portable contrivance for the same end; among these are some fine Persian examples, one of old green glazed ware, beautifully mounted. Again, in another are pipes, with their accompanying fire-bowl, used by the Ashantee tribes. An upright case, between the windows, contains snuff and tobacco graters, mostly formed of ivory and wood,—Italian, German, French, and Dutch,—some beautifully carved; some also of iron, of enamel, and of bronze.

Another contains, on the top stage, a complete apparatus for the smoking of opium, in its tray; and, at the side, various large-bowled pipes for the use of that narcotic passport to the land of dreams. On the other side are some charmingly-wrought Japanese pipes, with small metal bowls, to contain sufficient only for three or four whiffs, and load again—delicate contrivance of the Eastern epicure to enjoy the pure aroma of his choicest leaf, without vitiation of its freshness by too frequent percolation of smoke from the superior layer. These used to be described as opium pipes, but they are not such.

We then come to the snuff-bottles, among the most beautiful objects of the Exhibition. They fill three cases; first, those of stone and native materials, of rare green jade, of blood stone, crystal, fossil turquoise (?), and lovely agates. Next, the marvellous imitations of more precious materials in glass, some of the greatest elegance, shaming the ingenuity and artistic sentiment of beauty in our European productions; many of these are modern.

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* Jacquemart, "Merveilles de la Ceramique," part i page 238; and in the "Histoire de la Ceramique" he figures one of these bottles, on plate 5 of that elegant volume.

Snuff-bottles also of amber, exquisite Chinese and Japanese enamel, metal, lac, ivory, &c., &c. Then we have another series, in porcelain, double and single, brilliant in colour as a bed of flowers.

The window cases contain pouches from all parts. Canadian bead and leather work, of Oriental embroidery, of animals' skins, &c., and pipe cases of many materials, some of which are admirably carved.

On the inner side of the gallery the collection is continued. A series of snuff-boxes is perhaps more remarkable for the variety of material and form than for their high artistic value. Also bottles formed of gourds, carved and plain, of horn and stone, Oriental, of metal, and of ivory, European and other. Mark the curious Scandinavian series, like small powder-flasks, and three noble mulls, which crown the case. Tobacco boxes, engraved, Dutch, and English, of notable woods from historic trees and of various fabrics. Then the snuff and tobacco jars of early German stoneware, of the 17th century, of Dutch delft, &c. Cigar cases, of Chilian grass, and others. Snuff mortars and the "German Emigrant" tobacco-box, a figure of some pathos.

Again, in other cases are tobacco-pipes of clay, snake-shaped and maccaroni; some in contorted knots of painful complication, requiring no small skill in the making to preserve the inner tube open and unimpaired.

The last case that we need notice is filled with European pipes in carved wood, stone, bone, metal, meerschaum; a "dudeen," well served with twine, is a Crimean hero; one of steel, formed as a key, and various other fantastic contrivances. Nor must we forget the *chibouques* of Turkey and of Egypt.

Mr. Bragge's collection, in fact, perfectly illustrates the history and art of the uses of tobacco from the first commencement to the present time.

The writer, innocent of its enjoyment, can bear no tender feeling for the narcotic weed; he but values it as an excisable article, worthy to be taxed. Charmed by the living freshness of its broad green leaf, to him the odour of its cremation is unpalatable, the instruments for its contrivance not interesting, except where art is occasionally displayed upon their adornment; neither can he believe in the sanitary or social advantages of its habitual use. Snuff-taking might, perhaps, be condoned, merely through justification afforded by the means—the elegance of European boxes and Oriental bottles—but a waistcoat-pocket full of the grimy dust, after the manner of the Great Frederick, is too horrible a picture, except for history.

Before quitting the subject of Mr. Bragge's collection, we must not omit referring to the large series of early European clay tobacco pipes, stamped with the makers' names, and going back to a very early date, some being anterior, in all probability, by half a century, to the period of the publication of the *Counterblast,** in 1672. Tobacco was first noticed by Europeans in St. Domingo, about 1496, and was in abundant use by the Spaniards in Yucatan, as early as 1520. Sir John Hawkins, in 1565, and Sir Walter Raleigh and Sir Francis Drake, in 1586, have severally been credited for its introduction into England, where it was then only manufactured; it is said to have been first publicly smoked at the "Pied House," in Islington. Proclamations were issued against its use in 1584, and later, in 1614, the Star Chamber levied a duty of 6s. 10d. per lb.; but tobacco, like many a false faith, has survived much persecution.

There are other contributors to the illustration of tobacco. Mr. Franks shows a number of English horn-boxes, interesting from having portraits in relief of Charles II. and other sovereigns, the most numerous being those of Queen Anne. But in point of value for their material, for the enamel painting, the rich goldsmiths' work and jewellery, executed in the finest art of the period, the collection of snuff-boxes contributed by Mr. Mitchell bears the palm. A case of pipes is from the South Kensington Museum.

As a natural sequence, let us now pass on to drinking vessels and other objects for table use, beginning with the larger, the jugs, &c., from which the smaller were replenished.

We should like to have seen here a complete set of the vessels used by the ancient Greeks during their libations. The *crater*, or *celebe*, into which the wine was poured from the *amphora* and mixed; then ladled with the *cyathus*, or *trulla* (the *scinpulum* being probably reserved for libations to the Gods, two of which, an Egyptian and a Greek, of bronze, are in one of the cases), directly into the variously-formed cups of the drinkers, or into the vessel or jug which acted the part of our decanter. But time and specimens were insufficient, and the committee regretfully abandoned the idea.

Of antique pottery, which is not abundantly represented, are some jugs, one of which (from Capua) is ribbed and of unusual and elegant form. Drinking-cups are more numerous. Greek, from Nola, in remarkable freshness; others of tazza form (*cylix*), one of which, belonging to Mr. Soden Smith, is remarkable as a specimen of ancient mending with rivets, probably inserted some two thousand years ago; another, of uncommon form, has no foot, but terminates in a point beneath. This, like the *rhytons*, shaped as animals' heads (hardly represented here), must have been emptied at a draught, and "no heel taps." Cups of Castor ware and Roman pottery made in England belong to Mr. Evans; the "hare and hounds" cup from the Rhine, a Roman cup with triple masks to serve as foot, and scaly pine-cone sides. In antique glass there is only a patera and six drinking-glasses of the Roman period, interesting as having been found together in the neighbourhood of Tyre.

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* By King James 1st of England. "A Counterblast to Tobacco," to which is added a discourse by Dr. E. Maynwaringe, proving that tobacco is a cause of scurvy; with Dr. Thompson's treatise against smoking; cautions against drinking, poems against tobacco, by J. Sylvester, &c. London, 1672, quarto, with portrait of King James.

Next we have the Saxon wooden bucket, with bronze hooping and furniture, found at Bradford Abbas, and belonging to Mr. James Buckman; it is described in the account of excavations made of Fairford graves in the "Archæologia."

Of more recent days, the king of jugs is that grand leathern "Jack," which came originally from Kensington Palace, and is inscribed outside C.R., with the crown and date 1646. Of the same material and approximate time is Mr. Faulkener's leathern "botell," and Mr. Franks' silver-mounted mug. Mr. Soden Smith shows jugs and flasks of Bristol glass, one blotched with white and yellow; his also are some "Toby Philpot" jugs, but others belong to Mr. Campbell and to Mr. Franks. The passing thought occurs that these jug statuettes of this beery Silenus of our Georgean era, variously represented, are somewhat typical of the tendency of this section of the Exhibition. Two mounted jugs of Rouen faience, and gourd-shaped bottles of brown Nevers pottery; some ewers of beaten copper and of "latten," or brassy bronze, are Northern Italian, of the sixteenth century, good in forms—derived from the antique—and in external ornamentation. Mr. Temple Frere sends a valuable series of jugs, in delft and German stone ware. A fine silver-mounted flagon of German stone ware, with figures admirably modelled in relief, is from the Bernal collection, and now belongs to Mr. Campbell. Also Mr. Frere's are a "Litron" and a "Dubbel Kan;" these lead us to the tankards, of which that gentleman is also a large contributor. Mr. Alfred Morrison shows a noble old English carved wood — probably walnut — tankard, covered with scenes from the life of Christ, the figures carved in high relief, and with an inscription below. A later arrival is the celebrated "Glastonbury cup," belonging to Lord Arundel of Wardour, and said to have been made from wood of the Glastonbury thorn. Around its sides figures of the Apostles are carved in relief, standing in niches, while on the lid is represented the scene of the Crucifixion. Its probable date is about 1600. From Mr. Franks we have several of stone ware, one a Bavarian marriage tankard, dated 1600, and one of an unusual material—alabaster—carved with figures in relief. Mr. H. Willett sends a variety of jugs and mugs formed as figures—the watchman, toad mugs, foxes' heads, and a tyg, dated 1608.

Mr. John Evans sends a silver-mounted Swedish drinking-horn; Mr. Franks shows others, with ornament in niello, from the Caucasus. Mr. Durlacher a "mazer bowl," mounted in old silver foot and edging. There are some silver cups, English and other, and puzzle-cups of old English earthenware, from which you may drink if you know how, if not, beware!

Flasks, in the same material, are labelled "Sack," which speaks for itself, and "Whit," which probably means white wine. They are of white glazed English faience, and of the seventeenth century; these were doubtless used as decanters for serving the wine at table, their opacity rendering the labelling more necessary. Strangely enough, that learned and charming writer on ceramic history, M. Jacquemart, says of these (*Merveilles de la Ceramique*, Vol. III., p. 213, repeated in the *Histoire*, at p. 568):—"Certaines bouteilles à vins où sont inscrits les noms sack, claret, et whit, et datées de 1642 á 1659, sont considerées comme d'origine Anglaises; il ne sera pourtant pas impossible qu'elles eussent été faites dans le pays de production des vins"—as though they were bottles in which the wine was imported, and not flasks for its service on the table.

Two cases are filled with drinking-glasses, contributed by various owners. Many are old English, for the most part more remarkable for their substantial character than for the elegance of their forms, although there are good and suggestive models among them. Mr. Franks sends good specimens of German engraved glasses with their covers; but one of the most important is an English drinking-glass, engraved by the point, with portraits of Charles "C. R." in the "royal oak" between Charles "C. R." crowned and the Queen "K. Reg.," with the date 1663 and the royal arms. Curious Spanish glasses, with long spouts, like oil cans, are fashioned upon the same principle as the Caucasian vessels. A German "wiederkomm," enamelled with a stag hunt, and some Venetian glasses; German those with ornamentation in gilding between the outer glass and the inner liner. A huge green hock-glass, and an English barrel-shaped goblet, with impressed holes at the sides, for inserting the fingers with a firmer grip. Mr. Soden Smith's English drinking-glass, with a Queen Anne half-crown encased in the bottom. Last, not least, and very curious, is the yard of ale, or "forfeit glass," Venetian manufacture, of the seventeenth century, 37 inches in length, with bulbed end, and capable of containing 16 oz. of liquid.

Mr. Whithead contributes several fox and dog-head drinking-cups, extremely well-modelled in old English pottery and porcelain.

One case is devoted to teapots in variety. Chinese wheel teapots; a beautiful pot of Bötcher's, ware cut and polished on the wheel; Mr. Durlacher sends cock teapots, of fine old Dresden; a house teapot, of old Staffordshire, perhaps Eler's make; one Japanese, quaintly formed as a gourd, surmounted by a mushroom; and an elegant oval pot, with straight spout, of old English porcelain, shaped like those of silver, and ornamented with interlaced basket pattern in blue.

Another case is occupied by teacups, many of which belong also to Mr. Teesdale, and are of porcelain, of English, French, and German *fabriques*, for the most part of the last century. We notice elsewhere some elegant black and silver cups and coffee pot of Turkish earthenware, and some of lustred Persian.

Giant of all the vessels for serving stimulating or soothing drinks is the great "Kiki" or "Kava" bowl, from the South Sea Islands, belonging to Admiral Sir H Denham, the sight of which at once recalls the vivid picture of a "bout" described in that most racy book of travel, "South Sea Bubbles," by "The Earl and the Doctor.' This drink is prepared as follows:—The bowl, which ought to be an old one, is placed in the midst of the chamber; the kava root, chopped into thin slices, is laid before the young maidens who are to prepare it, and who, after rinsing the mouth, chew, or, to use the milder term selected, "ruminate" it into a pulp. This, made into balls of the size of a large walnut, is thrown into the bowl, which is filled up with water; the turbid mixture strained by sponging up with hybiscus fibre, is squeezed into the cocoa-nut bowls from which it is drank. The taste is said to be of a peppery pungency with a dash of rhubarb, and the effect produced a sleepy annihilation, called *nirwana*.

Among salt-cellars may be noted four of bronze, some gilded and with silver, Italian works of the palmy decades of the sixteenth century, full of that masculine vigour and knowledge of sculpturesque design so remarkable among the modellers of that period and art-fertile land.

The Rev. Montague Taylor sends some silver salt-cellars and cruets; but of the latter comprehensive utensil Captain Grover's walks over the course, as does Mrs. Day's beautiful silver bread-basket.

Spoons, English and foreign, occupy a case; many good English examples, belonging to Messrs. Temple Frere, Willett, Soden Smith, and others. Of good material and massive make, these are perhaps more to be admired for such qualities than for elegance of form or ornament, in which they can scarcely claim to rival their Italian, Flemish, and French brethren. Of the last, one, richly ornamented, might be the handiwork of Briot. The long-handled spoons, with small bowls, for eating mulberries, are noteworthy. A huge wooden spoon from the Niger shames any to be won at Oxford or at Cambridge.

Curious among cooking contrivances, and interesting from its history, is the tea apparatus which belonged to the great navigator, Captain Cook, and now to Admiral Tarleton.

The *Bombillas*, or maté gourds, from Monte Video, used for imbibing a strong infusion of the pounded tea through a silver tube, belong to Mr. Franks and Mr. Bland. They may have suggested the use of the straw in sherry cobbler, &c. Curious vessels from the Caucasus, for drinking a mixture of spiced wine, &c., through a long beak, belong to Mr. Franks and Mr. Durlacher; one is niello'd.

Of modern production two cases of stoneware in various forms are exhibited. One by Messrs. T. Smith and Co., of the Canal Potteries, Old Kent-road, who have been particularly successful in their blue colouring of the salt glaze; the other by Messrs. Doulton, whose master-piece occupies a central position in the Fine Arts Gallery above.

Messrs Pellatt and Wood contribute wine and water glasses, some of excellent form; and from Salviati we have reproductions of Venetian *trina*, *laticinio*, *millefiore*, and other ornamental pieces of great excellence.

We should not omit referring to the cheap, but hideous, heavy glass and porcelain jugs, cups, and goblets made for coffee-house use in Belgium. Nor can we greatly admire the wooden tubs in silver mountings, adapted to all purposes of table use by Messrs. Hancock. Beautifully made, no doubt, and neat while new, they are perhaps well suited for the luncheon room of a fancy dairy farm or rustic shooting-box, but hardly elsewhere.

In justice to those gentlemen who, by request of Her Majesty's Commissioners, acted together as a committee for the selection of ancient objects, having regard to their interesting character and genuine antiquity, we feel it only right to note, that in a tall case are contained many pieces of *soi-disant* ancient plate, silver ewers, and drinking vessels, formed as birds, &c.,

which that committee had rejected, but which have been retained (perhaps, with some others, in the category of "reproductions") by the superior direction.

After having made this general survey we may conclude that, although there is much to interest and instruct in this section of the Exhibition, it might be, with the exception of tobacco, more fully illustrated; and we cannot but think that, except for want of sufficient space, its object might be more appropriately and completely carried out at the South Kensington Museum than it can be here.

The numerous valuable objects preserved in that public treasure-house are in themselves a strong foundation on which to ground any further illustration to be gained by specimens obtained on loan; but they should not, for obvious reasons, be permitted to leave it; if sent here at all, every specimen illustrative of the category of the year would be required, a course which, having regard to the convenience of reference by the public, and the safety and preservation of the things themselves, the writer would consider as open to serious objection.

Pass we now on to the silks. One of the first we notice is English, of about 1720, a yellow ground, with pattern painted upon it; not quite lovely. There is a prettier example of the same mode of figuring, on a black ground, in a case near the window, lower down. Mrs. Cosway's dress, of rich brocade, gorgeous of pattern, is very marked, and one worked with gold, in a peculiar but hardly commendable design, is shown by Mrs. Cary. French, of the time of Louis XVI., is a lovely rose-salmon satin skirt and sac, hand-embroidered, with bunches of flowers; and a pale greenish blue, charmingly worked with sprays and knotted bouquets; these belong to Mrs. Robert Hollond. Continuing down the cases on that side, we find some good examples of the rich productions of the Italian looms. Many of these belong to Lady and Sir William Drake. A rich crimson Cardinalic (?) cope, a splendid piece of silk, with bold pattern on gold ground; a cope embroidered in gold on crimson; and various fragments of rich quality and design. In a wall-case at the end are some specimens, gorgeous with gold and silver figuring, in bold designs on purple, white, and crimson grounds; they are said to be Spanish, but we suspect they may have come from the Genoese looms of the 17th, or earlier years of the 16th century.

We must not pass the Oriental silks shown by Dr. Diamond, nor the grand old Chinese piece, wonderful in the animation of its hunting and shooting scenes, apparently for the delectation of a mandarin, who seems to be performing pic-nic. Mrs. Clarke's collection of Armenian, Smyrniote, and Turkish silks and embroidery is to be noted. Dr. Diamond contributes also some remarkable pieces of old English manufacture and handiwork. Very noteworthy is a piece covered with subjects embroidered with the needle; the principal subject is the Judgment of Solomon, who somewhat resembles Charles II. The initials "A. T.," worked in pearls, may be of the owner or the fair artist, a patient and painstaking worker, not aided by much knowledge of design. There were no schools at Kensington to instruct the young ladies of those days.

A white silk quilt is also a remarkable and very beautiful piece of hand-work, with birds, flowers, and fruit outlined in gold thread, and filled in with coloured silks. For richness of effect see the deep crimson table-cover in the same case, with velvet figure on a satin ground; it also is probably English.

Another rich English brocade, superb on a dignified dowager of the last century, is shown by Mrs. Dunlop.

One of the most striking features of this section is the series of coat and waistcoat pieces for Court use by gentlemen, some few of our fathers,' and many of our grandfathers' days. We can hardly believe that such coats of many colours were in use among the fashionable within so recent a period of our more prosaic style. Some of these pieces are as fresh as on the day they were made, but never made up. The waistcoats deserve notice for their charming patterns, enriched occasionally with glass and silver bugles. Some coats in the wall cases are elaborately and beautifully hand-embroidered, on corded silks,—one with gold. The brick-red velvet suit, diapered with white shamrocks, is said to have been worn by George the Third, in 1770;—we hardly like his taste. The Messrs. Simmons are chief contributors of these interesting costumes of the *ancien régime*.

We ought not to omit mention of some Algerine stuffs, of harmonious blending in colour; nor of an elaborately embroidered counterpane, shown by Mr. Dent, and said to have been worked at a convent in Spain.

All of these specimens deserve careful study and consideration by our manufacturers and their designers. There is a fund of instruction in them, from which much suggestive matter may be gleaned; and few manufactured articles of former days have a stronger claim to be judiciously collected and preserved in the museums connected with our art schools than examples of the unrivalled gorgeous silks of Italy, the elegant patterns of the French, or the massive qualities of many of these productions of our old English looms. Those of the East stand on their own ground, unmatched in harmony and power of colouring, in subdued richness of effect, and in the true art of their designs.

SURGICAL INSTRUMENTS AND APPLIANCES.

CLASS X.

By Robert Brudenell Carter, F.R.C.S.,
Ophthalmic Surgeon to St. George's Hospital.

The objects comprised within Class X. are arranged in the west theatre, on the balcony floor of the Royal Albert Hall. They are contributed by seventy-seven exhibitors, of whom forty are traders, twenty-eight are private persons or medical practitioners, and nine are corporate bodies. The exhibition is almost exclusively British, foreign countries being represented by only five traders, five private persons, and three corporate bodies; but it is worthy of remark that many of the manufacturing firms established in London are of foreign origin, as may be inferred from the names of Blaise and Co., Evrard, Krohne and Sesemann, Mayer and Meltzer, and Weiss and Son. The articles shown are very much more numerous than the exhibitors, a single number in the catalogue often referring to a case which contains a large collection of various instruments; but the absence of some of the leading names in the trade, especially of the house that stands highest in repute for quality, and of the house that makes an especial point of cheapness, renders it impossible to say that the English industry of the class is at all adequately or fairly represented. The refusal of Messrs. Weiss and Son to exhibit has induced several practitioners to show instruments for special purposes made for them by that firm; but still the gap left by their absence is one that cannot be filled up by such isolated or casual contributions.

Two manufacturers, Messrs. Blaise and Co., and Messrs. Evans and Wormull, exhibit collections of old and obsolete instruments; and similar collections have been lent by the Royal Colleges of Physicians and Surgeons, by the Royal Medical and Chirurgical, and the Odontological Societies; by other corporate bodies, and by a few private persons. Her Majesty's Commissioners have employed Signor Alessandro Castellani, of Rome, to make exact copies of the surgical instruments discovered at Pompeii; and to these copies he has added a collection of his own, of old instruments found in Italian villages, many of them of the Pompeian type. Hence the visitor is enabled to see something of the history of the mechanical aids of surgery, and to observe the changes which they have undergone from remote antiquity to the present day.

Besides the famous three-branched speculum, which, until its exhumation, was believed to be of comparatively modern invention, the Pompeian instruments consist of probes, small knives, and tweezers, and do not seem to have been fitted for the performance of any of the greater operations of surgery. Coming to more modern times, we find cases filled with more or less coarse and clumsy instruments, which were, nevertheless, well adapted for the purposes to which they were applied. Prior to the discovery of chloroform and its kindred agents, the pain of surgical operations was so great that few persons would submit to them; and the object chiefly aimed at by operators was rapidity, in order that this pain might not be unnecessarily prolonged. The minute and careful study of anatomy is of almost recent date; and, little more than a century ago, the amputation of a limb might be taken as the type of operative surgery. If a leg or an arm was the seat of incurable disease, or had sustained very serious injury, the last resource of the surgeon was to "cut it off;" and, in doing so, he had the twofold object of completing his operation as quickly as possible, and of performing it at a place which should be above the disease or injury, and which should leave a sound and useful stump. Hence his armamentarium consisted, in great measure, of knives adapted to make free and sweeping incisions, and of saws which would divide long bones with the utmost facility. Among the old instruments several circular saws will be observed, constructed to revolve by clockwork governed by a powerful coiled spring, and manifestly capable of much more rapid action than could be effected by any to-and-fro strokes made by the hand of the surgeon. The imperfect knowledge of anatomy in bygone times is well illustrated by a whole class of instruments called "gorgets," which were used to complete the incision in the cutting operation for the removal of stone from the bladder. They were furnished with a beak, made to travel in the groove of a staff previously introduced, and were designed to secure that the surgeon should neither lose his way among the structures, nor extend his incision beyond the limits determined by the breadth of the blade.

At a time when the more general and more profound study of anatomy had already qualified surgeons to deal with the various portions of the human body in a more discriminating manner, when the progress of science was teaching them to distinguish between local and constitutional maladies, when the processes of repair were beginning to be better understood, and when it had been found that wounds, instead of being left to discharge and fill up slowly, might often be made to heal perfectly in a few days, by bringing their surfaces and edges into absolute contact, the discovery of the effects of ether and chloroform suddenly removed the elements of time and pain from consideration. The knife lost its terrors for the patient, and it no longer mattered whether the performance of an operation required two minutes or twenty. From that date operative surgery became what has been called "Conservative;" not in the sense of standing upon the traditions of the past, but in the sense of preserving every portion of the body which it is not absolutely necessary to remove. Thus a disease of the knee-joint, which, in old times, would have been treated by amputation through the thigh, is now treated by opening the joint, by carefully cutting away the affected portions of bone and cartilage, and by closing the wound. Recovery takes place with loss of movement; but the patient gains by the vast difference between a stiff knee and a wooden leg. For operations of this class the wheel-saw of the ancients, or the broad flat saw of more modern times, has given way to a strip of strained watch-spring, its serrated edge capable of being set in any desired direction. The spring-saw, again, must be supplemented by scoops or gouges of various kinds, capable of cutting out the diseased bone that may lurk behind corners, or that may spread irregularly into certain portions of the shaft. And so, not for the diseases of joints only, but for many others, we have instruments adapted for delicate dissection around the limits of the disease, rather than for the coarse removal of portions of the body. We have also instruments for the accurate insertion and securing of sutures, and for other contrivances intended to expedite the work of healing.

The presence of some morbid fluid product within a natural cavity, as in the chest or in a joint, or within an unnatural cavity, as in the case of a large abscess, has long been a source of great difficulty to the surgeon. Such fluid, by its weight and bulk, may not only prevent the restoration of neighbouring parts to healthy action, but is often a source of urgent peril. If it be evacuated by incision, the entrance of air into the cavity is prone to set up decomposition, and may thus produce a speedily fatal issue. By means of an instrument called an "Aspirator," or "Pneumatic Aspirator," which is shown by several makers, many of these difficulties and risks are overcome. The aspirator consists of a glass exhausting syringe, containing about four ounces, and with a piston as accurately fitted as that of an air-pump. Its nozzle is divided into two branches, at right angles to one another, each provided with a secure stopcock. Half-a-dozen tubular gilt needles, of different length and calibre, are each made to fit tightly upon the nozzles. In order to use the instrument, the stopcocks are opened, and the piston is pushed fully down, to expel the contained air. The stopcocks are next closed, and the piston is pulled up to the top and locked in that position by a half-turn, the interior of the syringe being then nearly a vacuum. A suitable needle is then affixed to one of the nozzles, and its point is made to penetrate the soft parts in search of the fluid. When the opening in the needle-point has penetrated to a sufficient depth to be sheltered from the external air, the stopcock between the syringe and the needle is opened, and the latter is cautiously pushed onward. As soon as its point reaches any collection of fluid, this is instantly forced through the tube of the needle into the syringe by atmospheric pressure. When the syringe is full, the stopcock leading to the needle is closed, the other is opened, and the syringe is emptied into any convenient receptacle by pushing down the piston. The second stopcock is again closed, the piston drawn up and locked, and the stopcock to the needle opened; and so on, until the cavity is emptied, or until the operator is of opinion that enough has been removed. Finally, the needle is withdrawn, and its slender track is at once closed by the elasticity of the tissues.

An important class of modern instruments is composed of contrivances for tracing upon paper the extent and characteristics of various vital movements, such as those of the heart, of the pulse, and of respiration, by mechanism somewhat like that of the indicator of a steam engine. Where the physicians of former times could only estimate the characters of the pulse by feel, and express them more or less vaguely as softness, fulness, hardness, wiriness, and the like, and could record them only by the fleeting and deceptive memory of sensations, the sphygmograph allows the pulse to write its own peculiarities on a paper that can be preserved and compared with the results of subsequent examinations. As one illustration of the practical value of the contrivance, it may be mentioned that the pulse trace often allows an immediate opinion to be formed, within a few minutes after the first dose, of the propriety of pushing or discontinuing a stimulant. Instruments of this class are exhibited chiefly by Mr. Hawksley.

The use of mirrors, lenses, and artificial light, for the inspection of portions of the organism which are naturally concealed from view, is entirely of modern origin; and the interior of the eye, the ear, and the recesses of the throat, are now habitually examined in this manner. Ophthalmoscopes, otoscopes, and laryngoscopes, are exhibited by several makers, and there will also be found a variety of instruments adapted for operations upon the throat, and capable of being followed by sight in the throat mirror after they have passed round a corner that conceals them from direct vision.

Mr. Jeafferson, of Newcastle-on-Tyne, exhibits a highly ingenious instrument, of his own invention, for measuring the extent of the field of vision, either by white or by coloured light, and for other purposes important to the ophthalmic surgeon. It is called the "Photoperimeter," and is fully described in a printed paper attached to it.

The applications of electricity in surgical practice are now numerous. Two or three forms of "electric cautery" will be found, a contrivance by which a cold platinum wire may be placed round, or in contact with, any part that it is desired to destroy, and then suddenly heated to redness or whiteness by a galvanic current. Messrs. Evans and Wormull exhibit a "bullet detector," in which the contact of a probe with a buried metallic substance completes a galvanic circuit and rings a bell. Mr. Offord, of 296, Oxford-street, among other electrical appliances, exhibits what is hardly a surgical instrument—although it would often be useful in sickness—a portable call-bell, that can be placed in any room of a house, and rung by a sick person in any other, by the light pressure of a single finger only.

The branch of surgery most generally interesting to the public is, without doubt, dentistry; and in this department some important objects are displayed. The Odontological Society show a number of keys, pelicans, and other ancient implements for extraction, of the period when the sight of a dentist's door was of itself a sovereign remedy for toothache. Among the improvements in dental instruments, the chief are those which illustrate the recent great advances in the art of metallic stopping. Mr. Morrison, of St. Louis, Mo., sends a specimen of his "dental engine," a machine by which a drill, or any other revolving instrument, can be attached to a driving-rod, worked by a silent treadle, and applied within the mouth in any direction. Various forms of automatic hammer, for consolidating gold-stopping by a succession of taps of regulated force, are shown by different instrument makers; and there are also specimens of the sheet india-rubber used by dentists to form "coffer dams," by which a tooth, during the process of stopping, can be absolutely protected from the contact of the fluids of the mouth, which, if they find entrance into the cavity, interfere with the proper adhesion and consolidation of the gold or other material that is employed.

It is necessary also to mention some improved spectacles, exhibited by Dr. Noyes, and made by H. W. Hunter, both of New York, in which the necessary combinations for patients who are astigmatic after cataract operations, are constructed in a novel and ingenious manner. On these, and many other matters of interest, the limits prescribed for this Report forbid me to enter into details.

The number of visitors admitted on Thursday, 22nd inst., was as follows:—Season tickets, 201; on payment of 1s., 3,462; total, 3,663. On Friday, season tickets, 297; on payment of 1s., 4,371; total, 4,668. On Saturday, season tickets, 313; on payment of 1s., 5,083; total, 5,396.

The number of visitors admitted to the Exhibition during the week ending Saturday, May 24th, was as follows:—Season tickets, 1,256; on payment of 2s. 6d., 1,462; on payment of 1s., 17,764; total, 20,482.

The number admitted on Monday was, season tickets, 165; on payment of 1s., 2,765; total, 2,930. On Tuesday, season tickets, 177; on payment of 1s., 3,603; total, 3,780. On Wednesday, season tickets, 244; on payment of 2s. 6d., 1,551; total, 1,795.

A very interesting addition to the Exhibition has been opened in the Indian Court. The majority of the objects have been sent by the Indian Government, and comprise some very fine specimens of native workmanship. There is a very correct representation of a carpet bazaar, with the lay figure of an Indian smoking his hookah; while some very fine Indian tapestry is exhibited by London firms. Among the other exhibits are brass and copper utensils for domestic use, silks from Bombay and Scinde, and models of the various carts, waggons, and palkis used in the mountains. The gold and silver embroidery from Benares and Scinde is especially worthy of inspection. There is also a collection of water-colour paintings by Mr. William Taylor, the late Commissioner, an extensive collection of hookas, some gold work from Central Asia, and some very pretty lace-work from the missionary schools at Madras.

On Tuesday night the President of the Institution of Civil Engineers and Mrs. Hawksley gave a conversazione at the International Exhibition, which was attended by a great number of the members and associates of the Institution and their friends. The arrangements for the reception of the guests had been made on a very liberal scale. The staircases and passages were handsomely decorated with flowers; and, by permission of the commanding officer, the string band of the Royal Artillery, under the direction of Mr. Smyth, played a selection of music in the central room of the picture galleries. A number of recent scientific inventions and new discoveries were exhibited in these galleries, and by the excellent arrangements the guests, after having examined the pictures and inventions, could pass down to the lower gallery, where the machinery was put in motion for the occasion. Among the guests were his Serene Highness the Duke of Teck, the Duke of Sutherland, Lord and Lady Sondes, Sir Morton Peto, Sir E. Belcher, Lord H. Lennox, Dr. Voelcker, and many well known members of the profession. The company was very numerous.

His Imperial Majesty the Emperor of Germany has been pleased to allow the two German military cooks showing camp cooking at the International Exhibition to remain until the 6th July. The attention of the military authorities has been directed to this interesting demonstration of practical science, and it is now intended to invite the Militia and Volunteers to inspect it.

It is well known that the principal object of the establishment of the present series of exhibitions was the diffusion and advancement of technical instruction, and especially amongst the class of skilled artisans. Her Majesty's Commissioners are now engaged in considering the best means for rendering the exhibitions more practically conducive to this end by bringing the lessons to be derived from them directly home to the classes for whose benefit they were instituted. Amongst other steps the commissioners have taken for the purpose they have invited the companies of the City of London to assist them by their advice and co-operation, and their invitation has been received by the City companies in a manner which testifies great interest in the subject. It is intended, as a preliminary step, to hold a conference of representatives of the various companies during the ensuing month. The following companies have already expressed their intention of sending representatives to the conference:—Apothecaries, blacksmiths, clockmakers, clothworkers, coach and coach harness makers, coopers, curriers, drapers, dyers, feltmakers, glass sellers, haberdashers, ironmongers, joiners, loriners, masons, mercers, merchant tailors, needlemakers, pewterers, plasterers, plumbers, saddlers, spectacle makers, stationers, tin plate workers, wax chandlers, wheelwrights, and woolmen.

EXHIBITIONS.

The Vienna Exhibition.—The Vienna correspondent of the *Eastern Budget*, writing on the 24th, says:—"During the last few days the number of foreign visitors to the Exhibition has been increasing, and indeed the progress made in the building has been such that little more remains to be done that could make the Exhibition more interesting. The weather, too, has greatly improved; yesterday was our first real May-day. As for the hotel-keepers, their prices have now fallen to the rates usually charged here during the summer season. A good mid-day meal may be obtained at any hotel or restaurant for from 1s. 3d. to 2s. 6d., including wine, and a good clean bedroom for 2s. a day."

Proposed Art Exhibition at Aberdeen.—The committees appointed at the public meeting some weeks ago have made considerable progress in their arrangements. The exhibition will consist of works of art, divided into the following classes:—1. Paintings in oil or water-colours, miniatures. 2. Sculpture (in marble or the clay model), bronzes. 3. Gold and silver work, jewellery, gems, medals, carved work in wood, ivory, &c., decorative work in metal generally. 4. Porcelain, glass, and pottery, fine old watches, fans. 5. Illuminated MSS., engravings, etchings, and lithographs. 6. Photographic representations of works of art not themselves obtainable. 7. Tapestry, fine stuffs of artistic character and design, lace, embroidery. 8. Furniture of artistic design, antique. The articles must be the property of the persons handing them over, and must not be for sale. The rooms available for the exhibition are the joint town and county hall, the county committee-room, and adjoining rooms. So numerous are the articles already likely to be obtained that the accommodation, large though it be, will, it is feared, be too limited to show them all to advantage. The exhibition will be opened about the middle of July.

The United States Exhibition of 1876.—At the forthcoming Centennial Exposition at Philadelphia, in 1876, it is expected that a large amount of goods from abroad will be exhibited, but the high import duties of the United States' tariff, it is thought, might deter exhibitors from sending their contributions. To avoid this difficulty, and at the same time obey the law, it has been determined to class the exposition buildings as a bonded warehouse. Foreign goods, therefore, will be admitted free of duty and in bond, and when the exposition is over can be returned to their owners. It is only when they are sold in the United States that duty will have to be paid. The exposition buildings are to be in Fairmount-park, on the outskirts of the city, a large tract of land having been laid out for that purpose, spacious enough for the accommodation of the most extended structure of the kind ever erected for any universal exhibition.

The Lichfield Exhibition has, in consequence of the backward state of St. James's-hall, been postponed until August. The applications for space have been very numerous.

Ancient Needlework.—The private view of the Exhibition of Ancient Needlework in the South Kensington Museum is held this day (Friday).

METALLIC COMPRESSION CASTING.

A process, which has lately been in successful operation in the United States, has been introduced into this country by the patentee, Mr. J. J. C. Smith, and from its practical simplicity and general adaptability, as shown in operation at the inventor's offices, Ludgate-circus, it appears calculated to supersede, from its simplicity and economy, the ordinary processes at present in use for moulding, casting, and electrotyping. The two principal points of interest are the use of fine potter's clay, instead of sand, for the moulds, and the injection of the molten metal at the bottom, under great pressure, by a piston moving in a cylinder.

The electrotype process has many disadvantages, being limited to certain metals, the moulds for fine work are expensive, the deposition slow, and every step demands skilled labour, so that it cannot be produced cheaply. In the present ordinary process of moulding, too, the copy is always greatly inferior to the pattern. For objects of high art, manufacture-moulding is but a preparatory process, the skilled labour of the chaser must give it its finishing touches. By this new process of casting under compression, most of the articles in metal which are now produced by the skill of the engraver can be produced in quantity and with a perfection of finish surpassing that obtained by skilled manual labour, and at an infinitely less cost. The class of articles that can be made by this process are most numerous and of general use, and if they can be greatly cheapened and multiplied rapidly, the trade must necessarily expand. It includes such objects as ornamented door-knobs and escutcheons, card receivers or cups in relief, bronze ink-stands, salvers in white metal, silver-plated jewel, caskets, silver ware, clockcases, chandeliers, stamps, dies and brass types for bookbinders, dies or plates for stamping gilt wall papers, fancy borders and large ornamental letters for printers, metallic letters for patterns, hampers, house numbers, letter-boxes. &c., small bas-reliefs in iron and steel, screws and nuts, faucets or cocks.

Mr. Robert Mallet, F.R.S., reporting on the process after minute and careful examination, considers the invention one likely to prove of great importance. He adds—"In soundness, sharpness to form of pattern, perfection and beauty of surface and finish, these castings, untouched by any tool after leaving the moulds, transcend any I have ever seen."

CORRESPONDENCE.

THE NEW TAX ON KNOWLEDGE.

Sir,—A letter from Sir John Bennett, dated the 6th instant, appeared in your *Journal* of last Friday; it is a matter of regret that it did not appear sooner.

The subject is one of serious importance to this and other institutions. Should we be constantly deprived of that exemption from local rates secured to us by the Act of 1843, many societies of this kind must close their doors and the work of education be stopped. I hope it is not too late for the friends of education, in and out of Parliament, to bestir themselves, and wring from government an assent to the continuance of our present exemption.—I am, &c.,

J. S. Noldwritt, Hon. Sec.

Walworth Literary and Scientific Institute,
May 23, 1873.

The manufacture of glycerine has of late, in view of its constantly extending importance in the arts, been greatly expanded. During the past year the production in the United States alone reached 2,000,000lb., of which one firm in Cincinnati manufactured one-half.

The construction of the tramways in Edinburgh has cost about £10,000 a mile.

NOTES ON BOOKS.

Manual du Microscope: Dans ses Applications au Diagnostic et à la Clinique. By Drs. M. Duval et Léon Lereboullet (Paris, *G. Masson*).—This handy little work is intended, in the words of the authors, to aid in microscopic researches, which may be made readily by the bed side of the patient without the employment of complicated chemical agents or delicate dissections. Opening with a practical introduction to the microscope itself, the *chambre claire*, and chemical tests, in the measurement of microscopic objects, micrometers, and other apparatus, the authors deal in successive chapters with the microscopic study of the blood, pus, products of the skin, of the mucous membranes, of milk, &c. The authors state that, after having tested the exactitude of the results, they have given a *resumé* of the "Traité des Humeurs," by Professor C. H. Robin, and of the studies of the maladies of the scalp, by MM. Bazin and Davaine. Each chapter is preceded by an anatomic and physiological *resumé* of the principal facts which are indispensable for the microscopic study of the products of any part of the body, one object of the work being to aid army surgeons who may not have immediate access to classical treatises. The arrangement of the book is certainly methodical, the observations in each chapter being given, almost without exception, in the same order. First, on tissues; secondly, on secretions; thirdly, on foreign bodies; and lastly, on animal and vegetable parasites.

GENERAL NOTES.

Underground Railways in America.—The railroad tunnel at Baltimore, which is to unite the roads on the north and south sides of the city, is to be completed before the end of June, and, until the completion of the Broadway Underground Railway in New York, it will form the largest underground railroad possessed by any city in America.

Melbourne Museum.—The trustees of the Industrial and Technological Museum and the National Gallery, Melbourne, have issued a prospectus setting forth the various arrangements they have made for imparting instruction to all comers. It appears that there are five schools now in active operation—viz., chemistry and mineralogy, mathematics and practical geometry, telegraphy, painting, and design. The first is subdivided into classes for instruction in practical chemistry, elementary chemistry, and mineralogy; and the third for practice of telegraphy and theory of telegraphy. The next competitive exhibition is fixed for June 10.

Canadian Patent Laws. — The Commissioner of Patents, Canada, has presented to Parliament a bill for the further amendment of the Canadian patent laws. The amendment simplifies the preparation of the application, and does away with a great deal of the red tape proceedings now required. The design is to assimilate both the proceedings in preparation of papers and the procedure before the Patent-office to those of the United States.

Alexandra Palace.—On Saturday last the Palace was opened, without any great ceremony, to the public, the principal attractions being a concert and a flower-show. The Palace, like its predecessor at Sydenham, must always be looked upon as an outcome of the movement in favour of Exhibitions with which the Society of Arts has been so intimately connected. It is one of the gains that has arisen from the establishment of Exhibitions that so many places of healthful recreation have been provided for the great London population. The Crystal Palace in the south, the Bethnal Green Museum in the east, and now, the Alexandra Palace in the north, all owe their origin to the same source, and all alike have their useful purpose to subserve in educating and refining the tastes of the people.

Guano Adulteration.—Peruvian guano is frequently largely adulterated with clay, plaster of Paris, ochre, and inferior phosphatic guanos. We have often examined Peruvian guano containing from 30 to 60 per cent. of fraudulently added earthy or other useless matter. When genuine and of good quality, this kind of guano has a light brown or greyish colour. It consists of powder commingled with hard lumps, which, on being broken, exhibit a lighter colour and a crystalline appearance. A bushel of good guano weighs about 70 lbs., whilst adulterated kinds often weigh more than 100 lbs. per bushel. A rough test of the purity of the article is to burn three-quarters of an ounce of the suspected sample upon a piece of tin or iron placed on a clear fire. If the residue be not more than a quarter of an ounce, the guano is probably pure; but if the residue amounts to half an ounce, the sample is either extremely inferior or grossly adulterated.—*Journal of Applied Science.*

A Society for the Promotion of Scientific Industry has just been established in Manchester. Its object is the increase of the technical knowledge and skill of those engaged in the various industries, the improvement and advancement of manufactures and the industrial arts and sciences, and the general progress, extension, and well-being of industry and trade. The society is sending out artisans to Vienna to profit by the exhibition now being held there, as was done by the Society of Arts on the occasion of the Paris Exhibition, and it proposes to hold in the autumn an exhibition of designs in textile fabrics and of fuel economisers. It will be remembered that a letter advocating the formation of the society appeared in the *Journal* of Nov. 1, last year.

Separating Silver from Lead.—In the separation of lead from silver, some improvements have been announced by MM. Risway and Pauville, of Paris. The argentiferous lead is treated with magnesium or aluminium, either alone or alloyed with zinc, and the rich scum thus obtained is amalgamated with mercury. The inventors state that they are able to regenerate the metals which have been used in the process of extraction, and thus have greatly reduced the expense of separating the precious metal from the lead.

NOTICES.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Entomological, 7.
Royal Institution, 2. General Monthly Meeting.

Tues....Anthropological, 8.
Biblical Archæology, 8½. 1. Mr. H. Fox Talbot, "The Legend of Ishtar Descending to Hades." 2. Mr. P. Le Page Renouf, "The Preposition in the Egyptian Language." 3. Mr. R. Cull, "A Remarkable Engraved Babylon Brick Described in the Bible."
Zoological, 8½.
Royal Institution, 3. Mr. J. Parker, "Roman Archæology."

Wed. ...Obstetrical, 8.
Microscopical, 8.

Thurs..Linnæan, 8. 1. Dr. Hooker, "On the Plants of Kilmanjaro." 2. Mr. John Miers, "On the *Lecythidaceæ*."
Chemical, 8. 1. Sir John Conroy, "The Dioxides of Calcium and Strontium." 2. Mr. L. B. Hannay, "On Iodine Monochloride." 3. Mr. T. Wills, "On an Ozone Generator."
Royal Institution, 3. Professor Tyndall, "Light."

Fri ......Royal Institution, 9.
Geologists' Association, 8.
Philological, 8½.
Archæological Institute, 4.

Sat......Royal Institution, 3. Mr. J. Morley, "The Historic Method."

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,072. Vol. XXI.

FRIDAY, JUNE 6, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

PURCHASE OF RAILWAYS BY THE STATE.

A special meeting of the Society will take place, by order of the Council, on Friday, the 13th June, at 12 o'clock, when a paper will be read by William Galt, Esq., "On the Purchase of the Railways by the State." The Right Hon. the Earl of Derby will preside.

CONFERENCE.

The Twenty-second Annual Conference between the Council of the Society and the representatives of Institutions in Union, will take place at the Society's House, on Friday, the 27th June. The chair will be taken at 12 o'clock, by Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman of Council.

Secretaries of Institutions and Local Boards are requested to send, *immediately*, the names of the Representatives appointed to attend the Conference; and early notice should be given of any subjects which Institutions or Local Boards may desire their representatives to introduce to the notice of the Conference.

Secretaries of Institutions are requested to forward *at once*, by book post, copies of the last Annual Reports of their Institutions.

CONVERSAZIONE.

The Society's Conversazione will be held at the South Kensington Museum, on Friday evening, the 27th June. Cards will be issued in a few days.

ENDOWMENT FUND.

The following donations and subscriptions in aid of the Endowment Fund have been received:—

	£	s.	d.
Wm. Atkinson	50	0	0
W. R. Sandbach	50	0	0
Sir Walter C. Trevelyan, Bart.,	50	0	0
James Bentley	20	0	0
Col. A. Angus Croll	20	0	0
John Noble	20	0	0
G. T. Saul	5	0	0
W. R. Spicer	5	0	0
Chas. H. L. Woodd	5	0	0
Geo. W. Hart	2	2	0
John E. Evans	2	2	0
E. T. Blakely	1	1	0
Thomas Dixon	1	1	0
John S. Lapraik	1	1	0

PROCEEDINGS OF THE SOCIETY.

COMMITTEE ON THE MEANS OF PROTECTING THE METROPOLIS AGAINST CONFLAGRATION.

Mr. Henry Marten gave the following evidence:—

Q.—You are an engineer, are you not?

A.—I am.

Q.—With whom did you serve your time?

A.—With Mr. Wicksteed, the engineer of the East London Waterworks. Whilst with him I assisted in the construction of the Hull Corporation Water Works, and was afterwards appointed by him to see his plans carried out for the construction of the Wolverhampton Water Works.

Q.—What will be the cost of the proposed alterations?

A.—The cost of the above-mentioned alterations, for giving the constant, instead of the intermittent, supply at Wolverhampton, will not exceed 6d. a head of the population within the district. This is exclusive of the reservoir, which would have been essential to the continuance of the supply under the old system; including this, however, the whole cost will not exceed 2s. per head of the population. I think there are very few towns in which the cost of the alterations necessary for the introduction of the constant-supply system will exceed 2s. per head of the population, and that in general it will be found much under that amount.

Q.—What would be provided under that charge of 2s. per head?

A.—Where none have been previously provided it will cover the expense of providing the necessary reservoirs, and the alteration of the street mains, with the introduction of the additional stop-cocks, and will be sufficient to prepare all the internal house-fittings for the reception of the constant supply. In almost all towns in which the intermittent supply is in force, the fittings are in a very defective state. The water being on so short a time, it has been thought hardly worth while to see that these are kept in good repair, and consequently they will, as far as the taps and stopcocks are concerned, require almost a complete renewal. The useless piping and tanks, and old metal, however, which may be removed on the introduction of the constant system, will more than pay for these matters.

Q.—You state your belief that the wear and tear of street-cocks will be less under a system of constant supply. Have you observed any difference in the wear and tear of these in streets of much traffic compared with those of little traffic?

A.—I have not observed any perceptible difference between the wear and tear of the valves of cocks placed in a street where there is much traffic, as compared with the valves of those placed in streets of less traffic, but in the former case the iron boxes which cover them are more subject to injury, and we find them sometimes filled with dirt or "sludge" from the road.

Q.—Supposing the levels to be the same, will not the strain and damage of pipes and taps, from the hydraulic jerks, be greater on the intermittent than the constant supply system?

A.—Yes; because, under the intermittent system, the whole pressure of the works is brought to bear upon one particular spot, with a suddenness which often causes considerable damage from the recoil. Under the constant system, however, the pressure will only vary by imperceptible degrees, and there can be no jerks on the mains and pipes. In the houses none of the common bib-taps should be allowed to be used, but should be of the kind termed "screw-down," as they are every way better adapted for high pressure, and do away with all recoil.

CANTOR LECTURES.

The first lecture of the second course of Cantor Lectures for the Session, "On the Energies of the Imponderables, with especial reference to the Measurement and Utilisation of them," was delivered by the Rev. Arthur Rigg, M.A., on Monday evening, February 3rd, 1873, as follows:—

Lecture I.

Introduction—Inter-relations—Units of Measurement, &c.

"Imponderables," as a technical term, was in the last century a name given to those fluids which were supposed to convey electricity, light, heat, &c.; and because these fluids could not be isolated and weighed, all that men received through their agency were also named "imponderables." These phenomena are now regarded as being due to motions in ponderable matter, and they are considered rather as forces causing motion in this matter than either as fluids or as that which can be conveyed, *i.e.*, carried, by fluids. The term is, however, retained as a brief mode of expressing the subject of this course of lectures, especially as no one can confidently assert that it may not again be re-instated in the position it once occupied.

The "energies of the imponderables," then, is a phrase comprehending all results of those unseen, unknown, and by man unweighable powers which pervade space. By such powers the very sun, and planets, and stars are so influenced that they move in harmonious union or oneness, and, therefore, the name universe is applicable. With this extensive view of the influences and actions of the imponderables these lectures are not to be concerned. The bounds of them are, however, easily defined. This earth and that which man can utilise upon it are our limits. Even when thus "cabined, cribbed, confined" to the earth and the handiwork of men, still, those who have perused and thought over the title, viz., "The Energies of the Imponderables, with especial reference to the Measurement and Utilisation of them," may have commented upon it in spirit, saying, "Fools rush in where angels fear to tread." When body, form, and fashion were first given to the scheme of this course, that great was the presumption, and that great, therefore, would be the failure, were not unknown feelings.

The causes of such views are simple and easily made clear. The energies of the imponderables have in one form or another occupied the attention of the most thoughtful as well as the most practical men in every age. They may not have given this name to the subject of their investigation, but, call it what you will, the ultimate source of all power that nature gives to man is to be found in the energy of one or more of those unknown agents to which the name of imponderables has been given. To dwell upon this now would be to anticipate the series of lectures. It may suffice to state that the object of the course is to bring before you illustrations of the modes in which men have been led—or are now being led—to define not only the ways and varieties of ways in which each imponderable acts, but also to estimate by those measurements to which men appeal in material things, the amount or value (if the word be preferred) of that work in material things done by these imponderable elemental powers. To do this involves references, perhaps, in few words, to conclusions at which a life of self-devotion to one cause may have arrived, that life, too, being aided by the very highest of cultivated mental intelligence and the capability of employing such powers of scientific research, the very alphabet of which is beyond the attainment of the majority of men.

Whilst thus frankly, and at the outset, admitting how high a class of mind is required for these original investigations, it must not be overlooked that the principles which have governed the researches of these men, and the conclusions at which they have arrived, may be appreciated by many minds.

When the late Mr. Faraday was discoursing "On the Conservation of Force," he made a statement in relation to an observing and a mathematical mind which will have more weight by your generalisation of his words than by my dilution of them. Hence this quotation:—

"It may be supposed that one who has little or no mathematical knowledge should hardly assume a right to judge of the generality and force of a principle such as that which forms the subject of these remarks. My apology is this:—I do not perceive that a mathematical mind, simply as such, has any advantage over an equally acute mind not mathematical in perceiving the nature and power of a natural principle of action. It cannot of itself introduce the knowledge of any new principle. Dealing with any and every amount of static-electricity, the mathematical mind can and has balanced and adjusted them with wonderful advantage, and has foretold results which the experimentalist can do no more than verify. But it could not discover dynamic-electricity, nor electro-magnetism, nor magneto-electricity, or even suggest them; though, when once discovered by the experimentalist, it can take them up with extreme facility. So, in respect to the force of gravitation, it has calculated the results of the power in such a wonderful manner as to trace the known planets through their courses of perturbations, and in so doing has discovered a planet before unknown. There may be results of the gravitating force of other kinds than attraction inversely, as the square of the distance of which it knows nothing can discover nothing, and can neither assert nor deny their possibility or occurrence."[*]

Influenced by such views as these, it seemed that no disrespect to the highest intellect could accrue from an attempt to make clear, even to the lowest, a few of the fundamental principles from which important truths have been evolved. It must be borne in mind that to illustrate the modes by which these energies have been measured and utilised, and not to make any attempt at measuring them, is the leading principle which, thus early enunciated, may prevent misconceptions of the title.

The very words, "Energies of the Imponderables," are to some minds terms and not realities—symbols, like political watch-words, serving only to classify their professors—things for savans to discourse upon—provinces in that intellectual dreamland in which natural science is supposed to dwell. To the majority of men, to those who toil for their daily bread, and with all their toiling find but scant supply, the monastery of science, in which her monks live apart from the world and all its vulgar cares, seems a paradise in which is no unrest. Such is only one of many thousand delusions. Within the thinly-peopled world of those who investigate the laws of nature, there are all the pleasures and pains which meet the labourer with his spade, the mechanic with his tools, the merchant in his office, or the statesman in his cabinet. It is because students and investigators of nature's laws live much alone—because they cultivate a species of clanship—because there is amongst them a kind of Hindoo caste—that they are seldom in contact and companionship with the toilers in material things. This is much to be regretted. Although both parties are losers, yet the toilers in material things are by far the greatest losers.

Such men as these are the true pioneers of the human race, and that army is ill-directed which allows the work of preparation done by its pioneers to be so far in advance that the mountains they had levelled were again piled up—the rivers they had dried were again flowing, and the thorns once cleared from the desolate prairies were again rendering the ground unfertile. The men of science are they who give the sap of vitality to the tree of commerce. Society plucks the fruit, and seldom waters the plant. Such has been, and such still is, the case with investigators of natural science, if the men amongst whom they live take the fruit and care neither for the gardeners nor the garden.

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[*] P. 364, Proceedings of Royal Institution, on 27th Feb., 1857.

Look at the world—the beautiful glass in some of our stained windows is a lost art. Look at the temples in India, illustrations of which the photographs so truthfully reproduced in this room a few weeks since. Civilised Europe and self-satisfied England cannot, either by their St. Peter's at Rome or those recent productions which we are bound to recognise as the highest attainment of national architecture,—the Albert Hall and adjacent memorial—approach even at a distance. These temples of a religious profession, with which we are not even acquainted, and of which no records remain, abound in an architecture with which neither in its conception nor in its detail have we aught to compare. And of the materials the men of that age used, we may say the stone is stone still; the sharpness of the carvings is sharpness still.

Is all our dolomite a bastard dolomite? Why are we in England obliged to seek for Italians to form our moulds—to pour in the clay, and to sculpture the marble? Why do we go to Germany for our draughtsmen, our science, and our music? and to France for our adornments and our designs.

One illustration of the neglect of obviously social gain from want of scientific attention cannot, in this room, be out of place.

The Society of Arts was founded in 1753, and when the scientifically practical and theoretical minds of Count Rumford and others considered on what basis and why the "Royal Institution of Great Britain" should be founded, they expressed the objects of thus founding a Society, which should supplement the work of the Society of Arts, in the following title page to the charter of 1800:—

ROYAL INSTITUTION
OF
GREAT BRITAIN,
For Diffusing the Knowledge and Facilitating the General
Introduction of
USEFUL MECHANICAL INVENTIONS & IMPROVEMENTS;
And for Teaching by
COURSES OF PHILOSOPHICAL LECTURES AND EXPERIMENTS
THE
APPLICATION OF SCIENCE
TO THE
COMMON PURPOSES OF LIFE.

In reference to the necessity for so supplementing the work done here by our predecessors, in order to "advance the applications of science to the common purposes of life," the then managers state that "the giving of premiums to inventors was done by a most respectable society (the Society of Arts), but to diffuse knowledge needed another incorporation."

Whilst admitting how nobly the Royal Institution has done good work, and how generations yet unborn will look back with reverential gratitude to the boons which those who have laboured within its walls have conferred upon men, it is curious to mark how the views of its founders, and the one great purpose of its formation in 1800, are being realised by the Society of Arts in 1873.

In 1800 the managers of the Royal Institution, as their first act, constituted fourteen committees, for the following purposes:—

1. To investigate the various processes used in making bread, with a view to their improvement.
2. To investigate means for producing cheap and nutritious soups for feeding the poor.
3. Improvement of cottages and cottage fireplaces.
4. Improvements in the construction of stoves for warming dwelling-houses.
5. Improvements in kitchen fireplaces and kitchen utensils of private familes.
6. Improvements of the most useful articles of household furniture.
7. To ascertain, by experiment, the effects of various processes of cookery upon the food of cattle.
8. Improvement of kitchen fire-places and kitchen utensils used on shipboard.
9. Improvement of limekilns.
10. Ascertaining the effects of mixing clay, &c., with coal dust and cinders, in forming fire-balls and combustible cakes.
11. Improving the composition of mortar and cements.
12. To ascertain the best method of building cottages and farm-houses with earth rammed together.
13. A committee of mechanics for the improvement of useful machines of all descriptions.
14. A committee for improving the various processes necessary in producing iron from its ores, and in working and refining of iron and steel.

Thus did one noble foster-child of this Society prescribe its own duty, and, child-like, neglect that particular duty, and now that the child has attained the age of threescore years and ten, the nursing mother, by gold medals and money rewards, steps forward to complete the work begun by her foster-child,* and further, by these annual Cantor Lectures, she now does that which, not being done in 1800, led to the formation of the "Royal Institution of Great Britain."

This comes of the people of a country allowing the science of a country to dwell alone. All advances are first suggested by men who observe and think; they are extended by men who reason and test; they are utilized by men who act.

The pioneers of an army are not the fighting men; sailors navigate the ship; marines do the warfare.

The men who investigate the laws which govern the energies of the imponderables are not the men to utilize and apply them. The practical knowledge—the stimulus of interest—the capital of the manufacturer, are wanting to the philosopher; while the manufacturer on his part is equally in want of the general information and accurate reasoning of the man of science. When the commercial element enters, and another object of regard is set up for worship, the man of science cannot serve two masters; he cannot serve science and mammon. The more earnestly and heartily he serves the former, the less he bows to the latter. The service of natural science has within itself far more ennobling mental rewards than mammon can confer.

Longfellow, in his letter to Agassiz, on his fiftieth birthday (28th May, 1857), after alluding to the sacrifice he made of his country and his home, for the cause of natural history, well expresses what he feels who, single-minded, teaches men to read what is still unread in the manuscripts of God. Agassiz is described as—

> "He who wandered away and away,
> With Nature, the dear old nurse,
> Who sang to him night and day
> The rhymes of the universe."

And then comes a reward more welcome than money or honours—

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* A sum of £500 having been placed at the disposal of the Council of the Society of Arts, through Sir William Bodkin, by a gentleman who does not wish his name to appear, for promoting, by means of prizes or otherwise, economy in the use of coal for domestic purposes, the Council have decided to offer the following prizes:—1. For a new and improved system of grate suitable to existing chimneys as generally constructed, which shall, with the least amount of coal, answer best for warming and ventilating a room.—The Society's Gold Medal and Fifty Pounds. 2. For a new and improved system of grate, suitable to existing chimneys as generally constructed, which shall with the least amount of coal, best answer for cooking food, combined with warming and ventilating the room.—The Society's Gold Medal and Fifty Pounds. 3. For the best new and improved system of apparatus which shall, by means of gas, most efficiently and ecomically warm and ventilate a room.—The Society's Gold Medal and Fifty Pounds. 4. For the best new and improved system of apparatus which shall, by means of gas, be best adapted for cooking, combined with warming and ventilating the room.—The Society's Gold Medal and Fifty Pounds. 5. For any new and improved system or arrangements, not included in the foregoing, which shall efficiently and economically meet domestic requirements.—The Society's Gold Medal and Fifty Pounds.

"For whenever the way seems long,
Or his heart begins to fail,
Nature sings a more wonderful song,
Or tells a more marvellous tale."

This course of Cantor Lectures, in relation to the energies of the imponderables, is to be an attempt to occupy the border-land between pure scientific research and the ministration to social needs; to tread, in fact, upon neutral ground, to launch our boat upon the Rubicon which divides the provinces of science from those of commerce. It does not aspire to any claim on the nests of science; they who build them are welcome to the imagined and worthless immortality of a name. It does not propound to commerce new modes of amassing wealth. They may keep their wealth who can. But it does seek to bring before those whose daily bread and daily luxuries are derived from science, illustrations of some of the truths on which their daily labour rests. It will try to do this in plain and simple form, divested of those higher studies through which these truths have been in some measure attained, and in a thousand ways extended.

That the work is one worthy of all human intelligence may be inferred from the official document given by the authorities of that incorporation of men who are the real rulers of the earth, properly so called. Statesmen and politicians may influence the minds and bodies of men, but engineers influence all material things.

The Institution of Civil Engineers, established in 1818, long before passenger railways, telegraphs, &c., &c., were known, and now numbering among its members men in all parts of the globe, clearly and aptly defined the objects of their incorporation in words well fitted to the purposes of our present consideration. They then (in 1818) defined the object of their association to be "The acquisition of that species of knowledge which constitutes the profession of a civil engineer, whereby the great sources of power in nature —*i.e.*, the energies of the imponderables—are converted, adapted, and applied for the use and convenience of man."

It may be said, and with some show of reason, when the comprehensive title of these lectures is considered, a little well or completely done is better than much ill or very partially done. As a principle in education this is a truism which the Committee of Council on Education and our various School Boards would do well to adopt and illustrate; but these Cantor lectures are not to be scholastic lessons; they may teach, but the primary object of them is rather to be suggestive of thought—to give the minds of hearers and readers food for reflection, material for development, to arouse inquiry, to provoke investigation; to leave, in fact, an unsatisfied impression that there is more than the lecturer has expressed—and there is much for hearers and readers to consider. If thus they only lay in the foundations of knowledge, and in rough and sketchy outline show the superstructure, they will have done good service—they will have stimulated research, and so led to the acquisition of knowledge and a habit of mind more valuable far than any which can be given from this platform to you who sit at ease on those cushioned seats, willing to rest for a while under the delusive spell that the Society of Arts has thus found a right royal road (and perhaps a pleasant one) to learning. Such an unsatisfied feeling in relation to the energies named, and the measurement and utilisation of them, it is the object of this course to endeavour to create. If this result be attained, then in those future years, when by individual labour present difficulties are overcome, and light shines where thick darkness now overspreads, there will be cause for thanks, where, perhaps, when these lectures end an unsatisfied longing may alone be found.

Men need but watch the progress of science truths for a few years, or read the development, stage by stage, of any branch of investigation, to be satisfied of this, that with whatever pertinacity and show of reasoning any theory is propounded and established, it rapidly wanes. Astronomical and geological truths and facts, how often and again have they been satisfactorily (?) explained, and yet how soon and how rapidly has one explanation been so crushed out by another, that the first, which by its authors was applauded, is by the upholders of the second ridiculed.

The theories of the imponderables, with which we must occasionally deal or allude to, but with which we are in no degree further concerned, are, day by day, in a transition state. Like the cause of solar heat, or the rotation of the moon, they are a bloodless battle-field, on which, with our increasing love of talking and our decreasing love of working, words may war with words.

A triumphant victory to-day in science theory, may be the prelude to an ignominious defeat of the same theory to-morrow. Subject, doubtless, to many dissentient views, the belief that he who propounds theory, and uses theories solely as means or ways by which to convey ideas of how such and such facts may perhaps be brought about, and not as expressing a conviction that the way described is the actual plan in operation, he is the truly wise man. Those who allow themselves to dwell upon the conception and the development of theories, who build theory upon theory, who sometimes pile Ossa upon Pelion, and sometimes Pelion upon Ossa, are not unlike those whom Milton describes—

. . . . "Who reasoned high
Of providence, foreknowledge, will, and fate,
Fixed fate, free will, foreknowledge absolute,
And found no end, in wandering mazes lost."

Thus it is that the decisions of one age and one day differ from those of another age and another day. Theories, we must remember, are but opinions; with opinions, as such, this course of lectures is not concerned. The facts of nature, so far as they have yet been made apparent, or may be in process of being so, are our province. They change not. To those who have appealed to nature direct, and brought from her exhaustless stores of knowledge some truths that men may utilise, is due the information which is to be brought before you.

The mode by which they have won this knowledge is exactly that pursued in our courts of law and equity, to arrive at the truth on one point and on one point only. Look how long and tedious legal investigations seem, and yet in how few words the result is declared. Guilty or not guilty—Verdict for the plaintiff or verdict for the defendant. One or other of these very brief phrases records the conclusion or the judgment of many days of patient labours and searchings for truths.

To not less careful questioning by men in years past, as well as now current, we owe all we know of the energies, the measurement and utilisation of which is to be a feature in these lectures. That cross-questioning of the keenest and clearest kind has been essential may be inferred from the fact that these energies are so co-related—so mutually convertible—that they merge and change, Protean-like, one into the other so instantaneously, that no one energy can be conveniently retained alone and in operation. They thus pass and interchange without (to our eyes) a signal from any magician's wand.

The transmutations of the imponderables are accomplished in a way that would have gladdened the eyes of the most profound alchemist, could he have seen as great transmutations in some of the material things in which he worked. For example, whenever energy is lost by resistance heat is produced, *i.e.*, when the resistance is perfect and complete, admitting of no intermediate state. *E.g.*, if a wheel in machinery does not move easily, the consequence is heat, manifested on the shaft.

If, however, that energy can be converted into an intermediate state, then this state may be assumed—much as light from gas is an intermediate state between chemical affinity and heat. Do what we may, that from which energy results can neither be created nor destroyed.

In the case of blows by impact, as in the tongue of a bell, or the hammer on an anvil, or a clock, or a piano, or on a drum-head, or on a gong, then, whilst doubtless some part of this checked energy is converted into heat, yet a large portion is spent in the production of vibrations in matter, appreciable to our senses, and suggestive of vibrations in molecules, which our senses, aided by physical appliances, have not yet made visible, but which chemical changes, and what to the minds of science theorists of the present day, is conclusive evidence, seem to point as similar vibrations in the invisible molecules and atoms of which it is assumed that bodies consist.

These remarks may suffice to explain that, whilst to speak of estimating an "energy" is easy, yet to estimate that "energy" is an employment which tasks the keenest and most watchful faculties of the human mind, as well as claiming from human hands the production of some of their most exquisite and refined work.

The difficulty of the task results not so much from a solution of the simple problem which the words "estimate that energy" convey, as from the incompetence alluded to of isolating and continuing the special energy and noting its operation. For no one of nature's energies, be they ponderable or imponderable, is alone. Solitariness in the unseen, as well as in the seen, is no part of nature's plans.

Faraday seemed to have realised this view in great intensity when he wrote:—"If, as I believe, dualities are essential to the forces, are always equal, are mutually dependent, that one cannot appear or exist without the other; the proof of this would lead to many consequences of high importance to the philosophy of force generally."*

This interlacing of energies—this co-relation, as it is called, of physical forces, whilst it knits in harmonious union energies which are nominally distinct, baffles the investigator who wishes to assign to each its share in any specific work. For example, the energy of gravity operates everywhere, and our fundamental principle in hydraulics, that fluids press equally in all directions, may be granted as a postulate. The experiments by which it can be confirmed may be and is very clearly described, but no one has ever made or can make them. Gravity never ceases to impress upon fluids a downward tendency, and so prevents an equality of pressures in all directions being established.

It may be in the interest of the Moslem faith to assert that, without visible means, Mahomet's coffin rests between earth and heaven; but, assuming the truth of the tradition, or of the fact (whichever it be), we know well that gravity operates in all its wonted intensity, and that the coffin is held there (if held at all) by the introduction of some counteracting energy, as that of magnetism.

The energy of electricity is ever passing into heat—that of heat into electricity or light. Electricity, again, appears to assume the form of vitality; and then, again, it totally fails to fulfil the vital conditions. In some animals the exhaustion of their muscular energy is consequent upon the exhaustion of their vital energy, and no electrical appliance can restore the vital energy, even though it seems to restore the muscular. Take affinity. This passes, by means unknown to us, into electricity and heat.

There is also this peculiarity amongst these energies. The work of one energy estimated by any means known to us, gives no indication of the work of some other energy, resident or potential, in the same matter.

For example, the estimation of a drop of water by gravity standards—to speak of it as weighing so many grains—gives no indication whatever of its ability to promote affinities—to absorb and convey heat—to decompose light. And if even all these were known, there would still be no indication that upon an electrical standard of measurement, its destructive effects are equal to that of a flash of lightning.

The only energies that may be said to be non-interchangeable, are those of gravity and vitality. The former is enduring—the latter fleeting. The character of the one is persistence and constancy, that of the other, change and variety. Gravity may be said to be quietly resident in matter; vitality shows its presence by growth or motion.

Gravity is an energy pervading all nature, as intense in grains of sand as in the mountain; in a drop of water as in the river or the ocean. Disregarding alike the vitality of the plant or the animal—for gravity treats them as though they were as inert, indifferent, and unconscious of its presence as the soil of the garden, or the mineral under the earth—thus this energy, which is to occupy our chief consideration on Monday next, is alone, and yet we shall find how that it has been left for recent times to tabulate its measure, to report and utilise, under the guidance of ordinary arithmetical and mathematical rules, the scientific and social consequences of the measure so established.

The other energy, that of vitality, which is to occupy our attention a fortnight hence, can hardly as yet be said to have been measured. The time, however, is very near when the hope will be realised; that the energy of vitality—the mechanical, the statical, dynamical, and absolute energy, of course, is meant—may be reduced to as exact a science as those of light, heat, and electricity have recently been.

All who have questioned Nature are well aware how simply and truthfully she replies. It must, however, be steadily borne in mind that this truthfulness applies to the question and answer in their mutual relations. If the question be so put that Dame Nature has to answer in respect to the combination of two elements, and so is called upon to give a reply which is in truth the aggregate of the two, she does so. It behoves the questioner to frame his question with the utmost care, in order to eliminate what is extraneous to his purpose. All must have observed how difficult it is to frame a question which cannot be mis-read, or admit of a reply evidently based upon a view which the questioner never contemplated. For example, if the question relates to gravity, caution is needed to exclude the buoyancy and even viscosity of the air, and the centrifugal effects of the earth's rotation.

If it relate to electricity, caution is needed to exclude the most infinitesimal alloy of a metal—even a metal itself.

If it relate to vitality, caution is needed to exclude the effects of temporary exhilaration or prostration.

If it relate to affinity, caution is needed to exclude the complication of phenomena by variations in gaseous pressure or atmospheric temperature.

If it relate to heat, caution is needed to exclude peculiarly constituted substances, in their unknown and varying effects on heat from their atomic or rather molecular condition.

Although, for purposes of classification and the general distinction of the phenomena, the energies found in nature are arranged under the general headings which are prefixed to the respective lectures of this course, yet it must be borne in mind that these are verbal rather than emphatically actual distinctions. They are merely the terms recognised at the present day, and in a few years may be dismissed. The convertibility of energy just now alluded to is a phrase which conveys a clear meaning, but this convertibility is a process that cannot be followed. At one time in the science world a general principle seems to have been established in relation to it; again and again the hope fades, the principle is on no secure basis, whilst the convertibility is ever active. It may not inappropriately be asked which energy is the source of the others—which, in fact, seems to have the highest claim to be classed as *the one.* Doubtless, as a question of sequence, in time gravity must claim the first place, but, so far as our powers of utilising the energies of the imponderables are concerned, we are not able to appeal very hopefully to gravity. We cannot obtain the other energies from it. Gravity refuses to be converted; its political principles are of the type which permits no change. Nature's No. 1 must be gravity; man's No. 1 affinity. For example, oxygen and hydrogen manifest their affinities in obedience to some inexplicable law. They enter into what is called combination, and in so doing manifest one form of energy to which the name of the "energy of affinity" is given. But in the transition state—in the act of obeying the very imperfectly known laws of affinity—another energy of a different name and character appears, viz., heat. Evidence of the power of this energy—heat—is furnished to tests very different to those which may be applied to the energy of affinity. The heat is presented to the thermo-electric pile, and that a great change in the mode of its energy has taken place is obvious from the results it produces at a distance; to this new form of energy we give the name of electricity. By a species of magic, electricity has called forth an energy to which is given the name of magnetism. Suitable circumstances being presented to this new energy, there is a machine propelled and capable of doing mechanical work. We now call it mechanical energy.

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* Proceedings of Royal Institution for 1854, page 6.

Thus, by change superposed on change, the energy of an imponderable has been converted into that energy of the ponderable to which we are indebted for all, or nearly all, of arts, manufactures, and commerce.

The two imponderable energies into which chemical affinity cannot be converted are vitality and gravity. These two may, as we shall hereafter find, assume the form of the others—the others cannot assume their forms—at least not in any plain and honest sense. Except in these two, physical energy is a visible reproduction of the invisible doings of chemical affinity.

Simple as this process of transformation may appear, and convenient and useful as the suddenness of the change may be, it cannot be denied that to the investigator it is perplexing. Men, however, labour on, each perhaps winning a little from the unknown, and adding it to the known. Thus, although "hills peep o'er hills, and Alps on Alps arise," yet men of varied resources and patient perseverance have won those invaluable treasures of measurement and utilisation from the imponderable and unseen, which give the title to this course of Cantor Lectures.

Even Livingstone has not shown a more noble resolve, "to conquer or to die" than have those to whom we are indebted for all we know touching the modes of measuring the energies of gravity, vitality, affinity, electricity, light, and heat.

As illustrations of the difficulties of the tasks before them, it may suffice, in this introductory stage, briefly to observe that:—

Galvanic currents may escape notice unless the intensity of terrestrial magnetism be neutralised.

Dimagnetism and the magneto-electric spark escape notice, unless a large number of galvanic cells or their equivalent is used.

What was called the "smell of electricity" led Schonbein to the discovery of "ozone," a remarkable product, and one whose energies are yet unknown, although being slowly but surely developed.

That a vibrating magnetising needle came to rest sooner in the neighbourhood of a copper plate, now called a damper, then when the plate was away, led to the discovery of the induction of electric currents by Faraday.

Opinions from telescopic appearances of the size of the stars led to an idea that their discs differed; the phenomenon has been found to be due to the diffraction of light.

The velocity of sound was calculated, making due allowance for the direction of the wind; in recent years it has been found that the heat developed by one particle of air striking another, must be taken into account.

We are indebted to "energy" for all we have, and all that men have won. For example, this building and all that it contains is an example of one of the energies of gravity. The lightning, with its thunder, is an example of the energy of electricity. Power of hearing and of speaking are examples of the energy of vitality. The bread eaten and the wine drank are assimilated and become ours by the energy of affinity. It is owing to the energy of light that vision can be had; and to the energy of heat that railways and locomotion can be utilised.

The word "energy" itself, which has in these days, Phœnix-like, risen from its ashes, and which plays so important a part in the title to this course of Cantor lectures, may properly claim some notice.

The word has been adopted, rejected, and revived. It seems to have been first used by Lucretius, a Roman philosopher, who was born B.C. 95 and died B.C. 55. The word had been forgotten or laid in oblivion until Dr. Young, in his lectures at the Royal Institution in 1807, explained what he meant by energy, and illustrated his meaning by the impact of an ivory ball or balls upon a line of suspended balls.

Here are several ivory balls suspended so as to touch each other. If the end one be raised a little, and then allowed to fall, the ball at the other end will be driven away. The motion in the last ball resulted from energy expended in the raising of the first ball, and this first ball was raised by the energy of vitality. When, however, vitality no longer puts forth energy, than the energy of gravity operates, and causes the ball to fall. Such a simple experiment revived the word "energy," which has thus been re-introduced, and bids fair to hold an important place in science annals for some years.

Energy is from two Greek words, ἐν, within, and ἔργον, work; used in its true sense, it means the work "that is within." Whenever, then, we find that a power to do work exists, we may say, "there is energy." It needs not that the work be done, it is immaterial how long it has lain dormant, or whether it be in man's estimation great or small, we only need the assurance that there is the capacity to do. A loaded gun need not be discharged to assure us that in that which is in the gun is energy, and yet to ascertain or measure the energy the discharge must take place. When that has happened, we may say, within the gun is no energy. The gun itself is merely a contrivance by which certain combinations may be induced to exercise their energies; it has nothing to do with the communication or even introduction of the energy utilised. When the energy is within the barrel, and inoperative, we handle and play with the gun, disregarding the thought of energy, but when the energy of quiescence is to become energy in action, it behoves us to play with the gun no longer.

But how can the gun be again a means or an agent through which some one or other energy may remanifest itself. Clearly by another group of quiescent energies being introduced. This illustration of an expended and a reintroduced energy may suffice to give a character to an element in respect of all the energies, viz., their expenditure and reintroduction or re-creation. Either through the innate operation of natural causes or through the agency of vital energy, there must be a restoration. These restorations are effected in ways to which the name of legion may be applied. For example, a weight requires energy to raise it, a spring requires energy to bend it, air in a gun requires energy to com-

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[*] In Lecture 8, Young wrote:—"The term 'energy' may be applied with great propriety to the product of the mass (or weight) of a body into the square of the number expressing its velocity." This is not "energy" according to modern usage, but, for reasons which need not at present concern us, it is double of that to which in these days the term "energy" is applied.

press it, before any of these can be said to have energy in possession. The water in a mill-pond has been raised by the energy of the sun. The chemical affinities in a galvanic cell are innate. A labourer and a horse require food that they may work. So with many similar illustrations. In all these is a dormant or quiescent energy. Once let it loose and the Arabian Night's story of Sinbad and the Giant, or that boast of *Owen Glendower*, that he could

> "Call spirits from the vasty deep,"

would not be met with *Hotspur's* taunt,

> "Why, so can I, or so can any man;
> But will they come when you do call for them?"

These energies always come when rightly summoned.

Observe, energy presents itself in two forms—energy in quiescence, and energy in action. To these forms technical names have been given. Energy in quiescence is called potential energy; and energy in action is called kinetic energy. In this weight, suspended as pendulum, these two energies may be illustrated. If the weight be struck from its lowest position, then the kinetic energy of vitality as manifested through muscular action, sets it off. But if the weight be elevated and simply let fall, then the potential energy stored up in the act of lifting becomes kinetic energy, through the influence of what we call gravity.

To sum up. Belonging or attached to all that is material are certain powers or influences which cannot be separated and so weighed, hence these powers or influences are said to be "imponderable." Since these powers or influences affect the motions of bodies they are called forces, for force is that unknown influence which causes, retards, stops, or accelerates motion.

Again, when by such arrangements as nature calls into play, or men can contrive, these forces manifest themselves in action, they are said to be energetic.

Now, since we can plan to some extent how and when each force should manifest its energy, and obtain or retain the results, these results are called work. This may be measured or weighed, and it is through such work alone that a value can by men be placed upon the forces of the imponderables, which, by their energy, have done work.

The measurement, therefore, of the energies of the imponderables resolves itself into a measurement of the work they do. It is, therefore, very essential that the measurement of work should be by means easily reproducible, scientifically accurate, of universal application, beyond all question and all cavil, admitting of no elements which, under any circumstance, could vitiate or falsify a conclusion.

Three elements only are needed to fulfil these conditions, viz., the *mass* of the body moved, the *space* through which it moved, and the *time* during which by the operation of some force it was being moved. These three elements being known, all others or varieties can be derived from them; hence all others are called *derived* measurements. Reasoning thus, a pound weight from which mass may be deduced, a two foot rule by which space may be measured, and a clock by which time may be noted, are all that we require in England in order to determine measurements of work. But very clearly these three sources of fundamental units must be of an irreproachable character. Speaking generally, who dare venture to say that the pound weight he has, or the clock he has, or the two-foot rule he has, is more to be relied upon than the corresponding instrument in the possession of his neighbour. 'Tis amusing to listen to the pleadings of the owners of watches and two-foot rules, and scales and weights, as to the wonderful accuracy of those they possess.

Where lies the appeal? Who shall decide whether the second ticked by the watch which cost thirty shillings or that ticked by the chronometer which cost one hundred pounds is to be the true second? Who shall decide the inch and the pound when the owners disagree? The answer to these questions, doubtless, raises in your minds forms of difficulties not easily solved.

It may suffice, for this evening, to glance at one or two of these difficulties, in order that we may not think it a trifling with important interests in what, perhaps, seems a kind of childish quibbling, to suggest as a difficulty in such common affairs as a pound-weight, a second, and an inch. Let us first see that from these can be had all we use as measures.

When we say of anything it measures ten, twenty, thirty, or forty, we may add the words inches, feet, yards, or miles. These words must be in some way related. The measurement thus expressed consists of two parts, a numerical and a denominational one. The numerical is absolute and independent of the denominational one. This latter is, for a special case, the unit of measurement; hence there may be a great variety of units, all, however, by their inter-relations capable of being resolved into one. This one, this original, this is the difficult one to decide, and to it a portion of the lecture on Monday next must be given.

So far, then, for the unit of space. Now as to time. Let anyone attempt to measure time by the repetition of a unit derived from any ordinary source, and he will soon find himself in a labyrinth of doubts. All our measures of time are derived from astronomy. Of the unit of this our future grain there is the compound measure which some may say is put beyond the reach of such disparging remarks, viz., that invaluable measure in all commercial transactions, the pound weight. Time is our own; we waste it as we please; we do not pay for it. Space is our own; we can walk where and as we please; but, as to our food, that is ours by purchase, and we buy it by the pound weight.

Well, "truth," the proverb says, "is mighty and must prevail." The pound weight is quite worthless as a scientifically accurate and universal measure. There is really no such thing as weight for a universal measure, and yet nobody ever bought a pound of sugar without thinking they were getting at one time the same quantity as at another. That is not the case. Weight, speaking accurately, is a most variable measure, and is therefore one on which no reliance is to be placed in scientific investigation. What we do measure, scientifically speaking, when we speak of weight, is mass, and an endeavour shall be made to show you the difference between mass and weight.

First, weight is not at all to be relied upon. Here is a jar of water balanced on a scale-beam, but so as to hardly equal the weights on the other side. If I put my finger in the jar, the jar overbalances the weights. But why should the scale pan sink when one simply touches the water with the hand? It is not pressed down. The hand is merely put into another atmosphere, water, instead of air. Lest anyone should think that the jar is pressed down, let a weight hanging by a string, which sustains the weight, be suspended in the water, still the scale pan in which the jar of water is descends. Therefore the weight appears to be altered—there seems something or other about it which is not altogether correct. The matter presents itself again in this form. Here is a scale-beam with a block of wood at one end, and an exactly balanced weight at the other. Now, as the weights pass from one atmosphere to another they change in their relationship; and whilst the mass or quantity of matter contained in this block of wood and in this counterpoising weight remains the same, yet the relation of the weights does not remain the same. Some may say that if the matter undergoes no change, then the weight undergoes no change. It is the weight which undergoes a great change, but the matter undergoes no change. At present, both are in an atmosphere of air, and you see that the beam is in exact equilibrium; but now let each be immersed in an atmosphere of water, and you see at once how the relationship to each other is changed; they no longer balance. The mass of wood is the same as before, and, therefore, as far as moving from one atmosphere to another is concerned, masses must be considered, and not weights; therefore, where the atmosphere changes, there we must give up the idea of weight. There is another cause why weight will not act as a standard unit. Weight results from the action of gravity; it is not a property of matter at all. If we change the force of gravity which tends to pull a mass down, we then change the amount of pressure that the mass exerts on a spring. If we take a mass of matter at one of the poles, it is nearer to the centre of the earth than if it were at the equator, and in consequence it will be pulled down with greater force, so that what would weigh (say) 1½ lb. by a spring balance at the pole, would weigh (say) 1¼ lb. at the equator. Therefore, if we ordered a quantity of goods to be sent from some place near the poles towards the equator, and they were weighed by a spring balance, they would not weigh so much on reaching their destination as they did when they were shipped; and yet the quantity of matter would be exactly the same.

Observe, it is a spring balance, and not a scale beam, that is used. A spring balance measures force only, viz., in this case the depressing or pulling down force of gravity at the place where it is used. With a spring balance a gravitation experiment is made. If a scale beam be used, then as the change of gravity affects the weight in each scale pan equally, the relations between them will not be affected, and the scale beam will be in equilibrum when the contents of the scales are influenced by the varying force of gravity.

You saw, a short time ago, that weight varies by taking the mass into an atmosphere denser than that in which we live, and now you shall see the same result by changing the atmosphere for one more rare. Here is a glass beaker, suspended bottom upwards by a hook, so as to exactly balance a weight at the other end of the cord; the system is now in equilibrium. I will change the atmosphere within the beaker by admitting some ordinary coal gas into it, and you see the weight changes at once; the beaker appears to be lighter. These illustrations show that dealing with weight, we deal with that which is variable in all parts of the earth, and, owing to atmospheric changes, variable at the same time almost in the same position. Doubtless all of us who have attained years of discretion, have been asked the question in our earlier days, which was the heavier, a pound of lead or a pound of feathers. Here, in a glass case, is a bag of feathers (eiderdown) and a weight exactly balancing them.. Call the weight a pound of lead, and then truly the pound of lead is balanced by the pound of feathers. Now, the scale-beam is a delicate one, and accurately poised. By this pipe is admitted hydrogen gas into the case, the upper part of the case is closed, the hydrogen ascends, the air gradually escapes at the bottom, the scale-beam loses its equilibrium, and the bag of feathers descends, and is evidently heavier than the pound of lead.

This must for the present suffice to satisfy you that weight, as such, must not be considered an accurate measure, and that, somehow or another, a measure for mass must be obtained and used in the place of that which we call weight. These three units then—mass, space, and time—are sufficient for all purposes of measurement, and when reliable data have been furnished from whence these can be deduced, determined, and (if lost) restored, we shall be in possession of all that is required for the purpose of recording every measurement requisite for estimating and comparing the work done by the energy manifested by any one or more of the forces derived from "the imponderables."

An electrical apparatus, to be placed in the holds of ships, for the purpose of giving warning in case of leakage, has been devised by M. Sortais. On the entrance of water a current is established, and a communication is thus set in operatien, which gives notice to the officers on deck.

ANNUAL INTERNATIONAL EXHIBITIONS.

The Council, having been informed that her Majesty's Commissioners do not intend to publish Reports on the different departments of the Exhibition of the present year, and looking to the great importance to Arts, Manufactures, and Commerce that these annual displays should not pass away without some record, have decided to undertake that duty, and for this purpose have engaged the services of gentlemen specially skilled in the subjects of the several sections, to prepare such Reports for publication in the Society's *Journal*. The Council, however, desire it to be understood that, in publishing these reports, they do not necessarily adopt all the views expressed in them, which must be taken as those of the writers only.

The following report is the third that has been issued. The remainder will appear as soon as they are complete.

REPORT ON MACHINERY AND PROCESSES CONNECTED THEREWITH.

By the Rev. Arthur Rigg, M.A.

The subjects included in this report are located chiefly on the ground-floor, under the west galleries. They comprehend the silk-machinery of three foreign and eight English exhibitors, the confectionery and aerated-water machinery of one foreign and thirteen English exhibitors, the grain machinery of one foreign and seven English exhibitors, and various miscellaneous articles by twenty-four English exhibitors.

The report is drawn up in accordance with the following instruction:—"The report should be of such a nature and interest as will help the public to appreciate the special and new features of the objects exhibited."

3681.—Roland, Alfred, Orbe, Switzerland.

Although not forming part of a report on machinery, it may be well to state that outside the door, opposite to No. 3682, a tent, with canvas sides, is erected for the reception of many thousands of silkworms so soon as the temperature of the atmosphere is considered suitable.

3682.—Jouffray, A., Cadet, Fils, Rue Vimaine, Vienna; Isère, France.

The machinery consists of ordinary reels, driven by the most simple mechanical means. Those who have reared silkworms, and unwound cocoons by one at a time, may have considered the operation on a commercial scale, in establishments called "Filatures," would be very tedious. That operation is here carried on by Messrs. Jouffray.

A table, with a brass top, has inserted in it shallow tinned copper boilers, of diameters varying from six to eighteen inches, and about eight or ten inches in depth. In one of the larger of these boilers, filled with water, heated by steam from an inner ring of jets underneath a perforated movable tray-like bottom, one hundred or more cocoons are floated.

The operator, with a short whisk, not unlike such as are occasionally used for velvet-brushing, but larger, more bushy, and less close, causes these cocoons to be rapidly rolled about on the surface of the heated water.

To a spectator the object of this apparently unmeaning and persevered-in movement is unintelligible until the whisk is lifted up, and the operator, drawing the hand between the cocoons and the whisk, gathers together a number of filaments attached to the whisk by pieces of floss-like silk, and thus draws, as boats to the shore, those cocoons whose ends have been entangled in the whisk. The cocoons not thus moored float in the centre of the boiler. Another whisking lays hold of some of these.

The process of "reeling" now commences on four, or five, or more cocoons at one time, the filaments having a certain amount of adhesiveness, consequent upon a glutinous surface, adhere, and seem to form one thread. As this compound thread becomes the basis of future operations in silk manufacture, it requires the most watchful care on the part of the operator, that when one cocoon has rendered to the reel from five hundred to one thousand yards of silk, another should immediately supply its place. The skill with which the operator accomplishes this almost sleight-of-hand performance is worthy of observation; it seems that if the ends are but touched they adhere. Thus the operation is continued until there are no more cocoon boats in the harbour.*

3683. Rushton, Sons, and Co., Royal Depot Mills, Macclesfield.

This number includes a series of machines for preparing silk for the loom. The hanks of silk as prepared by the operation described under No. 3,682 are here placed on simple reels on the lower part of the framing of Machine No. 1, called a "winding machine." One end of the compound filament of each hank is passed through a clean circular eye—in some cases made of glass—and then brought to a bobbin rotating on a horizontal axis. The mode of communicating motion to this bobbin is by a little wooden roller on the bobbin spindle. This spindle, placed in two grooves, is parallel to a light shaft, having at one end a smoothly-turned metal wheel. The friction due to the weight of the spindle and bobbin, as conveyed by the little roller on the smooth wheel, gives motion to the bobbin. Thus the silk of the cocoon is simply transferred from the form of skein to that on a bobbin. A light swash-plate or face-cam acts upon a framing carrying the eyes, and so traverses each continuous thread from end to end of the bobbin.

The No. 2 Machine, called "a cleaning machine," transfers the silk as from the cocoons from one bobbin to another. In this transfer the silk passes between either two fixed small cylinders, about one inch diameter, or between two fixed parallel plates very close to each other. In either case, if any knot or other irregularity occurs, the process of transference ceases until the attendant removes the cause. So carefully is the gauge adjusted that any increase in the thickness of the silk consequent upon the operation of "reeling" is here detected, and the bobbin taken to another part of the machine. Thus, all roughnesses and irregularities in the silk off the cocoons are removed before the filaments are either spun or combined.

By the third machine, called "a doubling machine," the single silks from two, and sometimes three bobbins, are brought side by side (without being twisted) on to one bobbin. It is essential that the number of these should be preserved through the entire length coiled on, an arrangement is therefore made so that if one of the light silken and almost invisible filaments break, the motion of the bobbin should cease. This is accomplished by passing the filament through an eye in the end of a long wire, movable freely on a horizontal pin passed through an eye at the other end. As the silk is led over a light smooth bar before passing through the eye, the wire arm is thus held up. If, however, the silk should break, the arm falls, and in so doing strikes a brass, which raises a catch, and so (the bobbins being driven by friction only) that one where the catch is raised is brought to rest.

By the fourth machine—called "a spinning machine"—either a single filament, or those which, by the third machine, were multiplied, are slightly twisted or spun as they pass from the lower bobbins to the upper. It is on a fifth machine, and consequent upon the arrangements for spinning and twisting, that the term silk, as a general one, becomes resolved into two specific ones—viz., "Tram" and "Organzine." The term "Tram" is applied to the unspun, or but slightly twisted filaments, as brought from the cocoon-reeling, even though these filaments have been doubled. The term "Organzine" is applied to the twisted group of two or more spun filaments, which are thus prepared for the "warp" in the loom, or the threads which form the length of the manufactured web of silk. There are from ten to twenty twists put into each inch of combined silk thread.

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* Interesting accounts of "Experiments with Silkworms," &c., &c., will be found in the *Journal of the Society of Arts* for Feb. 7, 1855, Feb. 6, 1857, and in many papers in succeeding years.

The preparation of the silk for the weaver being by these machines completed, it is now requisite to arrange it ready for the dyer. This is done by re-transferring it from bobbins to the form of hanks. Such a transfer is being made on a part of the fifth of this series of machines. The mechanism is so constructed, by means of a "snail cam," that when a predetermined length of silk has been formed as a skein, a motion of the guiding eye takes place; thus, on a new part of the reel, commencing another skein, and so on in due course a third skein, &c. So precise and punctual are the motions that the length on a skein may be determined by the weight.

3684.—Higginbottom, W., Alexandra Mills, Derby.

These are five machines used for the purpose of preparing the filaments of silk for the manufacturer. A detailed description of the process has been given under No. 3,683.

3685.—Greenwood and Batley, Albion Works, Leeds.

A reference to the operations of preparing silk, from the cocoon to the loom, suggests that, even in these preliminary stages, there is much waste, in that there are numerous short lengths which cannot be treated as continuous threads. To utilise these and such other short filaments is the object of the machinery to which reference is now made. The type of the mechanism is that used in the cotton manufacture; for when silk ceases to be a filament, or long thread, it becomes a fibrous material, as cotton, and may be treated as such, subject to the consideration that the staple or length of each fibre is greater and more varied than that of cotton. The process by which these fibres, of such varied lengths, are prepared for the first of the series of machines in the Exhibition is not shown there.

The entangled fibres of waste silk are reduced to lengths averaging eight inches, and to flakes measuring about eight inches by three. These "flakes" in the silk now being wrought by the machinery, are derived from cocoons not workable by the process in No. 3,682, and from the waste produced by that process. The stages through which the silk passes are shown in case No. 3,610, under the east gallery. These flakes have been produced by a process of partial tearing, cutting, and careful combing which lays the fibres parallel, and enables an attendant to reduce them to lengths considered suitable. Such are brought to the Exhibition in baskets, and placed near the first machine, called "the Spreader." They are then laid by hand, one at a time, upon an endless band of leather, by which they are advanced until brought within the influence of a brass roller, with fine teeth or points on its surface. This roller delivers the fibres to a series of very fine-teethed metal combs, which are moving parallel to their length, and carrying with them the silk. By the action of these combs, and fluted rollers, which receive the silk from the combs, the "flakes" are not only still further combed, but, owing to the speed of the latter rollers being greater than that of the receiving ones and the combs, the silken fibres are drawn forward—the ends of the one flake are, as it were, "felted" over the ends of another, and dependent upon the purposes of the manufacture one yard of these "flakes" is extended to from ten to thirty yards, as the case may be. When each travelling comb has delivered the silken filaments, it descends, is concealed for a while from view, and then re-appears to run the same course—ever beginning, never ending. This motion is accomplished by the ends of the combs being carried on the grooves of two parallel square-threaded screws. If it were deemed requisite to shake the combs, or render their travel non-parallel, it might be done by destroying the uniformity of the screw-carriers, and making them (in technical language) "drunken." The combs are passed from one set of parallel screws to a lower set by "striking" cams, which cause their descent at one end; and by a similar but reverse screw motion to the former, each comb is carried back and rises to the first position, with a monotonous exactitude.

The combed and drawn silk fibres are cconveyed by an endless band from the drawing rollers, and coiled upon a large wooden wheel. An attendant frequently takes off lengths from this wheel, and lays them aside for the next process. The short and separate pieces are now a continuous light, flake-like ribbon.

By the next machine these lengths are formed into a "sliver." The mechanism in this, and, indeed, in the four succeeding frames, is evidently derived from that used for cotton. The chief difference consists in the introduction of these combs—"screw-gills" they are called—and they are rendered necessary, because the fibre of cotton is not so long as that of silk, and, therefore, "drawing" can in the former case be done in the short open space between the drawing rollers, but in the latter case this space is much too long to let the fibres be without some guidance; the combs supply this guidance.

As the machinery for cotton occupied the same room in the Exhibition of 1872, and was described in your Report, no further description is requisite here.

The last framing is for the purpose of arranging the threads of "spun" silk upon reels, ready for either the dyer or the manufacturer, as in the case of Nos. 3,683, 3,684.

The silken thread, as produced by 3,683, 3,684, is called "thrown" silk; that produced on 3,685 is called "spun" silk.

3686.—WARNER, SILLETT, and RAMM, 25, Newgate-street.

3687.—NORRIS and Co., 124, Wood-street, Cheapside.

These are three Jacquard looms, worked by manual labour. The description of one may suffice, and as there are elements in No. 3,686 not required for the patterns being woven in the other two, there will be no occasion to refer specially to them for the mechanism. Hanging on 3,687 is a drawing of the design being woven in that loom. This drawing is upon a large paper, divided into squares, as designs for wool work are arranged. Behind the loom 3686 there is a very large drawing, by Owen Jones, Esq., showing how the design now in the loom was prepared for transference to the cards. This ruled paper measures sixteen feet by nine feet and three inches, and contains 5,587,200 small squares. It is by a selection of these squares that the design is placed on the cards.

It will be observed that at the top of these three looms there are a number of cards in which holes are perforated. The holes in each card represent some of the squares in the pattern through which the needle of an embroiderer would pass, assuming the design to be one for tapestry. To form the design now being woven on No. 3,686 there are connected, in the manner seen at the upper part of the loom, nine thousand three hundred and twelve cards, in three lines. These cards are laced together, and measure one thousand yards in length, and weigh five and a-half hundred weights. The whole pack has to be turned over each time that the design is completed in the loom.

Immediately under the one top card in each line of cards there is a square metal boxing, filled on all sides with small holes; in fact, honeycombed, but with square instead of hexagonal cells. These boxings are on axes, in one and the same straight line, and by means of a catch, connected with a cord on which the workman's hand or foot can act, they may be turned through one-fourth of the circumference by one motion of the hand or foot. In so turning, the perforated cards are drawn forward, each card covering one side of the square boxing, except where the holes in cards previously alluded to are found. For this turning, the frame-work in which these boxes rotate is caused to move on one side. If the cards and the square boxings were taken away there would be seen a number of wires projecting horizontally from a series of openings in a fixed metal framing. Each of these wires is held forward by means of light coiled springs (not visible to a spectator) at the back ends of them. If now the square boxings with perforated cards over the back vertical side be permitted to fall upon the projecting wires, a number of them will be pressed back against the light springs, the remainder passing through the perforations in the cards and entering the honeycombed box. Between the visible ends and the back springs each wire is bent round, so as to form an eye, through which a vertical wire passes. These vertical wires have hooks at the top and bottom. Cords, to be hereafter alluded to, are attached to the bottom hooks. The top hooks of those wires, through eyes pressed back by the cards, are thrown out of the general line, and thus, when a narrow metal slip is raised by the hand or foot of the workman, those vertical wires only are raised which remain in the normal line, and therefore those lower hooks only are moved which form part of these wires.

A number of cords (7,272) pass from the warp to these hooks; concealed by the numerous threads of the warp are small delicate little glass frames, each containing six very closely formed eyes, placed vertically over one another; to the top eye a cord from a hook is attached—through the next four eyes four adjoining threads of the warp pass—to the lower eye is fastened a cord with a light leaden weight: thus the twenty-nine thousand and eighty-eight threads of the warp are passed through these eyes.

When now the wires are raised to which cords are attached, four times that number of threads are raised. But it may be requisite that only one or two of these four should have been raised. An arrangement for this purpose is made in hanging framings of threads near the operator's hands. These framings constitute what is named "a harness;" in them every thread in the warp has an eye to itself, and therefore, by the action of these eight framings, one or more of the raised threads can be depressed or raised higher, for the purposes of the design. This "harness" is not required where, as in No. 3,688, each thread has a cord and eye to itself. Thus, by the holes in the cards, and the movements consequent thereupon, the pattern alluded to in the early part of this description is transferred to the silk in the loom. The operation with the shuttle, &c., &c., is as in ordinary looms. There are minor peculiarities, of which details would extend this report to an unreasonable length, and they do not seem requisite in an account which only deals with the general principle on which Jacquard looms act for the production of the most beautiful of woven fabrics.

It may be interesting to state that the loom selected for the more detailed description is engaged in weaving furniture damask, from a design by Owen Jones, Esq. The shuttle is thrown through the warp one hundred and fourteen times to the inch, and a length of twenty-eight inches are required to complete the design.

The width of the piece of silk being woven is sixty-three inches, and when completed will be about sixty yards in length. The warp contains 1,022 miles of silk thread, and, including the thread on the shuttle, the piece when completed will have consumed 1,757 miles of silk as it comes from the bobbins. Each one of these threads consists of fifteen fine threads as produced by the worm, hence the piece being woven will require 26,355 miles of silk as it leaves the cocoon—more than sufficient to put a girdle round the earth. The number of worms necessary to produce this result is about seventy thousand.

3688.—STEVENS, J., Coventry.

These are two Jacquard looms, worked by steam, of the pattern used in Coventry for weaving silk scarfs, bookmarkers, and those narrow fabrics which are ornamented with designs woven in silks of various colours. In the published list of Messrs. Stevens' productions there is a very great variety. The particulars of that one in the loom on the spectator's right hand, when the writer of this report examined it, may prove the best introduction to the notice of the mechanism, &c. It is a bookmarker, with the music and words of "The Last Rose of Summer," also a spray of leaves and a rose. It is 10½ inches long and 2¼ inches broad; there are 600 threads of "organzine" silk in the breadth; and as 4,000 cards are required for the design, there are 4,000 threads of "organzine" silk in the length. Six such bookmarkers are being woven at the same time.

There is one arrangement of perforated cards similar to that described under No. 3,686. The sloping cords from the eyes, through which corresponding silks in the bookmarkers pass, are united to one and the same hook at the top; thus one set of cards causes the same operation to be repeated six times. It will therefore suffice if the following account be written as for one bookmarker only.

The warp consists of white thread only; there are six shuttles arranged as on shelves one over the other. These shuttles are charged with silks of different colours. Now, the cards at the top of the machine determine which of the white threads should be raised in order that one or other of the shuttles may pass under them; these cards also decide which coloured shuttle shall be selected for passing. The lifting of the chosen white threads from a general level determines the first part of this operation. The second part is determined as follows:—Near the floor, at the back of the loom, are five long but light iron rods passing from end to end; in the middle of these rods is an arm, to which a wire is fastened and passed to the mechanism where the cards are; the pulling of such of these wires as the cards may direct causes one or more of the light iron rods to turn. At each end of the loom, near the floor, there may be seen a short wooden roller, and, as the weaving proceeds, this roller ascends one or other of six inclined planes of varying heights. The long rods, by their partial turning, withdraw wedges underneath these inclined planes, and up that highest plane whose wedge is not withdrawn the rollers ascend. This ascent carries also a frame containing the shelves on which the coloured shuttles rest, and therefore brings any predetermined shuttle immediately opposite the opening between the previously-named white threads or warp. Thus placed, the next act is the causing of the shuttle to pass. This is done by a wooden contrivance fixed to the shuttle framing, "called a Marionette," about the level of a spectator's eye at the right-hand end of the loom. Two wooden hammers strike pegs which have been brought to the line of their blows by the action of the aforesaid rollers; the light blow causes a catch, under one or other of the hammers, to project, and this catch, being raised by a simple arm, traverses the shuttle arranged for that occasion. Action is communicated to the shuttles by racks and small wheels, not always visible, but moved by the leathers drawn by the piece lifted in the Marionette frame, each shuttle being connected by wheel-work to a separate rack sliding on the frame in which the shuttles are placed. The thread is "driven home" by the falling forward of the "batten" beam; the roller decends the inclined plane; the withdrawn wedges are restored; one of the 4,000 cards passes away, and another advances to signal to the warp and shuttles another operation.

4621.—ALLEN, F., Canal-road, Mile-end.

4645.—HILL and JONES, 3 and 4, Jewry-street, Aldgate.

These are illustrations of machinery and processes in the manufacture of sugar confectionery. The articles which arrest the attention of visitors are large, round, bulged-out copper vessels. These vessels are inclined at an angle of about 45 deg.; in some cases attached at the end of a shaft to which motion is given, in other cases attached to an inclined plate (a swash plate), or its equivalent, on a vertical shaft. A long iron rod, (No. 4621) projecting from the vessel in the case of "swash-plate," passes freely through the centre of a turned metal ball, about three inches in diameter. This ball is constrained to move in a vertical metal groove; consequently, when the shaft and swash-plate rotate a peculiar rolling motion is given to the jacketted copper pan, but it cannot rotate because of the arm which moves up and down sliding at the same time in the vertically-moving ball.

Granules of sugar, or seeds, as almonds, carraways, &c., &c., are placed in one of these pans; there, consequent upon the motion of the pan, they are caused to roll over and over, a small quantity of hot clarified sugar being gently poured or allowed continuously to drop upon them. The heat of the pan prevents rapid cooling. The liquid sugar is diffused through the mass, and when it has dried by exposure to the air in the pan, each seed is covered with a thin film of white sugar. A second pouring is now added, and thus supply after supply being furnished, the seeds are coated with such a thickness as the manufacturer desires. If it is wished to colour this confectionery, the same may be done by adding colouring-matter to the last supplies of sugar.

The peculiar mechanical arrangements are for producing an imitation of the motion by which the rounded form is given to pebbles from the action of the sea on the shore. The imitation is successful if similarity of sound may be taken as an indication.

Messrs. Hill and Jones had not completed arrangements for the production in the Exhibition of the manufacture of that sugar confectionery in which liqueurs, &c., &c., are contained within crystalline sugar cells. The following is a description of the process adopted for this purpose:—

Shallow trays, about 15 inches wide, are filled with starch-flour: a "strike," or levelling edge, is drawn over, and the surface thereby smoothed. On the underside of a narrow board, about 18 inches long and four inches broad, are fastened a number of hard plaster of Paris patterns of the forms to be made. These narrow boards are laid on the starch flour, again and again, until the surface is indented with the designs.

A pan of clarified sugar, at such a temperature and consistency as the workman deems suitable, has added to it and well stirred in the non-crystallisable liquid, as water, spirit, wine, &c. Some of this mixture is filled into a small ladle with six or eight spouts arranged at the same distance apart as the patterns in the open starch tray. Holding the many-spouted ladle over the first set of designs, the workman pours out the sugar, carrying the ladle at the same time the length of the tray. Each design is now filled with a crystallisable and non-crystallisable substance, and the manufacturer takes advantage of a physical law, that under the conditions described the crystalline element squeezes into the interior the non-crystalline one. The poured-out sugar requires one or two days to complete the crystallising process before removal from the starch flour.

The writer of this report commends to the consideration of the geologist and mineralogist this mode of making sugar confectionery enclosing liqueurs. The confectionery he has seen is all of the "amygdaloid" form, and may be suggestive in reference to those vesicular cavities in which agates, &c., are found. Such nodules are sometimes filled with earthy matter, at other times with matter of a gelatinous character. Further remarks on this would be out of place in the present report. Although not exactly similar, yet bearing upon the question, are two short papers in the *Edinburgh Philosophical Journal* for 1828 and 1829, "On Fluids in Minerals," by Nicol, who designed the prism which bears his name.

4623. Barnet and Foster, 23, Forston-street, Hoxton.

4638. Fleet and Co., 161 to 171, East-street, Walworth.

4646. Hayward, Tyler, and Co., 84 and 85, Upper Whitecross-street.

Although in each of these the respective exhibitors use substantially the same methods for producing aerated waters, yet the modes of closing the bottles are very different.

To produce the aerated water, a holder is filled with the required gas. A condensing-pump, usually worked by a cranked-shaft, is connected at its lower part by two pipes with regulating-taps, one communicating with a cistern of the liquid—the other with the gas in the holder. By this pump a mixture of these is forced into (in these cases) a brightly-polished cylinder with spherical ends. From this cylinder it can be drawn by taps, suitably arranged, in connection with the corking machinery.

4623.—The bottles are made so that when a glass marble is dropped into the neck it descends only so far as the commencement of that part of the bottle in which liquid is usually contained. The marble thus introduced by the maker of the bottle is closed in by the "welt" on the bottle where a cork is usually inserted. The "welt" is so moulded that an indiarubber ring put within is held there. This ring forms a seating for the round glass marble when the battle is inverted. The aerated water being introduced in the usual way, the bottle is inverted, the marble falls upon the seating, and thus the "corking" is completed.

To open the bottle either the finger or a piece of wood is used to press down the marble. An ingenious contrivance of grooves on one side of the recess in that part of the neck to which the marble descends prevents the opening being closed by a return of the marble whilst the liquid is being poured out.

4638.—This is exhibited as an improved arrangement of the apparatus for corking and wiring bottles containing aerated waters. The corks are inserted in a strong slightly coned cast-brass vertical tube. In the upper end of this a metal rod (loosely fitting) is introduced. The bottle to be filled is placed and firmly held at the lower end of the tube. By a tap, the opening of which is between the underside of the inserted cork and the bottle, aerated water is admitted, and when the bottle is filled the cork is depressed by suitable mechanical arrangements. It is then removed and handed to a boy, who places it where the cork is held until it is duly "wired."

4646.—Into each bottle there has been dropped a cylindrical piece of wood, slightly taper, of the size of a finger. As far from one end as the first joint of the finger a recess has been turned, about one-fourth of an inch deep and broad. A piece of taper brass tube, split at the wide end like a "larding needle," is next introduced into the bottle, and slipped over the aforesaid piece of wood. An india-rubber washer, with a small central hole, is slid along the taper tube until it reaches the opening into the bottle. A long brass tube forces this washer downwards, and thus it is fixed in the recess previously described. This forms the cork. The bottle being inverted over the pipe by which it is to be filled, a small-bore tube at the end of this pipe not only keeps the novel stopper at one side but serves as an outlet for air when the aerated water is admitted. On withdrawing this tube the taper wood with the washer is slightly held within the neck, and the pressure of the gas, due to the aerated water, effectually closes the bottle. The usual mode of opening is by holding the bottle, with a slight inclination, and pressing the projecting end of the wooden stopper.

4624.—Batty and Co., 15, Pavement, Finsbury.

The only process carried on here is that of preparing oranges, &c., for marmalade. The pulp being taken out by the action of a revolving wood, shaped much like the interior of half a lemon; the rind is next cut into shreds by a plan described under No. 4,630.

4626.—Carr T., Montpelier-road, Bristol, and J. J. Cunningham, Edinburgh.

The machinery here exhibited is called "A disintegrating flour mill"—its purpose is to convert wheat grains into flour by a process very different from that of grinding.

The large discs—the inner faces of which are corrugated—have steel pins, of half-inch diameter, two and a-half inches apart, on these corrugations. These pins are placed so near the inner edges of the raised corrugations as to permit them to run close to and within the hollows of the corrugations on the opposite disc. The discs rotate in opposite directions. For the purpose of the Exhibition the pins are painted different colours, in order that the line of travel of any set of pins may be seen.

Surrounding the axle, on the outside of the large disc on the left of the spectator, a feed-pipe may be arranged in connection with a hopper. By this the wheat is admitted between the pegged discs through openings, which can be regulated. When now the aforesaid discs are in rapid rotation, centrifugal action carries the wheat amongst the pins; there it is knocked from pin to pin, and occasionally rubbed between the pins and the side of the corrugation to which these pins are near. The product is discharged into a casing, surrounding the rim. The ordinary working speed of discs seven feet in diameter is 400 revolutions per minute.

Those interested in the development of this contrivance (the patent for which was extended by the Privy Council in Jan. 1873) may refer to a comprehensive pamphlet by the makers—also to a report in the proceedings of the British Association for 1871 on page 229 of the volume. An arrangement similar to that now described, but with smaller discs and stronger pins, has been used for disintegrating ores, minerals, clays, manures, &c., &c.

4630.—Collier, L., Wellington Works, River-street, Rochdale.

In addition to the machines in operation forming sugar confectionery, amongst a number exhibited here, there are elsewhere three not in operation.

One, a roller with twenty-eight steel circular cutting blades; on an axis parallel to this are brass arms, each of which enters, at its outer edge, between two of the aforesaid blades. For the first operation the axis with the brass arms may be removed. Gum—duly sweetened and flavoured for jujubes, and reduced, by rolling and exposure to air and regulated temperature, to the required thickness and consistency—is placed upon the metal table and brought within the operation of the cutting blades; these, and a smooth roller underneath, draw the material forward and divide it into ribbons; this done, the axis and arms, if removed, are restored. The ribbons of sweetened gum are now laid with their longer sides to the circular blades, and when advanced are cut into the well-known diamond forms. These small forms would adhere to the roller and blades but are prevented by the operation of the arms, which strike them off, and they descend a sloping metal table prepared for this purpose.

A second, is a machine for cutting oranges, lemons, &c., for the making of marmalade. There is a brass disc which can be rotated on a horizontal axis. In this disc are inserted, at equal distances and radially, eight blades, which project and can be adjusted as irons are in a joiner's plane. These blades rotate past and close to the open end of a short metal tube or closed trough; opposite to this open end is a piston, or plug, which can be advanced by a rack or pinion; when so advancing, oranges, lemons, &c. (previously placed in the trough and the lid being closed), are pressed against the rotating cutters and so prepared for marmalade, as carried on at No. 4,624.

The third is a metal cylinder, about fifteen inches long and three inches in diameter, the bottom of which is perforated and movable: a plunger fits this cylinder.

When the material of which certain biscuits are to be made has been placed in the cylinder, and the plug, containing metal openings which form the longitudinal design of the biscuit, has been placed at the end, the plunger is advanced, and the material exudes from the openings corrugat d or marked according to the inserted design: these are then cut to the required length, and baked.

4631.—Messrs. J. and J. COLMAN, 108, Cannon-street.

Messrs. J. and J. Colman here separate pure mustard from the seed. Two steel crushing rollers, each about eighteen inches diameter, rotate in opposite directions, their distance apart being so adjusted that seed passing between them is crushed. This crushed seed is then put into deep metal mortars, where by the falling of pestles weighing about 50lbs., and which are raised by wiper cams, a still further disintegration takes place. The oil which mustard seed contains so clogs the surfaces of millstones that the usual operation for reducing grain to an impalpable powder cannot be employed. Motion is given by a crank on a vertical shaft to sieves covered with silk of a finer character than that used for flour. Thus the bran is separated from what is used as mustard. From this bran oil is extracted by hydraulic pressure, and the refuse cake of mustard seed bran is used by farmers as a means of destroying "wire-worms."

The circular tin boxes in which the mustard is sold, are also made here. The cylindrical part been coiled, and the lap-joint hooked in, a second machine, by lever pressure, squeezes the lap, forming at the same time a recess in the lap for the bottom. The lids and bottoms are pressed out and shaped by a punching machine, the former by three punches acting in succession on the same piece of metal, and the latter by two. A bottom being slipped into the lower part of the cylinder, it is placed on a tray of solder, heated by a gas flame from a Bunsen's burner. Capillary action causes the junction of the metals to be soon filled with solder. The box is now completed, and one of the numerous punched-out lids is used for a cover.

The machine for V-grooving strips of wood for the making of packing cases, consists of a shaft, on which can be fixed, as an ordinary cutter of the wood planing machine, a V-shaped cutter. A strip of wood, of the breadth and length of the two sides and ends of a packing case, is laid ready to be drawn in by fluted friction gripping wheels. When thus drawn it is grooved, and being delivered from the machine a little glue is inserted in the V-grooves, the four sides are bent, and the box completed by having a bottom and lid fixed to these sides in the usual manner.

4632.—COMPAGNIE FRANCAISE, 69, Bermondsey New Road.

Cocoa-nibs, prepared by heat, and winnowed so that the husk is separated, are brought to the machinery here exhibited. These nibs, with a due allowance of prepared vanilla, are placed on a circular stone slab with raised iron rim. On this slab rest two coned small broad-edge runners; beneath it, in the lower casing of the frame-work, are rings of jets of gas by which the slab can be heated. Above the slab, and descending from the upper cross-framing, is a shaft, at the lower part of it are arms, which being rotated, stir the crushed cocoa and vanilla.

This preliminary stage completed the reduction to a finer state is accomplished by very hard stone rollers, whose distance asunder is adjustable in the usual manner. The crushed and ground cocoa, duly flavoured, after passing these rollers, is placed in the hopper of a machine similar to that with which sausages are made; from this it is forced on to a small gauged metal table, and, whilst still in a plastic state, transferred to tin or tinned-copper trays, the bottoms of which have the names of the makers or other device in intaglio. A number of these filled trays are placed on a table, which is tossed or jolted by a mechanical arrangement as noisy and racketting as ingenuity could well suggest. The writer of this Report differs from the opinion that no other means can be devised to cause the plastic cocoa to settle in the intaglio device or lettering.

4635.—CRISCUOLO, KAY, and Co., 57, Gracechurch-street.

The manufacture of maccaroni is here accomplished by machinery, and your reporter is informed this is the first attempt to do so. Although the works of Messrs. Criscuolo, Kay, and Co. are located in England, yet the workmen are Italians. A large edge-runner of Italian marble kneads the dough, of a granulated rather than impalpable powder of wheat called "Semolina."* This wheat is chiefly grown on Italian soil. If one of the grains be divided with a knife there will be seen that a very small portion of the interior is white (or flour), the remaining contents of the outer coating being "semolina," of varying quality. Skilful millers in the neighbourhood of Naples contrive to produce a large proportion of semolina from wheat grown there.

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* This granulation is not unlike what millers in some parts of England call "sharps," and in other parts of England call "middlings."

A person in charge of Messrs. Criscuolo, Kay, and Co.'s machinery informed the writer that the Italian wheat then in our hands contained—

15 per cent. of flour.
24 ,, bran.
16 ,, semolina (second quality).
3 ,, semolina (first quality, coarse).
42 ,, semolina (first quality, fine), and suitable for the best maccaroni.

The dough, after having been kneaded in a comparatively dry state for one hour, under a heavy marble edge-runner, similar to those used in mortar mills, is placed in a strong metal cylinder, heated by gas-flames playing on the outer cylindrical surface. There are a number of movable bottoms for this cylinder; each, however, is perforated with small orifices. If these orifices are cylindrical, pins are so held as to form the pressed-out dough like a pine, the object being to facilitate the drying of the maccaroni, by permitting air to be in contact with the inner as well as the outer surface of the substance. As the dough is forced through these openings by powerful mechanical pressure upon a piston a man receives it, and, cutting it into lengths, it is taken to a room, at one of the windows in which persons are engaged in folding it. The drying in this room, and also in an annex, occupies many days before the process is completed and the maccaroni ready for the market.

4651.—Legg, R., Eagle-wharf, Hoxton.

The self-acting machine for cutting tobacco is the same in principle as the one used for chopping hay. The cut tobacco is then laid on a tray warmed by gas flames. Here it is kneaded—or rather treated as confectioners treat dough when it is to be converted into "puff" paste. This lightens the cut and solidified tobacco, rendering it of a uniform density suitable for the market.

For 4,638 see 4,623.
,, 4,645 ,, 4,621.
,, 4,646 ,, 4,623.

4663.—Sears, J. N., and Co., Langbourn Chambers, 17, Fenchurch-street.

The principle involved in this apparatus for cleaning and sifting wheat is that of causing the grains to meet a regulated air-blast, which carries with it the lighter grains and some of the refuse, whilst the heavier grains descend. This is combined with a second apparatus, by which the grains are, as it were, rubbed against each other and against the concave surface of a smooth perforated metal cylinder; through the perforations the dust, &c., passes, and the cleaned wheat falls into a receptacle prepared for it.

4666.—Tallerman, D., 113, Cannon-street.

This process of preserving meat is by the placing of tins containing the meat in a bath of chloride of calcium. Each tin is completely closed by soldering, except at a very small punctured hole in what would be ordinarily called a lid. Steam pipes form that floor of the bath on which the tins are placed; the temperature of the chloride of calcium is raised to 220°; in this the tins remain for an hour and a half; the small orifice is then soldered; the temperature of the bath is increased, and after half an hour the tins are removed and the process is completed.

4670. Tullock and Co., 54 and 55, Leadenhall-street.

This cocoa-flaking machinery is not unlike that used for grinding coffee. Advantage is taken of the oily character of cocoa in forcing the ground material between a fixed edge and a rotating disc, in order to expose a larger surface of it to the hot-water at the breakfast table. It is this part of the process that is called "flaking."

4827. Diamond Rock Boring Co., 2, Westminster-chambers, Victoria-street.

These are two machines for boring rocks, &c. The smaller one is to be used in mines, quarries, &c.; the larger one for investigating the strata beneath the surface of the earth. The former is called by the exhibitors a "drill head;" the latter a "prospecting machine."

In a collar at the end of a tube, in the small machine, certain diamonds of a black opaque character are fixed. By any of the usual machinery this tube is caused to rotate as a trephine or crown-saw, and by a screw arrangement, to which the tube is attached, the advance of this rotating, diamond boring-head may be regulated, as in an ordinary drilling-machine, and holes bored. There is a friction-collar on rollers to receive the end-thrust of the boring-head.

The larger machine acts upon a similar principle, but in it arrangements are made for adding pipe to pipe, for which purpose parallel bars are fixed at the top to support the lengths of pipe being added. The work is so carried on that the central core of the rotating diamond boring-head is enclosed in the tube, and, therefore, is a sample of the thickness, inclination, &c., of the strata through which the boring-head may have passed.* In both these machines provision is made for passing water down the tube, and so washing away externally to the tube the *débris* resulting from the operation of boring. The large, flat weights in the prospecting machine are used to counterbalance the boring-tubes, and so relieve the diamonds at the end from any load in excess of that requisite to secure the advance of the work.

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* An example of this is in a glass-tube by the side of the machine.

4854.—Marsden, H. R., Meadow-lane, Leeds.

The construction of this machine for breaking stones and crushing ores is simple. Invisible, consequent upon the covering frame-work, is what is called a "toggle-joint," by the action of which a jaw, with a strongly-formed corrugated surface, opens and closes. To this jaw the stones, ores, &c., &c., are supplied, and so crushed. The crushed material may be discharged into an inclined rotating perforated cylinder, and so divided by sifting into heaps of varying degrees of coarseness.

4886.—Tilghman, Philadelphia, per Newton and Son, 66, Chancery-lane.

This is a recently contrived scheme for the employment of sand for purposes such as the engraving, boring, &c., of stone, glass, &c.*

The principle of the apparatus is by a blast of air, steam, &c., &c., to cause innumerable particles of sand to impinge where portions of glass, stone, metal, &c., &c., are to be removed. Mr. Tilghman is thus enabled to produce not only excellent work, but with a rapidity almost incredible. For example, a square or triangular hole of half an inch in the side can be bored through a sheet of ordinary plate window glass in less than one minute. Designs of lace work—also photographs—can be "eroded" or "ground" on glass with great rapidity.

There are two machines now in operation upon glass, and one at work on stone. The small machine is to appearance a very plain painted box or stand—nothing of machinery visible. In the top of this box are two holes, about an inch and a half in diameter. If the wooden casings were removed, there might be seen below these holes a pipe, which descends, and is formed somewhat trumpet-mouthed on the outside of the bottom of the box. Below this mouth is a turned wooden basin. From the upper part of the box, on the spectator's left hand, a pipe passes underneath the floor to the centre of a rotating fan, near the wall of the room, and therefore by this a vacuum can be formed in the box. As the only inlet of air is past the trumpet-mouthed opening, a rapid current ascends the pipe connected with it whenever the exhaust-fan is at work. From large hoppers (funnel-shaped) containing sand, a regulated quantity falls towards the turned wooden basin; in falling on the basin it is influenced by the entering air, is jetted from the pipe, and so strikes upon, say, glass covering the holes; the exposed glass is rapidly depolished. Where, however, an elastic substance, as paper, india rubber, &c., covers the glass, no action of the sand takes place.

If interstices or openings be formed in this elastic substance, as a pattern, then the surface of the glass is removed in accordance with such pattern, and to a depth dependent upon the time of exposure, and the intensity of the current of air, and quality of the sand.

Next to this small "vacuum" machine is a large compressed air-blast one, capable of acting upon a sheet of glass three feet broad. A design in paper or lace being pasted on the glass, it is laid upon endless bands, by the motion of which it may be carried forward. In the middle of the compartment (which is glazed upon one side so that spectators may see the operation) provision is made, by a suitably-formed transverse opening for a blast of air with sand. When the ordinary machinery is set in motion this blast commences, the glass is travelled at a pre-arranged velocity, and in as little time as one may require to read this account, the ornamented glass is delivered at the side of the box opposite to that at which it entered. The design, printed on the next page, is from an electrotype of one of the sand engravings upon glass.

So slightly an elastic surface as the changed character of some of the materials used in photography suffices to resist the action of the sand; hence the photographic design may be etched by sand on glass. Examples of various works done by this process are on a table near to the machine. The third machine is in a separate building. It consists of a wooden table, on which the stone is laid. This table can be traversed impulsively in one direction, by the action of a Clement's driver, on a spur wheel, and so motion is given to a rack.

Above the table, provision is made for traversing the combined steam and sand jet. This is accomplished by a mangle-wheel motion, variable according to the breadth of the stone to be operated upon. By these two motions, transverse to each other, every portion of the stone may be reached. The steam and sand jet is arranged upon the plan adopted by Mr. Siemens, for exhausting the telegraph despatch tubes—the sand being admitted by an inner small tube, surrounded by jets of steam, as from concentric rays of an argand burner. Whilst your reporter was present, a delicate and somewhat intricate cast-iron pattern was laid upon a piece of marble. The steam in the boiler was at 55 lbs. pressure. In five minutes the marble, measuring 13 inches by six, was penetrated to a depth of about 3-16ths of an inch, leaving the surface as originally polished, and with the beautiful tracery design in high relief. The sand is ordinary silver sand, and was used at the rate of one pint per minute; the slab of marble was three-quarters of an inch in thickness, and was rapidly cut by the sand blast, and so separated from a larger piece.

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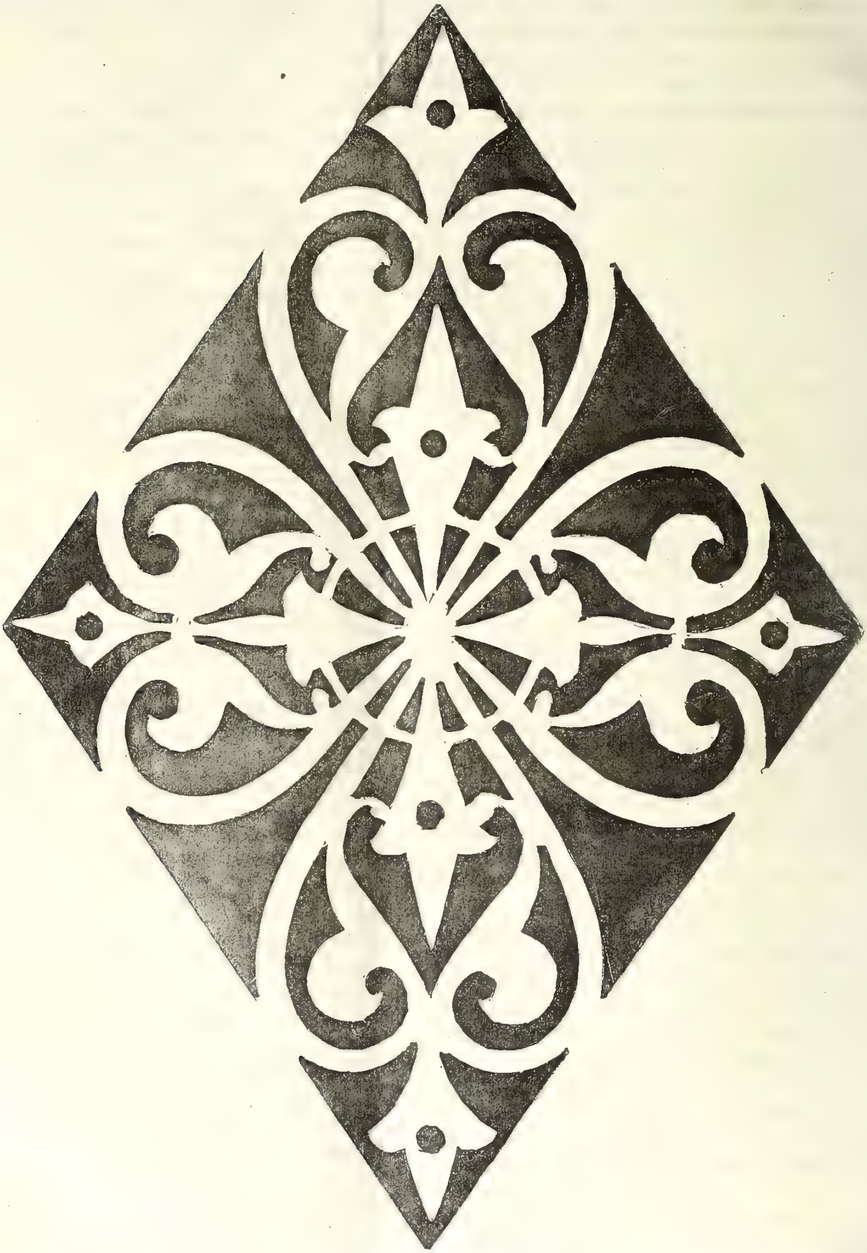
* A description of this machine appeared in the *Journal* of May 23.



This eroding action of sand mixed with water has formed many of the ravines and glens in our island. If the following statement, made to the writer of this report about ten years ago, be true in fact, there is a property in water which has not yet been utilised. Whilst standing near a new steam-boiler which was being tested under water pressure, and when the load was near its maximum, a small and (except that the sun shone upon it so that the light was decomposed) imperceptible jet appeared; the writer was about to pass his finger across it, when a workman said, "Don't do that, sir; a boy had his finger cut off with one of those jets." Might not a jet of water be used as a saw?

4901, 4907. 4916.—These are boilers, of peculiar and different constructions, for each of which special advantages are claimed by the inventors. Those interested in the question can refer to the published pamphlets. There is also with No. 4,916 a peculiar self-acting feed-water arrangement.

The number of visitors admitted to the Exhibition on Thursday, 29th inst., was as follows:—Season tickets, 207; on payment of 1s., 3,707; total, 3,914. On Friday, season tickets, 162; on payment of 1s., 3,177; total, 3,339. On Saturday, season tickets, 944; on payment of 1s., 4,856; total, 5,800.

The number of visitors admitted to the Exhibition during the week ending Saturday, May 31st, was as follows:—Season tickets, 1,899; on payment of 2s. 6d., 1,551; on payment of 1s., 18,108; total, 21,558.

The number admitted on Monday was, season tickets, 231; on payment of 1s., 10,555; total, 10,786. On Tuesday, season tickets, 143; on payment of 1s., 5,045; total, 5,188. On Wednesday, season tickets, 241; on payment of 2s. 6d., 1,445; total, 1,686.

EXHIBITIONS.

The Vienna Exhibition.—It is understood, says the *Athenæum*, that by far the most important of the fine-art sections of the Vienna Exhibition, *i.e.*, the French, will not be ready until July, after the closing of the current *Salon*, when many of the finest pictures in that gathering will be removed to Vienna. No fewer than five new pictures by M. A. Stevens, two by M. Gérôme, three by M. Meissonier, and others by Mr. Alma Tadema, will probably find places in the French Court. The works of MM. Meissonier and Gérôme are, it is said, to be new ones—in fact they are still in hand. It is estimated that during the ensuing three months fully 22,000 cabin passengers will visit Europe from America, attracted there by the Vienna Exhibition.

The Cincinnati Industrial Exposition.—The fourth yearly Industrial Fair will open in Cincinnati on the 3rd of September, and close on the 4th of October.

PURCHASE OF RAILWAYS BY THE STATE.

An article in the last number of the *Quarterly Review* is devoted to a summary of the arrangements for and against this important question. The impartiality, and the evident wish to show the exact condition of matters at present, with which the article is distinguished, render it worthy of the attention of all those who take an interest in the question. In view of the paper to be read before the Society on the 13th inst., by Mr. Galt, it has seemed worth while to reproduce here some of the remarks of the reviewer. The arguments of what may be called, for convenience sake, the conservative party, are stated as follows:—

1. "Would not the amount of patronage placed at the command of government be objectionable in a constitutional point of view?

2. "Could railways be administered, managed, and worked by the State?

3. "Might not the absorption of the railways by the State, in their purchase by government on its behalf, prove to be a losing operation in a financial point of view?"

The first of these arguments is perhaps the most popular of all with those who are either definitely opposed to the scheme, or who have not looked deeply into the matter, but yet regard the proposed change with mistrust. The Quarterly reviewer does not enter into any serious discussion of this objection, nor perhaps does he give it the amount of consideration it deserves—if not from its intrinsic weight, at least from the persistency with which it is again and again put forward. Those who urge this consideration seem to forget that we are not under a *régime*, such as that in America, where all public functionaries, from the president down to the letter-carrier, go out and come in with a change of government. We do not find that any evil results arise from patronage among the rank and file of the army, and probably there would be no more accruing if the porters and navigators in a railway were, like private soldiers, paid by the State. A government cannot sway the nation by its appointments of postmen or railway stokers, and as to employment in the higher positions, they, like all other posts in the Civil Service, would probably be awarded by examination. It is indeed just possible that the alarmists are right, and that if the ministers had in their hands the appointments to the lucrative offices of signalmen and porters, a gigantic system of bribery and corruption might arise; but there is no reason whatever to expect such a thing, and history and common sense alike go to prove its impossibility.

As to the management of the railways, the reviewer, and possibly with justice, entirely neglects the idea that railways might be bought and farmed by the State. This has been suggested, but it does not appear that any serious support has ever been given to the proposition. He shows that there must be of necessity an immense saving in the legitimate working expenses of the railways, when they are conducted with a view to one profit and one interest—that of the public—instead of with regard to half-a-dozen different and generally opposing interests. As to the argument from the dockyards, he holds that the parallel is not a just one, and that it is not fair to compare the ever-changing and progressive requirements of a navy with the constant and absolute demands of a railroad system.

The third point is the principal one, and the one upon which, in all likelihood, the settlement of the matter will eventually turn. Mr. Benson, in his work on the subject, has calculated the amount likely to be required, and the results which might be expected, from the Board of Trade returns. The net receipts for 1871 were over 25 millions and a half; deducting 14 millions and a half interest on preferential capital, there remains 11 millions balance, or 5 per cent. on ordinary capital. This may be taken as worth 20 years' purchase, supposing there was no fluctuation, or 224 millions and a half. Allowing a rise of 6 per cent. per annum in value, or say 10 years' purchase, we may add 112 millions and a half. To this we may also put on 33 millions and a half as bonus for compulsory sale. All this would produce a sum of 370 millions and a half. This money would be raised by a 3¾ per cent. stock, the yearly interest of which would be nearly 13 millions. There would consequently be a loss in the first year or so, but then the rise of 6 per cent. per annum would rapidly come in to cover this, and in a few years the profit would not only cover the original loss, but would bring in a large and growing income. Such is, in the briefest possible space, Mr. Benson's project, the figures of which are given at length in the *Review*. The results do not greatly differ from those arrived at by Mr. Biddulph Martin, after a rather different series of calculations.

The expected advantages of the scheme are now pretty much the same as those set forth in Sir Rowland Hill's report in 1866:—

1. Pecuniary gain to the State.
2. Gain to railway proprietors in steadiness and security of income.
3. Security against costly Parliamentary contests.
4. Reduction in fares, freights, &c.
5. Greater efficiency in management.
6. Increased postal facilities, and a cheap parcels delivery.

Besides a cost (according to the late Mr. Graves) of a reduction of 25 per cent. on working expenses.

Such are, in brief, the main considerations put forward by the author of the article. The conclusions at which he arrives may best be given in his own words:—

"The utter disregard of all law and system under which our internal communications have been constructed will render the railways of England a permanent monument of the ridiculous and disastrous achievements of 'healthy competition' and 'independent enterprise' embarked in hopeless and unequal race with gigantic industrial monopolies. But the experience of the past, no less than the manifest tendencies of the present, may afford us a timely warning for the future; and it is to be hoped that we have, at all events, learnt the futility of all attempts to manage our railway companies by arming a subordinate department of the Government with powers to scold and irritate when it cannot command, and to issue orders when it cannot impose penalties on disobedience. We have tried the *laissez faire* policy, and it has failed; we have tried a meddlesome policy and it has failed also. We have now, in the language of Captain Tyler, to meet the coming day when all the railways, having completed their several systems, may, and probably in their own interests will, 'combine together to take advantage of the public.' In the face of this contingency, we have simply to make our choice between two alternatives, either 'to let the State manage the railways, or let the railways manage the State.'"

GENERAL NOTES.

South Kensington Museum.—The late Countess of Waldegrave has bequeathed to the South Kensington Museum three silver-gilt bells, all of different designs, and of historical interest. They were appended to the canopies used at the coronation of George II., George III., and George IV. These canopies were borne by the Barons of the Cinque Ports, in accordance with an immemorial custom. The first husband of the late Lady Waldegrave (Mr. Milward) was one of the Barons, and it was through him that the bells came into the possession of the testatrix.

Scientific Expedition to Paraguay.—Dr. Leoni Levi, the Consul General for Paraguay, is arranging a scientific commission, to inquire into the resources of Paraguay. The commission is to consist of botanical, agricultural, geological, mineralogical, and geographical surveyors. It is understood that the Consul General has in view to appoint a French botanist, of great reputation, and a Scotch agriculturist, but has made no arrangement for the geologist and geographer. Dr. Levi would be glad to give information to anybody who might be willing to offer his co-operation in such a scientific expedition.

Scientific Education.—Sir Josiah Mason, who has already built and endowed an orphanage at Erdington, near Birmingham, at a cost of more than a quarter of a million, has now arranged to erect and endow a Scientific College in Birmingham, on which will probably be expended at least an equal amount. All the arrangements for this munificent gift have been completed. The site has been secured, and the deed of foundation duly enrolled in the Court of Chancery. The institution is to be called "Josiah Mason's College for the study of Practical Science." A preparatory school may be added to the college, and the instruction to be given is strictly confined to subjects specially adapted to the "practical, mechanical, and artistic requirements" of the Midland district, more particularly the boroughs of Kidderminster and Birmingham. The trustees have power to include mechanics and architecture and all other subjects necessary to carry out the objects of the founder. The site selected for the college is in Edmund-street. It is in the centre of the town, and close to the Town Hall, the Central Free Libraries, the Midland Institute, the new Post-Office, and the proposed Corporation buildings. The land is therefore of the greatest value, and the founder has already laid out upwards of £20,000 on the site. He has also conveyed landed property producing about £600 a year, and there is a clause in the deed in which he states it to be his intention to devote by his will additional funds for the use of the college.

Scientific Society for Buenos Ayres.—A scientific society has recently been established at Buenos Ayres, with Mr. A. Luis Huergo for its first president. According to their programme, the members have arranged for carrying out several branches of original research.

Silk Growing.—Mrs. Neill had another meeting at the end of March of the friends and supporters of her sericicultural movement in Melbourne. The "grain" imported from M. Roland's establishment has turned out well, and several have obtained first-class cocoons from it. Mr. C. Brady writes from the Tweed River, New South Wales, reporting that he has also successfully raised cocoons from the grain brought out for him from Europe by Mrs. Neill. The pursuit of silk-growing has already been taken up by a good many ladies, and the movement appears to have much vitality. From Western Australia we learn that Governor Weld has granted one hundred acres of land at King George's Sound to a lady who proposes to carry on silk-growing there, and a bonus of £500 has been offered by the Government of Western Australia for the first bale of silk exported from that colony. Some of the sericiculturists in South Australia propose to send here one of their number, a Mr. Francis, to make himself acquainted with Roland's system as introduced by Mrs. Neill. Near Melbourne a very advantageous offer of a piece of land at Brighton has been made to the Ladies' Association by a lady resident of that suburb; it is proposed to grow mulberry trees on this land for the supply of the Melbourne district. By the last two mails orders have been sent to France for large supplies of seed for trees. Mrs. Neill is endeavouring to effect arrangements for using Mr. J. Harrison's refrigerating process for the future transport of silkworm grain between Australia and Europe.—*Journal of Applied Science.*

NOTICES.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Social Science Association, 8. Mr. F. W. Lowndes, on "Infanticide."
Royal United Service Institute, $8\frac{1}{2}$. Major A. Moncreiff, "Further Observations on the Moncreiff System of Mounting Ordnance."
Society of Engineers, $7\frac{1}{2}$ Mr. S. Alfred Varley, "Communication between Passengers, Guards, and Drivers in Railway Trains."
Geographical, $8\frac{1}{2}$.
British Architects, 8.

Tues. ...Photographic, 8.

Wed. ...Geological, 8.
Royal Literary Fund, 3.
Royal Society of Literature, $4\frac{1}{4}$.
Archæological Association, 8.

Thurs...Royal, $8\frac{1}{2}$.
Antiquaries, $8\frac{1}{2}$.
Royal Society Club, 6.
Mathematical, 8.

Fri ......**SOCIETY OF ARTS, 12.** Special Meeting. Mr. W. Galt, "On the Purchase of the Railways by the State."
Astronomical, 8.
Quekett, 8.
Architectural Association, $7\frac{1}{2}$. Mr. F. Chambers, "The Popular Estimate of Architecture"

Sat......Royal Botanic, $3\frac{3}{4}$.
Trades Guild of Learning (at the House of the Society of Arts), 11 and 3. Conference for the purpose of establishing the Guild.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,073. VOL. XXI.

FRIDAY, JUNE 13, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

PURCHASE OF RAILWAYS BY THE STATE.

A special meeting of the Society will take place, by order of the Council, to-day (Friday), the 13th June, at 12 o'clock, when a paper will be read by WILLIAM GALT, Esq., "On the Purchase of the Railways by the State." The Right Hon. the Earl of DERBY will preside.

CONFERENCE.

The Twenty-second Annual Conference between the Council of the Society and the representatives of Institutions in Union, will take place at the Society's House, on Friday, the 27th June. The chair will be taken at 12 o'clock, by Major-General F. EARDLEY-WILMOT, R.A., F.R.S., Chairman of Council.

Secretaries of Institutions and Local Boards are requested to send, *immediately*, the names of the Representatives appointed to attend the Conference; and early notice should be given of any subjects which Institutions or Local Boards may desire their representatives to introduce to the notice of the Conference.

CONVERSAZIONE.

The Society's Conversazione will be held at the South Kensington Museum, on Friday evening, the 27th June. Cards are now in course of issue.

ESSAYS FOR THE ENCOURAGEMENT OF THRIFT.

Sir Joseph Whitworth has offered prizes of the value of one hundred pounds, to be obtained through the Society of Arts, for the best Essays on the "Advantages that would be likely to arise if railway companies and limited companies generally were each to establish a savings-bank for the working classes in their employ." With this offer he has transmitted the following observations:—

OBSERVATIONS.

1. Is not a good rate of interest, with perfect security, more likely to promote the habit of saving than any other plan that can be devised?

2. Sir Joseph Whitworth suggests that the interest to be paid on the deposits should be the same as the dividend, with a guarantee that it shall not be less than 4 per cent.

3. By paying the same rate of interest as the dividend earned, there is a bond of union established between labour and capital.

4. An Act of Parliament might make the deposits of the industrial classes the first charge on the estate.

5. The proprietor of a private establishment, whose profits are not made known, might undertake to pay, say 7 or 8 per cent. when the profits reached that amount or more, the proprietor giving an undertaking to pay not less than 4 per cent.

6. In the case of Agriculture, each county might have its savings bank for the savings of both men and women in the said county, and the interest to be paid might be 6 or 7 per cent.

7. To do this there might be a rate collected along with the poor-rate, to be called the interest or industrial rate.

8. As this rate increased, no doubt the poor-rate would diminish, and if the habit of saving became general among the labouring classes, there would probably be great gain to the property-owning classes, considering the great variety of ways in which they have now to contribute for the support of the unfortunate who now make no provision for themselves.

9. In order to realise what might be the probable saving to those who encourage the savings-banks thus suggested, Sir Joseph Whitworth points to the list of charities, also institutions, such as infirmaries, hospitals, union-houses, prisons, police, &c., &c.

10. In any establishment, if only one-third of those employed deposited savings, they would have immense influence over the other two-thirds of their fellow-workmen.

11. Men who spend all their earnings are generally reckless, and become the dupes of agitators; but the man who has put by some of his earnings will be likely to exercise forethought, and will not be led away by others.

12. In South Wales is it likely there would have been the late turn-out, if the different establishments had each had such a savings bank as that proposed?

13. In the case of a man or woman falling into distress from causes beyond their control, what better proof could be given that they were deserving of sympathy and assistance from their friends, than the fact that they had put by savings at a time when they were able to do so. The rule of action should be to do as little as possible for those who do as little as possible for themselves.

14. Some of the points to be considered by the essayists will be the amount to which the savings shall be limited, and when the depositor wishes to withdraw the whole or any part of the sum deposited what notice shall be given.

15. The co-operative system is no doubt effecting much good, but if the system here sketched out were adopted, the greatest good, in the shortest time possible, might be effected.

The principal subjects which the essayists should consider are the preceding.

The Council have accepted this offer, and appointed a Committee to arrange the details for obtaining the essays.

GENERAL EXAMINATIONS, 1873.

PRIZES AND CERTIFICATES AWARDED TO CANDIDATES.

PRIZES.

His Royal Highness the Prince Consort's Prize of Twenty-Five Guineas to

No. 1107—Thomas Richard Clarke, aged 21, formerly of the Salford Working Men's College, and now of the Birkbeck Literary and Scientific Institution, accountant's clerk, who has obtained the following First-class Certificates in the present and three preceding years :—

1870—Arithmetic—First-class Certificate.
„ Geography—First-class Certificate, with First Prize, and Royal Geographical Society's Prize.
„ English History—First-class Certificate.
1871—Metric System—First-class Certificate, with First Prize.
1872—Book-keeping—First-class Certificate, with First Prize.
„ English Language—First-class Certificate.
1873—Logic—First-class Certificate, with Second Prize.
„ Political Economy—First-class Certificate, with Second Prize.

The Council Prize (for Female Candidates) of Ten Guineas

Has not been awarded this year, as no candidate qualified to receive prizes has fulfilled the required conditions.

Arithmetic	1st Prize	£5	To No. 910—James Owen, 26, Pembroke Dock Mechanics' Institution, shipwright
	2nd Prize	3	„ 242—Abner W. Brown, 29, Aldershot and Farnham District Board, sergeant
			*No Prize for Females awarded**
Book-keeping	1st Prize	5	„ 927—William Wing, 19, Rotherham Literary and Mechanics' Institution, clerk
	2nd Prize	3	„ 1001—Joseph J. Edwards, 23, Swindon Mechanics' Institution, clerk
	Females' Prize	2	„ 1115—Julia Lawrence, 19, Birkbeck Literary and Scientific Institution (no occupation stated)
Floriculture	1st Prize	5	„ 731—William Falconer, 22, St. Stephen's Evening School Westminster, gardener
	2nd Prize	3	„ 505—James M. Smith, 25, Hull Young People's Christian and Literary Institute, gardener
Fruit and Vegetable Culture	1st Prize	5	„ 505—James M. Smith, 25, Hull Young People's Christian and Literary Institute, gardener
	2nd Prize	3	„ 731—William Falconer, 22, St. Stephen's Evening School, Westminster, gardener
Political Economy	1st Prize	5	„ 1097—Jeannette G. Wilkinson, 29, Birkbeck Literary and Scientific Institution, upholstress
	2nd Prize	3	„ 1107—Thomas R. Clarke, 21, Birkbeck Literary and Scientific Institution, accountants' clerk
English History	1st Prize	5	„ 1157—William H. Wright, 18, Birkbeck Literary and Scientific Institution, clerk
	2nd Prize	3	„ 235—Percival Waugh, 18, Edinburgh Watt Institution, clerk
			*No Prize for Females awarded**
English Language	1st Prize	5	„ 581—Henry Beer, 22, City of London College, clerk
	2nd Prize	3	„ 602—William D. Fish, 20, City of London College, clerk
			*No Prize for Females awarded**
Logic	1st Prize	5	„ 855—Alexander Gibson, 19, Manchester Mechanics' Institution, draughtsman
	2nd Prize	3	„ 1107—Thomas R. Clarke, 21, Birkbeck Literary and Scientific Institution, accountants' clerk

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* No Female Candidate qualified to receive Prizes obtained a First-class Certificate in this subject.

French	1st Prize......	£5	To No. 706—Frank G. Whiteman, 29, Royal Polytechnic Institution, clerk
	2nd Prize	3	,, 1153—Richard W. Bennett, 20, Birkbeck Literary and Scientific Institution, clerk
	Females' Prize	2	,, 1120—Francesca E. Arundale, 25, Birkbeck Literary and Scientific Institution (no occupation stated)
German	1st Prize......	5	,, 499—John Martin, 25, Hull Young People's Christian and Literary Institute, clerk
	2nd Prize	3	,, 1188—John Taylor, 17, Leeds Young Men's Christian Association, apprentice
			No Prize for Females awarded†
Italian	1st Prize......	5	,, 718—Robert W. Wilkins, 28, Royal Polytechnic Institution, clerk
			No Second Prize awarded‡
			No Prize for Females awarded†
Spanish	1st Prize......	5	,, 102—Edward Edmonds, 22, Birmingham and Midland Institute, clerk
	2nd Prize	3	,, 330—Henry Hill, 18, Glasgow Athenæum, clerk
Theory of Music	1st Prize......	5	,, 1158—George F. Crawte, 31, Birkbeck Literary and Scientific Institution, clerk
	2nd Prize and Females' Prize	3 2	,, 191—Fanny Ollis, 17, Devonport Mechanics' Institution (no occupation stated)

The Prizes offered by Mrs. Harry Chester in Political Economy have been awarded as follows :—

Third Prize of £2 to No. 862*—Henry Vosper, 22, Manchester Mechanics' Institution, buyer
Prize of Books value £1 ,, 602—William D. Fish, 20, City of London College, in Civil Service
,, ,, ,, 855—Alexander Gibson, 19, Manchester Mechanics' Institution, draughtsman
,, ,, ,, 1166—William Allingham, 22, Birkbeck Literary and Scientific Institution, Civil Service writer

The Prizes offered by the Council for Writing from Dictation have been awarded as follows :—

1st Prize of £3 to No. 1149—John R. Smith, 28, Birkbeck Literary and Scientific Institution, Civil Service writer
2nd ,, 2 ,, 235—Percival Waugh, 18, Edinburgh Watt Institute, clerk
3rd ,, 1 ,, 664—George Smith, 18, City of London College, clerk

The Prizes offered by the Council for Writing and Manuscript Printing have been awarded as follows :—

1st Prize of £3 to No. 1149—John R. Smith, 28, Birkbeck Literary and Scientific Institution, Civil Service writer
2nd ,, 2 ,, 141—Wheater Smith, 20, Bradford Mechanics' Institution, surveyor
3rd ,, 1 ,, 621—Frederic A. Huntley, 18, City of London College, engineer's draughtsman

The Prizes offered by the Council for the four best specimens of Handwriting, as shown in any of the Papers worked in any subject, have been awarded as follows :—

1st Prize of £5 to No. 664—George Smith, 18, City of London College, clerk
2nd ,, 3 ,, 1157—William H. Wright, 18, Birkbeck Literary and Scientific Institution, clerk
3rd ,, 2 ,, 615—Arthur Hill, 19, City of London College, clerk
4th ,, 1 ,, 681—John J. Wootton, 19, City of London College, clerk

VIVA-VOCE EXAMINATION IN MODERN LANGUAGES.

The vivâ-voce examination in Modern Languages, as proposed in the memorandum furnished by Mr. Hyde Clarke, Member of the Council, has been held this year, at two Institutions, the subject taken being French, and the Examiners report the results as follows :—

No. 554—Thomas Marson, 21, Lichfield Working Men's Association, gardener, "very good."
,, 813—Margaret S. Rorke, 17, Manchester Mechanics' Institution, no occupation stated, "very good."
,, 801—John Wardle, 21, Manchester Mechanics' Institution, clerk, "very good."
,, 824—George Nelson, 24, Manchester Mechanics' Institution, warehouseman, "good."
,, 861*-William Mitchell, 27, Manchester Mechanics' Institution, traveller, "good."

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† No Female Candidate qualified to receive Prizes obtained a First-class Certificate in this subject.
‡ No other First-class Certificates were given in this subject.

CERTIFICATES.

The following is an Alphabetical List of the Candidates who have obtained Certificates.

The number following the name gives the age of the Candidate.

(1st) after a subject signifies a First-class Certificate.
(2d) ,, ,, Second-class ,,
(3d) ,, ,, Third-class ,,

The occupations stated are either present or proposed.

5—Abel, John, 26, Aberdeen M.I., clerk—Eng. Lang. (3d)
577—Abell, Thomas K., 19, City of London Coll., clerk —Bkpg. (3d)
412—Ackroyd, Herbert, 21, Halifax W.M. Coll., clerk —Bkpg. (2d)
51—Adamson, William, 31, Arbroath Local Board, mechanic—Th. of Music. (2d)
1216—Adcock, George, 25, Leicester W.M. Coll., baker —Eng. Lang. (1st)
413—Ainley, William H., 19, Halifax W.M. Coll., draper—Bkpg. (2d)
400—Aitchison, John G., 19, Glasgow M.I., measurer's assistant—Arith. (2d)
234—Aitken, Thomas, 17, Edinburgh Watt Inst., civil engineer—Arith. (3d)
1132—Aldridge, Louisa B., 23, Birkbeck Lit. and Sci. Inst. (no occupation stated)—French (3d)
579—Alexander, William M., 33, City of London Coll., architect's assistant—Bkpg. (1st)
96—Allen, William, 23, Birmingham and Mid. Inst., clerk—Eng. Lang. (3d)
1166—Allingham, William, 22, Birkbeck Lit. and Sci. Inst., civil service writer—Logic (3d); Pol. Econ. (1st), with a prize of books to the value of £1
460—Allison, John B., 21, Hull Ch. Inst., clerk—Bkpg. (1st); Eng. Hist. (2d)
461—Allison, William, 17, Hull Ch. Inst., clerk—Bkpg. (1st)
148—Amos, Henry W., 26, Bromley (Kent) Lit. Inst., clerk—Bkpg. (1st)
1170—Anderson, Ernest M., 18, Birkbeck Lit. and Sci. Inst., law stationer—French (3d)
344—Anderson, John M., 17, Glasgow Ath., clerk—German (2nd); French (3d)
349—Anderson, Thomas, 17, Glasgow Ath., clerk—French (3d)
779—Anderton, Thomas, 20, Manchester M.I., tin-plate worker—Bkpg. (1st)
1219—Andrew, Noah, 19, Leicester W.M. Coll., clerk—Bkpg. (3d)
1205*-Andrews, Richard, 31, Leeds Young Men's Chr. Assoc., clerk—Bkpg. (3d)
97—Anslow, Anna, 27, Birmingham and Mid. Inst., teacher—French (3d)
172—Armstrong, John, 23, Carlisle M.I., engineers' clerk—Logic (2d); Eng. Lang. (2d)
165—Armstrong, Joseph, 20, Carlisle M. I., (no occupation)—Arith. (2d)
69—Armstrong, Thomas S. 19, Ashford M.I., railway accountant's clerk—Eng. Hist. (3d); Bkpg. (1st)
1120—Arundale, Francesca E., 25, Birkbeck Lit. and Sci. Inst. (no occupation stated)—French (1st), with the prize of £2 for females; Arith. (3d)
83—Ashford, John T., 16, Bacup M.I., pupil teacher —Arith. (3d)
236—Ashton, John, 28, Edinburgh Watt Inst., goldsmith—Th. of Music (2d)
930—Ashworth, George, 16, Salford W.M. Coll., clerk —Arith. (3d)
86—Ashworth, James, 16, Bacup M.I., pupil teacher —Arith. (1st); Eng. Lang. (3d)
560—Atkinson, Robert H., 20, Liverpool Inst., clerk—Arith. (1st); Eng. Lang. (2d)
580—Austin, Harry K., 16, City of London Coll., clerk —Arith. (3d)
533—Aylward, Walter C., 17, Ipswich W.M. Coll., shoemaker—Bkpg. (2d)

1144—Bacon, Augustus C., 19, Birkbeck Lit. and Sci. Inst., clerk—Arith. (2d); Bkpg. (2d)
716—Bailey, Frederick G., 19, Royal Polytechnic Inst., stationer—Bkpg. (2d)
71—Bailey, George, 17, Ashford M.I., railway accountants' clerk—Arith. (2d); Bkpg. (1st)
562—Bain, David, 24, Liverpool Inst., teacher—Arith. (3d); Eng. Lang. (1st)
296—Baird, Charles J., 20, Glasgow Ath., clerk—Bkpg. (3d)
1129—Baker, Amy F., 18, Birkbeck Lit. and Sci. Inst., governess—French (3d)
745—Baker, Henry, 20, St. Stephens' Evg. School, Westminster, clerk—Eng. Lang. (2d); Arith. (2d)
735—Baker, James, 19, St. Stephens' Evg. Sch., Westminster, paper-hanger—Arith. (3d)
257—Bald, Claud, 19, Glasgow Anderson. Univ. Pop. Evg. Classes, engine fitter—Th. of Music (2d)
98—Ball, George E., 18, Birmingham and Mid. Inst., pupil teacher—Arith. (2d)
1203—Barraclough, Henry, 16, Leeds Young Men's Chr. Assoc., pupil teacher—French (3d)
982—Barratt, William, 24, Stockport Sund. Sch. Imp. Soc., warehouseman—Arith. (3d)
976—Barrett, John, 26, Stockport M. I., warehouseman, —Arith (3d); Bkpg. (3d)
556—Barrow, James H. M., 25, Liverpool Inst., teacher—Logic (1st)
836—Barry, John, 16, Manchester M.I., clerk—Bkpg. (2d)
798—Barry, Thomas, 20, Manchester M.I., clerk—French (1st)
1031—Bartle, Harry, 17, Wakefield M.I., clerk—Arith. (3d); Bkpg. (1st)
1119—Bartlett, Edwin H., 22, Birkbeck Lit. and Sci. Inst., traveller—French (3d)
865—Baxter, John, 17, Mossley M.I., tailor—Eng. Lang. (2d)
984—Baxter, Thomas, 17, Stockport Sund. Sch. Imp. Soc,, tin plate worker—Arith. (3d)
452—Beaumont, Thomas S., 18, Huddersfield M.I., wool sorter—German (2d)
552—Beaumont, William, 26, Leeds Ch. Inst., attorney's clerk—Bkpg. (1st)
854—Beckett, George E., 21, Manchester M.I., clerk—Arith. (3d); Bkpg. (1st)
581—Beer, Henry, 22, City of London Coll., clerk—Logic (1st); Pol. Econ. (1st); Eng. Lang. (1st), with the first prize of £5.
582—Beken, Amos, 20, City of London Coll., clerk—French (3d)
1059—Bell, John F., 16, York Inst., clerk—Arith. (1st)
1185—Bell, Thomas W., 20, Leeds Young Men's Chr. Assoc., salesman—Eng. Lang. (3d)
925—Bell, William, 23, Richmond Parochial Library, gardener—Floriculture (2d); Fruit and Veg. Cult. (2d)
258—Bell, William B., 23, Glasgow Anderson. Univ. Pop. Evg. Classes, warehouseman — Th. of Music (2d)
973—Bennett, Harry, 16, Stockport M.I., hatter—Bkpg. (3d)
74—Bennett, Henry J., 17, Ashford M.I., fitter apprentice—Arith. (2d)
1153—Bennett, Richard W., 20, Birkbeck Lit. and Sci. Inst., clerk — Arith. (1st); German (3d); French (1st), with the second prize of £3; Eng. Lang. (2d)
906—Bettany, Caroline, 17, Penzance (no occupation) Arith. (2d); Th. of Music (3d); French (3d); Eng. Lang. (3d)

695—Beynon, Richard, 23, Royal Polytechnic Inst., draper—Arith. (3d); Eng. Lang. (3d)
583—Biden, Lewis M., 16, City of London Coll., lawyer—Arith. (1st); French (3d)
259—Bilsland, Thomas, 23, Glasgow Anderson. Univ. Pop. Evg. Classes, lithographic printer—Th. of Music (3d)
571—Birch, James A., 25, Liverpool Inst., clerk—Bkpg. (2d)
530—Bixby, Josiah W., 17, Ipswich W. M. Coll., timekeeper—Bkpg. (2d)
22—Blackhall, Alexander, 16, Aberdeen M.I., clerk—Eng. Lang. (3d)
375—Blacklock, John, 24, Glasgow M.I., flesher—Bkpg. (1st)
1202—Blake, George, 24, Leeds Young Men. Chr. Assoc., in woollen warehouse—Bkpg. (3d)
1208—Blake, George, 19, Bow and Bromley Inst., clerk—Bkpg. (3d)
1065—Bland, Frank, 17, York Inst., articled teacher—Bkpg. (3d)
158—Blaylock, Robert, 20, Carlisle M. I., clerk—Arith. (2d)
188—Blocksidge, William H., 17, Dudley M.I., shorthand writer—Arith. (3d)
991—Bond, John, 21, Stockport Sund. Sch. Imp. Soc., warehouseman—Arith. (3d)
523—Bone, Ernest E., 17, Hyde M.I., articled clerk—Arith. (3d); Eng. Lang. (3d)
932—Bonsall, Eleanor, 26, Salford W.M. Coll., music-teacher—Arith. (2d)
772—Booth, James, 19, Manchester M.I., clerk—Arith. (1st); Pol. Econ. (3d)
888—Boothby, John, 16, Oldham Lyceum, engineers' apprentice—Arith. (3d)
889—Boothby, William, 19, Oldham Lyceum, surveyors' apprentice—Arith. (3d); Th. of Music (3d); Eng. Lang. (3d)
325—Borland, John G., 20, Glasgow Ath., clerk—French (3d)
707—Bourne, Frederick, 21, Royal Polytechnic Inst., clerk—Bkpg. (2d)
33—Bow, George, 16, Aberdeen M.I., clerk—Eng. Lang. (3d)
563—Bowe, Frederick, 17, Liverpool Inst., clerk—Bkpg. (3d)
1—Bowie, William, 18, Aberdeen M.I., granite letter-cutter—Eng. Lang. (2d)
846—Bowman, Henry J., 21, Manchester M.I., salesman—Bkpg. (1st)
175—Bowman, John, 20, Carlisle M.I., book-keeper—Arith. (3d)
848—Bowman, William J., 16, Manchester M.I., warehouseman—Bkpg. (1st)
819—Bradley, John, 23, Manchester M.I., warehouseman—Eng. Hist. (2d).
761—Bradshaw, James, 20, Manchester M.I., clerk—Bkpg. (1st)
900—Brady, Edward G., 16, Parsonstown Young Men's Chr. Assoc., clerk—Eng. Hist. (2d)
480—Braimbridge, Edward D., 19, Hull Young People's Chr. and Lit. Inst., boot and shoe dealer—Eng. Lang. (2d)
840—Bramwell, Robert, 19, Manchester M.I., clerk—Bpkg. (1st)
1092—Bray, William H., 18, Birkbeck Lit. and Sci. Inst., clerk—Arith. (3d)
415—Brear, Thomas, 17, Halifax W. M. Coll., warehouseman—Arith. (2d); Bkpg. (3d)
129—Briggs, Walter, 26, Blackburn Sci. Sch., leather-cutter—Arith. (1st)
733—Bristol, Joseph H., 16, St. Stephen's Evg. Sch., Westminster, clerk—Arith. (3d)
517—Broadhead, Charles K., 20, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (2d)
177—Brockbank, John, 20, Carlisle M.I., architectural draughtsman—Eng. Lang. (2d)
294—Brodie, Neil, 25, Glasgow Ath., teacher—French (3d)
790—Brodrick, Thomas, 17, Manchester M.I., book-keeper—Arith. (1st)
1077—Brookes, John, 18, Bolton M.I., clerk—Arith. (1st)
752—Brooks, Francis T., 21, Tonic-sol-fa Teacher's Assoc., teacher of singing—Th. of Music (3d)
868—Brooks, John H., 18, Mossley M.I., clerk—Arith. (3d); Eng. Lang. (2d)
936—Brooks, Joshua, 17, Salford W.M. Coll. mechanical draughtsman—Arith. (2d)
242—Brown, Abner W., 29, Aldershot, sergeant—Arith. (1st) with the second prize of £3; Bkpg. (2d)
693—Brown, Annie O., 30, Royal Polytechnic Inst., teacher—German (2d)
441—Brown, George E., 16, Hertford Lit. and Sci. Inst., pupil teacher—Arith. (2d)
1023—Brown, George W., 19, Wakefield M.I., coachmaker—Arith. (3d)
1000—Brown, James, 30, Swindon M.I., clerk—Th. of Music (2d)
931—Brown, James B., 16, Salford W. M. Coll., pupil teacher—Arith. (3d)
1123—Brown, John, 19, Birkbeck Lit. and Sci. Inst., warehouseman—French (3d)
585—Brown, Patrick, 20, City of London Coll., clerk—French (2d)
151—Broxup, James, 31, Burnley M.I., mechanic—German (2d)
1124—Bruce, Frank, 21, Birkbeck Lit. and Sci. Inst., clerk —French (3d)
458—Bruce, William, 24, Hull Ch. Inst., clerk—Bkpg. (1st); Eng. Hist. (2d)
260—Buchanan, James, 20, Glasgow Anderson. Univ. Pop. Evg. Classes, clerk—Th. of Music (2d)
373—Buchanan, John, 16, Glasgow M.I., clerk—Arith. (2d); Bkpg. (2d)
309—Buchanan, Walter, 16, Glasgow Ath., clerk—Spanish (3d)
903—Budds, Benjamin, 17, Parsonstown Young Men's Chr. Assoc., clerk—Arith. (3d)
1137—Bülow, Charles B., 20, Birkbeck Lit. and Sci. Inst., stamper—Eng. Lang. (3d)
586—Burke, Charles, 23, City of London Coll., clerk—German (2d)
587—Burnett, David, 22, City of London Coll., surveyor—Pol. Econ. (2d)
368—Burnside James, 22, Glasgow M.I., warehouseman—Bkpg. (2d)
588—Burt, Charles F., 18, City of London Coll., clerk—French (2d)
850—Bushell, Patrick, 24, Manchester M.I., clerk—Bkpg. (1st)
589—Butler, James, 18, City of London Coll., chronometer maker's assistant—Arith. (2d); French (3d)
590—Butler, Joseph, 20, City of London Coll., engineer Arith. (1st); French (3d)

30—Calder, David, 19, Aberdeen M.I., clerk—Eng. Lang. (2d)
487—Calvard, Benjamin, 21, Hull Young People's Chr. and Lit. Inst., engine-fitter—Arith. (3d)
488—Calvard, Frederick, 17, Hull Young People's Chr. and Lit. Inst., engine-fitter—Arith. (3d)
923—Cameron, John, 23, Richmond Parochial Library, gardener—Floriculture (1st); Fruit and Veg. Culture (2d)
885—Capsey, Thomas, 16, Oldham Lyceum, book-keeper—Arith. (2d)
892—Carewell, Allan B., 22, Paisley Artisans' Inst., bookbinder—French (2d)
293—Carmichael, Robert R., 20, Glasgow Ath., warehouseman—Eng. Lang. (2d)
591—Carpenter, George, 28, City of London Coll., clerk—Bkpg. (1st)

261—Carroll, Henry A., 21, Glasgow Anderson. Pop. Evg. Classes, pattern-maker—(Arith. (2d)
157—Carruthers, George, 19, Carlisle M.I. (no occupation)—Arith. (3d)
152—Castlehow, Frederick J., 19, Carlisle M.I., ironmonger—Arith. (3d)
886—Chadwick, John, 17, Oldham Lyceum, pawnbrokers' apprentice—Eng. Lang. (3d)
207—Chalmers, Robert, 25, Dundee Young Men's Chr. Assoc., mechanic—Arith. (1st)
200—Chalmers, William, 19, Dundee Young Men's Chr. Assoc., clerk—German (2d)
1112—Chaloner, Arthur B., 20, Birkbeck Lit. and Sci. Inst., civil service writer—Arith. (3d); Eng. Hist. (3d); Bkpg. (2d)
1055—Chaloner, Robert P., 17, York Inst., clerk—Arith. (1st); Th. of Music (2d)
444—Chapman, Alice M., 17, Hertford Lit. and Sci. Inst., pupil teacher—Arith. (3d); Eng. Lang. (3d)
1126—Chapman, Annie, 36, Birkbeck Lit. and Sci. Inst., governess—English Hist. (2d)
1159—Chatterley, Robert J., 26, Birkbeck Lit. and Sci. Inst., warehouseman—Eng. Hist. (3d)
316—Chisholm, James, 22, Glasgow Ath., clerk—German (2d); French (2d)
1179—Chisholm, James, 27, Birkbeck Lit. and Sci. Inst., actuary—Pol. Econ. (2d)
192—Churchward, Edwin, 16, Devonport M.I. (no occupation stated)—Arith. (2d)
592—Clark, Frederic, 31, City of London Coll., in civil service—Bkpg. (1st)
906—Clarke, Arthur D., 18, Pembroke Dock M.I., clerk—Arith. (2d)
246—Clarke, David J., 17, Aldershot (no occupation)—Arith. (1st); Eng. Hist. (3d)
154—Clarke, Robert, 16, Carlisle M.I., clerk—Arith. (1st)
1107—Clarke, Thomas R., 21, Birkbeck Lit. and Sci. Inst., clerk—Logic (1st); Pol. Econ. (1st), with the second prize of £3 in each subject; and the Prince Consort's prize of 25 guineas.
389—Clews, Robert, 19, Glasgow M.I., clerk—Eng. Lang. (2nd)
515—Close, John, 16, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (3d)
417—Close, Thomas, 17, Halifax W.M. Coll., assistant overlooker—Bkpg. (3d)
594—Closs, Samuel, 24, City of London Coll., clerk—Bkpg. (1st)
977—Clough, James, 18, Stockport M.I., roller coverer—Bkpg. (3d)
794—Coe, Samuel, 26, Manchester M.I., spinner—Arith. (3d)
183—Cole, George W., 16, Crewe M.I., apprentice fitter—Arith. (3d)
940—Collinge, Harriett, 18, Salford W.M. Coll., pupil teacher—Arith. (2d)
1167—Collins, John W., 21, Birkbeck Lit. and Sci. Inst., law clerk—Th. of Music (1st)
482—Collinson, Barron, 19, Hull Young People's Chr. and Lit. Inst., clerk—Eng. Lang. (3d)
456—Collison, Robert, 32, Hull Ch. Inst., assistant overseer—Bkpg. (1st)
595—Connor, Joseph J., 19, City of London Coll., clerk—Arith. (2d)
729—Conolly, Hugh F., 17, St. Stephen's Evg. Sch., Westminster, pupil teacher—Arith. (3d); Eng. Hist. (3d); Eng. Lang. (3d)
549—Cooper, Alfred, 26, Leeds Ch. Inst., cashier—Bkpg. (1st)
301—Cooper, Francis W., 18, Glasgow Ath., clerk—Arith. (2d); French (3d)
561—Cooper, Herbert, 18, Liverpool Inst., clerk—Th. of Music (2d)
532—Cooper, William G., 17, Ipswich W.M. Coll., clerk—Bkpg. (3d)
379—Corbet, Robert, 22, Glasgow M.I., clerk—Bkpg. (1st)
683—Cosier, Elizabeth, 30, Royal Polytechnic Inst. (no occupation)—German (2d)
682—Cosier, Jane, 20, Royal Polytechnic Inst. (no occupation)—French (3d)
542—Coston, William E. N., 16, King's Lynn Ath., clerk—Bkpg. (3d)
525—Cotton, John A., 20, Ipswich W.M. Coll., clerk—French (3d)
881—Cowan, Bernard, 24, Newcastle-on-Tyne Ch. Inst., gardener—Floriculture (2d); Fruit and Veg. Culture (2d)
876—Cowell, Charles, 24, Newcastle-on-Tyne Ch. Inst., clerk—Arith. (2d); Bkpg. (1st)
760—Cowle, Margaret, 26, Manchester M.I., schoolmistress—French (3d)
1130—Crabtree, Jean, 28, Birkbeck Lit. and Sci. Inst., teacher—French (3d)
91—Crabtree, William, 16, Bacup M.I., weaver—Arith. (3d)
935—Craig, Robert H., 21, Salford W.M. Coll., bookkeeper—Arith. (1st)
418—Craven, Walter, 21, Halifax W.M. Coll., woolsorter—Bkpg. (2d)
596—Crawley, William, 26, City of London Coll., articled clerk—French (1st)
1158—Crawte, George F., 31, Birkbeck Lit. and Sci. Inst., clerk—Th. of Music (1st), with the first prize of £5
708—Crocker, Charles J., 19, Royal Polytechnic Inst., pupil teacher—Eng. Hist. (3d); Eng. Lang. (2d)
196—Cross, Bessie, 19, Devonport M.I. (no occupation stated)—Th. of Music (1st)
1138—Crossingham, Thomas E., 22, Birkbeck Lit. and Sci. Inst., carpet salesman—Arith. (1st)
937—Crossley, Thomas, 16, Salford W.M. Coll., librarian Arith. (2d)
212—Croudace, Laurence A., 18, Dundee Young Men's Chr. Assoc., mechanic—Arith. (1st)
348—Crum, John, 21, Glasgow Ath., clerk—French (3d)
240—Cuffling, Joseph, 23, Aldershot, soldier—Arith. (1st); Eng. Hist. (3d)
419—Cundall, Robert T., 19, Halifax W.M. Coll., weaver—Bkpg. (3d)
887—Cunliffe, William B., 18, Oldham Lyceum, bookkeeper—Arith. (2d)
355—Cunningham, Alexander, 17, Glasgow M.I., pupil teacher—Arith. (2d)
1155—Curtis, John A., 24, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st)
751—Curtis, John A., 24, Tonic Sol-fa Teachers' Assoc. clerk—Th. of Music (2d)
262—Cuthbert, James A., 22, Glasgow Anderson. Pop. Evg. Classes, law clerk—Arith. (3d); Th. of Music (3d); Bkpg. (3d)

101—Dabbs, William A., 19, Birmingham and Mid. Inst., analytical chemist—Th. of Music (2d)
255—Dadswell, George T., 20, Farnham Young Men's Assoc., clerk—French (2d)
215—Dallas, James, 17, Dundee Young Men's Chr. Assoc., apprentice mechanic—Arith. (2d)
1171—Dangerfield, James, 20, Birkbeck Lit. and Sci. Inst., lithographer—Th. of Music (2d)
597—Davis, Edward J., 23, City of London Coll., clerk—French (3d)
1168—Davison, Robert T., 23, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)
787—Dawson, Charles, 21, Manchester M.I., clerk—French (3d)
263—Dawson, Robert, 22, Glasgow Anderson. Univ. Pop. Evg. Classes, letter press printer—Th. of Music (2d)
685—Dexter, Mary A., 38, Royal Polytechnic Inst., teacher—German (3d)
264—Dick, James, 22, Glasgow Anderson. Univ. Pop. Evg. Classes, teacher—Th. of Music (2d)

401—Dick, William, 16, Glasgow M.I., in a warehouse—French (3d)
598—Dickson, John, 31, City of London Coll., bookkeeper—Bkpg. (1st)
469—Dixon, James, 31, Hull Ch. Inst., attorney's clerk—Bkpg. (1st)
56—Dockerty, William H., 21, Ashby-de-la-Zouch Young Men's Mut. Imp. Soc., fancy leather finisher—Bkpg. (3d)
599—Dolden, Alfred E., 18, City of London Coll., clerk—Bkpg. (2d)
6—Donald, Alexander W., 19, Aberdeen M.I., clerk French (2d)
265—Donaldson, James, 26, Glasgow Anderson. Univ. Pop. Evg. Classes, warehouseman—Th. of Music (2d)
755—Donkersley, Joe, 18, Lockwood M.I., clerk—Arith. (2d)
514—Dossor, Robert, 17, Hull Young People's Chr. and Lit. Inst., grocer—Arith. (2d); Bkpg. (2d)
307—Downie, Thomas, 23, Glasgow Ath., clerk—Logic (3d)
142—Drake, Abraham M., 16, Bradford M.I., overlooker—Arith. (2d)
442—Draper, Charles H., 16, Hertford Lit. and Sci. Inst., pupil teacher—Logic (2d)
804—Dryden, Andrew, 21, Manchester M.I., clerk—Arith. (2d)
902—Duff, David K., 17, Parsonstown Young Men's Chr. Assoc., draper's assistant—Arith. (3d)
1069—Duffill, Sarah E., 16, York Inst. (no occupation stated)—Th. of Music (1st)
213—Duke, George, 21, Dundee Young Men's Chr. Assoc. clerk—Arith. (2d)
319—Dunbar, Robert M., 21, Glasgow Ath., warehouseman—French (2d)
199—Duncan, William G., 41, Dundee Young Men's Chr. Assoc., grocer—Arith. (2d)
1036—Dunn, George, 23, Watford Public Library, clerk—French (3d)
942—Dunstan, William, 18, Salford W.M. Coll., clerk—Bkpg. (1st)
749—Dyer, Frederick, 20, Tonic Sol-fa Teachers' Assoc., chair maker—Th. of Music (3d)

399—Eadie, John, 16, Glasgow M.I., warehouse apprentice—Arith. (3d)
600—Eardley, Edward L., 21, City of London Coll., civil service writer—Logic (3rd); Eng. Hist. (2d); Eng. Lang. (1st)
209—Easson, William, 19, Dundee Young Men's Chr. Assoc., clerk—(Arith. (1st.)
41—Easton, David, 23, Aberdeen M.I., clerk—French (1st)
72—Eden, Thomas, 19, Ashford M.I., fitter-apprentice—Arith. (3d)
1058—Edgoose, Lucilla F., 17, York Inst., (no occupation)—Th. of Music (2d)
920—Edmonds, Andrew T., 18, Penzance, pupil teacher—Arith. (1st); Eng. Lang. (3d)
102—Edmonds, Edward, 22, Birmingham and Mid. Inst., clerk—Spanish (1st), with the first prize of £5; Eng. Lang. (2d)
1162—Edmonds, Richard, 43, Birkbeck Lit. and Sci. Inst., engineer—Th. of Music (2d)
95—Edwards, John, 22, Bacup M.I., carder—Arith. (3d)
1001—Edwards, Joseph J., 23, Swindon M.I., clerk—Bkpg. (1st), with the second prize of £3
1103—Eede, Henry, 24, Birkbeck Lit. and Sci. Inst., solicitor's clerk—Pol. Econ. (2d)
559—Egan, William M., 20, Liverpool Inst., clerk—Bkpg. (2d)
986—Entwistle, Benjamin, 18, Stockport Sund. Sch. Imp. Soc., hatter—Arith. (3d)
776—Entwistle, Peter, 16, Manchester M.I., office-boy, Arith. (2d); Bkpg. (1st)
1101—Essex, Benjamin S., 19, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)
2—Esson, James, 18, Aberdeen M.I., warehouseman—Arith. (3d)
1035—Evans, Alice, 27, Walworth Lit. and Sci. Inst., schoolmistress—German (3d)
66—Evans, Edward C., 16, Ashford M.I., pupil-teacher—Arith. (1st); French (1st)
1100—Evans, William, 19, Birkbeck Lit. and Sci. Inst., stamper—Arith. (3d)
1178—Everitt, Philip, 23, Birkbeck Lit. and Sci. Inst., clerk—Pol. Econ. (2d)

266—Fairley, William, 22, Glasgow Anderson. Univ. Pop. Evg. Classes, warehouseman—Th. of Music (2d)
731—Falconer, William, 22, St. Stephen's Evg. Sch., Westminster, gardener—Floriculture (1st), with the first prize of £5; Fruit and Veg. Culture (1st), with the second prize of £3
57—Farmer, George, 21, Ashby-de-la-Zouch Young Men's Mut. Imp. Soc., bookkeeper—Bkpg. (2d)
134—Farnworth, Eli, 20, Bolton Ch. Inst., packer—Arith. (2d)
204—Farquhar, James, 27, Dundee Young Men's Chr. Assoc., pattern maker—Arith. (2d)
359—Farquhar, James, 25, Glasgow M.I., joiner—Bkpg. (2d)
992—Farrell, Robert H., 16, Stockport Sund. Sch. Imp. Soc., clerk—Arith. (3d)
407—Feather, Frederick, 21, Halifax M.I., warehouseman—Arith. (3d)
602—Fish, William D., 20, City of London Coll., clerk—Pol. Econ. (1st), with a prize of books to the value of £1; Eng. Lang. (1st), with the second prize of £3
1109—Flegg, Robert, 22, Birkbeck Lit. and Sci. Inst., book-keeper—Arith. (2d); Eng. Hist. (2d); Eng. Lang. (3d)
1163—Flegg, Thomas, 17, Birkbeck Lit. and Sci. Inst., clerk—Arith. (2d)
508—Flowers, Frederick, 22, Hull Young People's Chr. and Lit. Inst., music-seller's assistant—Bkpg. (2d)
29—Forbes, Alexander, 21, Aberdeen M.I., clerk—Arith. (2d)
237—Forde, William, 17, Aldershot, assistant armorer—Arith. (1st); Eng. Lang. (3d)
422—Fossard, Alfred, 37, Halifax W.M. Coll., warehouseman—Bkpg. (2d)
512—Foster, Alfred, 19, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (2d)
703—Fozard, Catherine, 27, Royal Polytechnic Inst. (no occupation stated)—French (3d)
489—Frear, John R., 18, Hull Young People's Chr. and Lit. Inst., brass finisher—Arith. (3d)
241—French, Frederick, 22, Aldershot, lance corporal—Arith. (2d); Eng. Hist. (3d)
732—Fulkes, George J., 18, St. Stephen's Evg. Sch., Westminster, pupil teacher—Eng. Hist. (2d); Eng. Lang. (3d)

1009—Garrett, John H., 16, Swindon M.I., pattern maker—Th. of Music (3d)
536—Garrod, Philander N., 17, Ipswich W.M. Coll., clerk—Bkpg. (2d)
1105—Gates, John W., 23, Birkbeck Lit. and Sci. Inst., salesman of woven goods—German (2d); French (2d)
604—Gattke, Charles T., 18, City of London Coll., clerk—French (3d)
404—Gaukroger, Samuel, 17, Halifax M.I., clerk—Eng. Hist. (2d)
851—Gemmell, Robert S., 25, Manchester M.I., stationer's assistant—Bkpg. (1st)
855—Gibson, Alexander, 19, Manchester M.I., draughtsman—Logic (1st), with the first prize of £5;

Eng. Hist. (2d); Pol. Econ. (1st), with a prize of books to the value of £1; Eng. Lang. (1st)
558—Gibson, Charles, 28, Kendal Chr. and Lit. Inst., accountant—Arith. (3d)
203—Glassford, Walter P., 18, Dundee Young Men's Chr. Assoc., mechanic—Arith. (3d)
459—Gleadow, Robert, 19, Hull Ch. Inst., clerk—Bkpg. (1st)
341—Gloag, Matthew, 22, Glasgow Ath., clerk—German (2d); French (2d)
1154—Godard, John G., 21, Birkbeck Lit. and Sci. Inst., clerk—Arith. (3d); French (2d); Eng. Lang. (2d)
186—Godfrey, Amy, 21, Derby M.I., governess—Eng. Hist. (3d); French (3d)
852—Goodfellow, James, 19, Manchester M.I., salesman—Bkpg. (1st)
540—Gordon, Alfred R., 16, Kendal Chr. and Lit. Inst., pupil teacher—Arith. (3d)
546—Gordon, John, 18, Leeds Ch. Inst., clerk—French (2d)
371—Gordon, John, 17, Glasgow M.I., tobacconist—Arith. (3d)
193—Grant, Emilie B., 16, Devonport M.I. (no occupation stated)—Arith. (2d); Th. of Music (1st)
829—Gratrix, Timothy, 21, Manchester M.I., clerk—Arith. (3d); Bkpg. (1st)
336—Gray, James, 21, Glasgow Ath., warehouseman—French (3d)
364—Gray, James, 17, Glasgow M.I., stationer's assistant—Eng. Lang. (3d)
504—Gray, John, 26, Hull Young People's Chr. and Lit. Inst., gardener—Floriculture (2d)
202—Gray, William, 24, Dundee Young Men's Chr. Assoc., mill overseer—Eng. Lang. (3d)
1211—Green, Henry, 18, Leicester W.M. Coll., engineer—Arith. (3d); English. Lang. (3d)
70—Green, John W., 16, Ashford M.I., railway accountant's clerk—Arith. (2d); Bkpg. (2d)
816—Green, William E., 23, Manchester M.I., watchmaker—Eng. Lang. (3d)
915—Griffiths, David G., 17, Pembroke Dock M.I., pupil teacher—Eng. Lang. (2d)
606—Grigg, William J., 19, City of London Coll., shorthand clerk—Th. of Music (1st)
736—Grills, Francis J., 24, St. Stephen's Evg. Sch., Westminster, porter—Arith. (3d)
841—Grimes, John, 24, Manchester M.I., clerk—Bkpg. (2d)
155—Grundy, Thomas, 19, Carlisle M.I., clerk—Arith. (3d)
838—Guilmette, Stanley, 20, Manchester M.I., clerk—Bkpg. (1st)
947—Gyte, George, 18, Salford W.M. Coll., clerk—Bkpg. (1st)

106—Haden, Charles, 32, Birmingham and Mid. Inst., cashier—Bkpg. (3d)
970—Hadfield, Levi B., 19, Stockport M.I., warehouseman—Bkpg. (3d)
974—Hadfield, Walter, 16, Stockport M.I., clerk—Arith. (3d); Bkpg. (3d)
884—Hague, Charles, 21, Oldham Lyceum, weaver—Arith. (3d)
161—Hall, Joseph, 19, Carlisle M.I., clerk—Arith. (2d)
520—Hall, Thomas N., 22, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (2d)
1141—Hallam, John, 22, Birkbeck Lit. and Sci. Inst., clerk—Pol. Econ. (2d)
832—Halliwell, Francis T., 20, Manchester M.I., timekeeper—Bkpg. (1st)
1043—Hallworth, John, 18, Watford Public Library, clerk—Arith. (3d)
81—Hamer, Ralph T., 21, Bacup M.I., warper—Arith. (3d)
381—Hamilton, Robert H., 18, Glasgow M.I., compositor—Eng. Lang. (3d)
951—Hampson, Thomas, 20, Salford W.M. Coll., clerk—Arith. (3d)
531—Hancock, Arthur E., 19, Ipswich W.M. Coll., clerk—Bkpg (2d)
946—Hancock, Lillias, 16, Salford W.M. Coll., pupil teacher—Arith. (2d)
607—Haines, Charles F., 25, City of London Coll., clerk—Bkpg. (1st)
1125—Harbour, Thomas, 25, Birkbeck Lit. and Sci. Inst., music compositor—Th. of Music (1st)
315—Hardie, F. W., 20, Glasgow Ath., clerk—Spanish (1st)
495—Harding, John S. M., 20, Hull Young People's Chr. and Lit. Inst., clerk—Arith. (2d)
694—Harding, Marie, 31, Royal Polytechnic Inst., teacher—German (2d)
945—Hardman, John, 21, Salford W.M. Coll., joiner, Arith. (3d)
1173—Hardy, Fanny M., 23, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (2d)
1121—Harman, Henry, 19, Birkbeck Lit. and Sci. Inst., clerk—French (3d)
543—Harper, John, 21, King's Lynn Ath., clerk—Bkpg. (2d)
739—Harte, John, 21, St. Stephen's Evg. Sch. Westminster, clerk—Arith. (2d)
811—Hartley, Henry, 25, Manchester M.I., warehouseman—French (3d)
609—Harrold, Henry, 19, City of London Coll., clerk—Bkpg. (3d)
610—Harrold, John, 17, City of London Coll, clerk—Bkpg. (1st)
522—Harrison, Joseph, 19, Hyde M.I., engineer—Arith (1st)
470—Harrison, Joseph L., 28, Hull Ch. Inst., assistant-overseer—Bkpg. (1st)
882—Harrison, William G., 21, Newcastle-on-Tyne Ch. Inst., teacher—French (3d)
612—Harvey, Francis, 33, City of London Coll., clerk—Bkpg. (2d)
918—Harvey, George, 16, Penzance, pupil teacher—Arith (1st); Eng. Lang. (3d)
613—Harvey, Thomas, 23, City of London Coll., clerk Bkpg. (2d)
1152—Harvey, William A., 19, Birkbeck Lit. and Sci. Inst., Civil Service Writer—Eng. Lang. (2d)
1169—Haselden, William H., 20, Birkbeck Lit. and Sci. Inst., shorthand writer—Th. of Music. (3d)
1076—Hatton, John, 21, Bolton M.I., piecer—Arith. (3d)
507—Hay, William, 25, Hull Young People's Ch. and Lit. Inst., clerk—Bkpg. (1st)
890—Hayes, Thomas, 22, Oldham Lyceum, mechanic—Arith. (2d)
75—Hayward, William, 30, Ashford M.I., tailor—French (2d)
1114—Healey, George, 19, Birkbeck Lit. and Sci. Inst., clerk—French (3d); Bkpg. (1st)
614—Henderson, John D., 19, City of London Coll., (no occupation stated)—Arith. (2d); Eng. Lang. (3d)
1207—Henderson, Robert, 30, Bow and Bromley Inst., carpenter—Bkpg. (3d)
734—Hendré, Francis H., 23, St. Stephen's Evg. Sch., Westminster, clerk—German (3d); French (3d)
1191—Hepworth, Norris R., 16, Leeds Young Men's Chr. Assoc., clerk—Arith. (2d)
104—Herbert, Josiah, 17, Birmingham and Mid. Inst., pupil teacher—French (3d)
877—Hewitt, James, 19, Newcastle-on-Tyne Ch. Inst., gardener—Arith. (3d)
411—Heyhurst, Phineas, 22, Halifax M.I., joiner—Eng. Lang. (3d)
547—Hicks, Frederick, 25, Leeds Ch. Inst., clerk—Bkpg. (3d)

1190—Higgins, Alfred, 17, Leeds Young Men's Chr. Assoc., book-keeper—Arith. (3d)

133—Higginson, John, 19, Bolton Ch. Inst., maker up—Arith. (3d)

828—Higham, Sydney, 26, Manchester M.I., cashier—Bkpg. (1st)

1106—Higson, John, 22, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)

615—Hill, Arthur, 19, City of London Coll., clerk—Eng. Hist. (2d); and the third prize of £2 for Handwriting.

109—Hill, Elizabeth, 31, Birmingham and Mid. Inst., governess—Eng. Lang. (2d)

1110—Hill, George J., 16, Birkbeck Lit. and Sci. Inst., clerk—Arith. (2d); Eng. Hist. (2d); Eng. Lang. (2d)

330—Hill, Henry, 18, Glasgow Ath., clerk—Spanish (1st), with the second prize of £3; French (2d); Italian (2d)

575*—Hill, Henry A., 20, Liverpool Inst., engineer—Arith. (3d)

1174—Hind, Charles, 41, Birkbeck Lit. and Sci. Inst., warehouseman—Pol. Econ. (3d)

423—Hindle, Charles E., 18, Halifax W.M. Coll., cotton worker—Bkpg. (3d)

996—Hinds, James, 16, Stourbridge Associated Institutes, solicitor's clerk—Arith. (3d)

616—Hislop, Edward, 20, City of London Coll., jeweller—Th. of Music (2d); Eng. Lang. (2d)

617—Hockley, Harry, 18, City of London Coll., clerk—Bkpg. (3d)

998—Hofield, John T., 24, Swindon M.I., clerk—Th. of Music (1st)

189—Holbrook, George W. H., 19, Dudley M.I., pupil teacher—Arith. (2d)

939—Holden, Joseph, 18, Salford W.M. Coll., clerk—Arith. (3d)

864—Hollingworth, James E., 16, Mossley M.I., cotton piecer—Bkpg. (3d)

845—Hollingworth, Robert H., 17, Manchester M.I., clerk—Bkpg. (1st)

699—Holmes, Marian J., 21, Royal Polytechnic Inst., (no occupation stated)—French (3d)

893—Holmes, Matthew, 25, Paisley Artisans' Inst., pattern maker—Th. of Music (2d)

944—Homer, Eliza M., 19, Salford W.M. Coll., pupil-teacher—Arith. (3d)

964—Homer, John J., 16, Salford W.M. Coll., apprentice draughtsman—Arith. (3d)

103—Hood, Joseph, 29, Birmingham and Mid. Inst., clerk—Arith. (2d)

174—Hope, Thomas, 21, Carlisle M.I., book-keeper—Arith. (3d)

618—Horner, Benjamin, 17, City of London Coll., clerk—Arith. (1st); Eng. Hist. (3d); Bkpg. (1st)

93—Horsfall, John, 16, Bacup M.I., jobber—Arith. (3d)

445—Horsfield, George, 32, Hitchen M.I., clerk—Bkpg. (1st)

919—Hosking, Edwin W. G., 17, Penzance, pupil teacher—Arith. (1st); Eng. Lang. (3d)

179—Howarth, John, 28, Chorley M.I., clerk—Bkpg. (2d)

268—Howat, David, 29, Glasgow Anderson. Univ. Pop. Evg. Classes, compositor—Th. of Music (2d)

167—Howie, Robert, 19, Carlisle M.I., solicitor's clerk—Arith. (2d)

839—Howles, John, 18, Manchester M.I., clerk—Arith. (3d); Bkpg. (1st)

576*—Howorth, Benjamin, 19, Liverpool Inst., accountant—Pol. Econ. (3d)

79—Hoyle, Isaac H., 17, Bacup M.I., warehouseman, Arith. (3d)

619—Hudson, Lewis, 17, City of London Coll., clerk—Arith. (3d)

843—Hudson, William G., 20, Manchester M.I., warehouseman—Bkpg. (2d)

713—Hughes, George C., 18, Royal Polytechnic Inst., clerk—Eng. Lang. (2d)

773—Hughes, Joseph S., 24, Manchester M.I., clerk—Bkpg. (1st)

620—Hughson, John G., 24, City of London Coll., clerk—Bkpg. (1st)

185—Hullett, Cecilia M., 25, Derby M.I., governess—Eng. Hist. (2d)

108—Hulme, Josiah, 19, Birmingham and Mid. Inst., clerk—Arith. (1st); Eng. Hist. (1st)

768—Hunter, Henry J., 18, Manchester M.I., apprentice mechanic—Arith. (2d); Eng. Hist. (3d)

269—Hunter, John, 19, Glasgow Anderson. Univ. Pop. Evg. Classes, pawnbrokers' assistant—Arith. (2d)

306—Hunter, Peter, 22, Glasgow Ath., chemist—Logic (3d)

25—Hunter, Stephen, 19, Aberdeen M.I., clerk—Eng. Lang. (3d)

50—Hunter, William, 27, Arbroath Local Board, engine-fitter—Th. of Music (1st)

621—Huntley, Frederic A., 18, City of London Coll., engineers' draughtsman—Arith. (3d); and the third prize of £1 for Writing and Manuscript Printing.

343—Husband, William D., 20, Glasgow Ath., clerk—French (3d)

566—Hyatt, Edward S., 18, Liverpool Inst., clerk—Th. of Music (1st)

59—Illsley, Hiram, 24, Ashby-de-la-Zouch Young Men's Mut. Imp. Soc., coachbuilder—Bkpg. (3d)

789—Ingham, John, 22, Manchester M.I., clerk—Arith. (2d)

311—Ingram, George, 24, Glasgow Ath., book-keeper—Logic (2d)

687—Inkster, Annie, 16, Royal Polytechnic Inst., pupil teacher—Arith. (3d); Eng. Lang. (3d)

622—Irwin, William, 21, City of London Coll., clerk—Pol. Econ. (3d)

623—Jackson, Charles W. B., 24, City of London Coll., warehouseman—Bkpg. (2d)

783—Jackson, John R., 20, Manchester M.I., clerk—Arith. (1st)

110—Jackson, Lilly D., 16, Birmingham and Mid. Inst., pupil teacher—Eng. Lang. (3d)

145—Jackson, Thomas R., 18, Bradford M.I., attorney's clerk—Eng. Lang. (2d)

1033—James, Job, 22, Walsall Ch. Inst., clerk—Arith. (3d); Bkpg. (3d)

391—James, Robert, 16, Glasgow M.I. (no occupation stated)—Eng. Lang. (3d)

1074—James, Welsh, 24, Bolton M.I., certificated teacher—Arith. (2d); Eng. Hist. (2d); Eng. Lang. (3d)

1010—Jerman, Hugh, 36, Thirsk M.I., schoolmaster—Th. of Music (1st)

1206—Jerwood, Walter, 22, Bow and Bromley Inst., clerk—Arith. (3d)

624—Jewell, Thomas O., 31, City of London Coll., warehouseman—Bkpg. (1st)

689—Johnson, Henry J., 17, Royal Polytechnic Inst., clerk—Eng. Lang. (3d)

988—Johnson, James H., 17, Stockport Sunday Sch. Imp. Soc., mechanic's apprentice—Arith. (3d)

111—Johnson, Marion, 23, Birmingham and Mid. Inst., teacher—French (1st)

511—Johnston, George G., 20, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (1st)

1087—Johnston, James, 19, Bolton M.I., warehouseman—Arith. (3d)

1078—Johnston, Thomas, 20, Bolton M.I., millwright pattern maker—Arith. (3d); Eng. Lang. (3d)

327—Johnstone, James, 19, Glasgow Ath., clerk—French (3d)

576—Jones, William, 26, Liverpool Inst., carpenter and joiner—Arith. (2d); Bkpg. (3d)

496—Jones, W. H., 16, Hull Young People's Chr. and Lit. Inst., joiner's apprentice—Arith. (3d)
477—Judge, Robert W., 33, Hull Ch. Inst., clerk—Bkpg. (1st)

957—Kay, William, 18, Salford W.M. Coll., saddler—Arith. (3d)
248—Keay, Patrick, 34, Aldershot, soldier—Arith. (2d)
535—Kedgley, Robert W., 17, Ipswich W.M. Coll., baker—Bkpg. (2d)
68—Keene, James G., 18, Ashford M.I., railway accountant's clerk—Arith. (2d); Bkpg. (3d)
462—Keightley, John N., 16, Hull Ch. Inst., clerk—Bkpg. (1st)
626—Kelley, Frank, 17, City of London Coll., clerk—Bkpg. (2d)
334—Kellock, Alexander, 20, Glasgow Ath., clerk—French (3d)
358—Kellock, James, 16, Glasgow M.I., clerk—Arith. (3d)
1193—Kelsey, Walter S., 18, Leeds Young Men's Chr. Assoc., in woollen manufactory—German (2d)
627—Kendrick, George E., 22, City of London Coll., clerk—Bkpg. (1st)
521—Kenny, Thomas, 20, Hyde M.I., clerk—Arith. (2d); Eng. Lang. (2d)
844—Kenyon, Matthew H., 22, Manchester M.I., warehouseman—Bkpg. (1st)
628—Ker, William R., 20, City of London Coll., clerk—Eng. Hist. (2d); Pol. Econ. (2d); Bkpg. (2d)
698—Kettle, Charles E., 39, Royal Polytechnic Inst., civil service clerk—Th. of Music (1st)
211—Kidd, James, 18, Dundee Young Men's Chr. Assoc., mechanic—Arith. (2d)
4—Kilgour, William, 16, Aberdeen M.I., clerk—French (3d)
738—King, Henry, 18, St. Stephen's Evg. Sch., Westminster, carpenter—Arith. (2d)
60—King, John P., 24, Ashby-de-la-Zouch Young Men's Mut. Imp. Soc., solicitor's clerk—Bkpg. (2d)
205—Kyd, David R., 22, Dundee Young Men's Chr. Assoc., clerk—Arith. (1st); Eng. Hist. (3d); Bkpg. (3d)

1066—Lake, Edward, 19, York Inst., clerk—Eng. Hist. (3d)
696—Lamb, Emily A., 32, Royal Polytechnic Inst., teacher—German (2d)
629—Lambert, Francis, 27, City of London Coll., clerk—Bkpg. (1st)
169—Lambert, John, 16, Carlisle M.I. (no occupation)—Arith. (2d)
630—Lambert, Richard, 20, City of London Coll., clerk—Bkpg. (1st)
88—Lancaster, James H., 16, Bacup M.I., mule-piecer—Arith. (3d)
76—Langley, George R., 17, Ashford M.I., general merchant—Bkpg. (1st)
1024—Latham, Edward, 18, Wakefield M.I., stonemason—Arith. (3d)
178—Lattimer, Margaret B., 16, Carlisle M.I., assistant teacher—Arith. (1st); Eng. Hist. (2d); French (3d); Eng. Lang. (1st)
350—Laurence, John, 27, Glasgow Ath., teacher—German (3d)
424—Lawrence, Frank, 18, Halifax W.M. Coll., assistant broker—Arith. (3d); Bkpg. (3d)
1115—Lawrence, Julia, 19, Birkbeck Lit. and Sci. Inst. (no occupation stated)—Bkpg. (1st), with the prize of £2 for females
534—Laws, Frederick J., 17, Ipswich W.M. Coll., clerk—Bkpg. (1st)
1146—Laws, Henry A., 22, Birkbeck Lit. and Sci. Inst., bookbinder—Th. of Music (1st)
867—Lawton, Fred, 22, Mossley M.I., minder—Bkpg. (1st)
894—Lee, Charles H., 21, Paisley Artisans' Inst., clerk—Arith. (1st)
757—Lee, Fred, 17, Lockwood M.I., clerk—Arith. (3d)
631—Lee, William H., 20, City of London Coll., civil service writer—Arith. (2d); Eng. Hist. (1st); Bkpg. (3d)
632—Le Maistre, Alfred J., 21, City of London Coll., clerk—French (3d)
545—Lemmon, Charles H., 18, King's Lynn Ath., clerk—Bkpg. (2d)
1142—Lichtenstein, Maurice, 17, Birkbeck Lit. and Sci. Inst. (no occupation)—Arith. (2d)
270—Lillie, John, 25, Glasgow Anderson. Univ. Pop. Evg. Classes, clerk—Th. of Music (1st)
47—Lindsay, Adam, 27, Arbroath Local Board, flax-mill overseer—Th. of Music (2d)
271—Lindsay, James, 23, Glasgow Anderson. Univ. Pop. Evg. Classes, clerk—Th. of Music (2d)
544—Lindsey, John T., 27, King's Lynn Ath., solicitor's clerk—Bkpg. (1st)
472—Littlewood, Ernest C., 18, Hull Ch. Inst., bookseller's apprentice—German (3d)
541—Littlewood, Joseph, 17, Kendal Chr. and Lit. Inst., clerk—Arith. (1st)
160—Lloyd, Thomas R., 17, Carlisle M.I. (no occupation)—Arith. (2d)
32—Lobban, Margaret, 18, Aberdeen M.I., governess—French (2d)
847—Lockhart, John, 22, Manchester M.I., warehouseman—Bkpg. (1st)
1002—Lockyer, Oliver, 21, Swindon M.I., clerk—Bkpg. (2d)
406—Lodge, Alfred, 24, Halifax M.I., gardener—Arith. (3d)
84—Lomax, Zeno, 17, Bacup M.I., pupil teacher—Arith. (2d); Eng. Lang. (3d)
634—Long, Alfred, 16, City of London Coll., office boy—Arith. (3d)
143—Long, George, 19, Bradford M.I., warp dresser—Arith. (1st)
958—Longshaw, Thomas, 22, Salford W.M. Coll., roller coverer—Arith. (3d)
173—Lord, Alfred, 19, Carlisle M.I., clerk—Bkpg. (3d)
49—Lorimer, James, 33, Arbroath Local Board, engine fitter—Th. of Music (2d)
112—Lowe, Jane R., 19, Birmingham and Mid. Inst. (no occupation stated)—Eng. Lang. (2d)
256*—Lyford, Henry, 24, Aldershot, gunner—French (3d)
425—Lynch, Robert, 19, Halifax W.M. Coll., warp sizer—Eng. Lang. (3d)
303—McAlpine, John, 22, Glasgow Ath., warehouseman—Bkpg. (2d)
895—McArthur, Angus, 34, Paisley Artizans' Inst., weaver's foreman—Th. of Music (3d)
3—McBain, James, 23, Aberdeen M.I., factory operative—Eng. Lang. (3d)
558—McCay, Thomas C. N., 19, Liverpool Inst., clerk—Eng. Lang. (2d)
1018—McConnell, John, 24, Wakefield M.I., clerk—Arith. (1st)
320—McCrindale, James, 17, Glasgow Ath., clerk—Arith. (3d)
370—McDevitt, Patrick, 18, Glasgow M.I., bootmaker—Arith. (3d)
323—McEwan, John, 17, Glasgow Ath., clerk—French (3d)
12—M'Hardy, Charles, 23, Aberdeen M.I., clerk—Arith. (1st)
247—Mack, Henry, 22, Aldershot, soldier—Eng. Hist. (3d); Eng. Lang. (3d)
274—McKay, Alexander, 37, Glasgow Anderson Univ. Pop. Evg. Classes, cloth lapper—Th. of Music (3d)
510—McKay, George P., 19, Hull Young People's Chr. and Lit. Inst., Civil Service writer—Bkpg. (2d)

914—Macken, Arthur, 17, Pembroke Dock M.I., pupil teacher—Eng. Lang. (2d)

398—McKenzie, Duncan, 25, Glasgow M.I., clerk—Eng. Lang. (3d)

926—McKenzie, Henry, 23, Richmond Parochial Library, gardener—Floriculture (3d); Fruit and Veg. Culture (3d)

275—McKinlay, James, 25, Glasgow Anderson. Univ. Pop. Evg. Classes, hand-mill warper—Th. of Music (2d)

1093—McLarney, Robert, 28, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st); French (3d)

28—McLean, George, 30, Aberdeen M.I., clerk—Bkpg. (1st)

312—McMenan, William, 25, Glasgow Ath., clerk—French (1st)

805—McMillan, John, 18, Manchester M.I., clerk—Arith. (1st); Bkpg. (1st)

276—McNabb, Hugh, 30, Glasgow Anderson. Univ. Pop. Evg. Classes, music salesman—Th. of Music (1st)

314—Macnair, Andrew, 18, Glasgow Ath., clerk—French (3d)

339—McNaught, Alexander S., 21, Glasgow Ath., clerk—French (3d)

572—McNeill, Arthur, 23, Liverpool Inst., clerk—Arith. (3d)

218—McNicoll, Charles, 18, Dundee Young Men's Ch. Assoc., apprentice clerk—Arith. (2d)

797—Madders, John W., 17, Manchester M.I., warehouseman—French (3d)

995—Malpass, Arthur, 16, Stourbridge Associated Institutes, clerk—Arith. (2d)

871—Marland, James E., 18, Mossley M.I., cotton weaver—Bkpg. (2d)

171—Marrs, William G., 18, Carlisle M.I. (no occupation)—Arith. (1st)

1030—Marshall, Charles H., 17, Wakefield M.I., clerk—Arith. (3d); Bkpg. (3d)

426—Marshall, James T., 17, Halifax W.M. Coll., in a warehouse—Bkpg. (3d)

554—Marson, Thomas, 21, Lichfield W.M. Assoc., gardener—French (2d); Th. of Music (2d)

635—Martin, Arthur J., 19, City of London Coll., warehouseman—Bkpg. (1st)

232—Martin, George, 19, Dundee Young Men's Chr. Assoc., draper's assistant—Arith. (3d)

499—Martin, John, 25, Hull Young People's Chr. and Lit. Inst., clerk—German (1st), with the first prize of £5.

1161—Martin, Mary E., 24, Birkbeck Lit. and Sci. Inst. (no occupation stated)—French (2d)

503—Mason, Joseph, 20, Hull Young People's Chr. and Lit. Inst., gardener—Fruit and Veg. Culture (3d)

637—May, William, 23, City of London Coll., clerk—Spanish (3d); French (3d)

807—Mears, William B., 17, Manchester M.I., pupil teacher—Arith. (3d); Eng. Lang. (3d)

762—Mellor, James, 31, Manchester M.I., certificated teacher—French (3d)

956—Merrill, Richard, 18, Salford W.M. Coll., clerk—Bkpg. (1st)

35—Meston, William, 23, Aberdeen M.I., book-keeper—Pol. Econ. (2d)

467—Metcalfe, George H., 20, Hull Ch. Inst., clerk—Bkpg. (1st)

190—Metherell, Samuel J., 19, Devonport M.I., solicitor's clerk—Arith. (1st)

638—Milbourn, John G., 43, City of London Coll., cooper—Arith. (3d)

402—Millar, George J., 16, Glasgow M.I., mining engineer—Arith. (3d)

639—Millar, James H., 31, City of London Coll., clerk—Bkpg. (1st)

238—Miller, Samuel G., 20, Aldershot, soldier—Arith. (2d); Eng. Lang. (3d)

769—Mills, Thomas G., 22, Manchester M.I., draughtsman—Arith. (2d); Eng. Lang. (3d)

277—Milne, Alexander, 24, Glasgow Anderson. Univ. Pop. Evg. Classes, clerk—Bkpg. (2d)

557—Milne, John H., 21, Liverpool Inst., articled clerk—Logic (2d); Eng. Lang. (2d)

427—Milner, Farnell, 17, Halifax W.M. Coll., iron and tin-plate worker—Arith. (2d); Eng. Lang. (3d)

278—Mitchell, James, 21, Glasgow Anderson. Univ. Pop. Evg. Classes, warehouseman—Th. of Music (2d)

519—Mobbs, Richard, 22, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (1st)

842—Monaghan, William, 21, Manchester M.I., stationer—Bkpg. (2d)

113—Monk, Havilah, 22, Birmingham and Mid. Inst., clerk—Eng. Lang. (3d)

746—Moody, Richard A., 29, Tonic Sol-fa Teachers' Assoc., paper stainer—Th. of Music (3d)

166—Moore, Thomas, 21, Carlisle M.I. (no occupation)—Arith. (3d)

451—Moore, Thomas H., 16, Huddersfield M.I., attorney's clerk—Arith. (2d); French (3d); Eng. Lang. (1st)

342—Morgan, Henry, 22, Glasgow Ath., clerk—Arith. (1st); Eng. Lang. (2d)

1080—Morgan, John, 18, Bolton M.I., articled clerk—Eng. Hist. (3d)

714—Morse, Rosa E. S., 27, Royal Polytechnic Inst., governess—German (3d); French, (3d)

830—Morton, William, 18, Manchester M.I., warehouseman—(Bkpg. (1st)

641—Mosey, James Y., 16, City of London Coll., clerk—Arith. (2d)

642—Mosey, Philip S., 24, City of London Coll., clerk—Arith. (2d)

802—Mott, Henry, 20, Manchester M.I., clerk—Eng. Hist. (2d); Eng. Lang. (2d)

643—Mountjoy, Richard A., 30, City of London Coll., clerk—Eng. Lang. (1st)

153—Muncaster, James D.. 20, Carlisle M.I., clerk—Arith. (1st)

1140—Mungeam, Mary S., 30, Birkbeck Lit. and Sci. Inst. (no occupation)—French (3d)

725—Muir, George J., 16, St. Stephen's Evg. Sch., Westminster, pupil teacher—Arith. (3d)

429—Murgatroyd, Arthur, 19, Halifax W.M. Coll., painter—Arith. (3d)

14—Murray, Janet J., 23, Aberdeen M.I. (no occupation stated)—French (3d)

44—Myers, John B., 19, Accrington M.I., letter carrier—Arith. (2d)

1034—Myring, Kate, 25, Walsall Ch. Inst., governess—French (3d); Eng. Lang. (2d)

684—Narraway, Clara M., 25, Royal Polytechnic Inst., (no occupation stated)—French (3d)

644—Neems, Edwin W., 17, City of London Coll., clerk—French (3d); Eng. Lang. (2d)

279—Neil, James W., 23, Glasgow Anderson. Univ Pop. Evg. Classes, warper—Th. of Music (2d)

292*—Neilson, David, 27, Glasgow Anderson. Univ. Pop. Evg. Classes, book-keeper—Bkpg. (2d)

824—Nelson, George, 24, Manchester M.I., warehouseman—French (2d)

721—Nettleton, Charles W., 18, St. Stephen's Evg. Sch., Westminster, gas-meter maker—Arith. (2d)

646—Nobbs, Alfred W., 20, Ashford M.I., clerk—Bkpg. (1st)

115—Norman, John G., 27, Birmingham and Mid. Inst., jeweller—French (3d)

1172—Norris, John, 20, Birkbeck Lit. and Sci. Inst., compositor—Th. of Music (2d)

950—Nichols, William, 21, Salford W.M. Coll., clerk—Bkpg. (1st)

821—Nicoll, Thomas C., 21, Manchester M.I., clerk—Bkpg. (2d)

354—Niven, William A., 17, Glasgow M.I., draughtsman—Arith. (3d)

741—Nutting, George, 17, St. Stephen's Evg. Sch., Westminster, joiner—Arith. (3d)

430—Oates, Frank, 16, Halifax W.M. Coll., clerk—Arith. (2d); Eng. Hist. (3d); Eng. Lang. (3d)
18—Ogilvie, Robert, 23, Aberdeen M.I., hardware merchant's assistant—French (3d)
709—Oliver, James F., 37, Royal Polytechnic Inst., clerk—German (3d)
191—Ollis, Fanny L., 17, Devonport M.I. (no occupation stated)—Th. of Music (1st), with the second prize of £3, and the prize of £2 for females
896—O'May, Robert, 24, Paisley Artisans' Inst., warehouseman—Arith. (2d)
61—Orchard, George D., 19, Ashby-de-la-Zouch Young Men's Mut. Imp. Soc., auctioneer's assistant—Bkpg. (3d)
254—Osborne, John A., 20, Aldershot, soldier—Arith. (2d)
164—Ostle, Wilson, 18, Carlisle M.I. (no occupation)—Arith. (3d)
910—Owen, James, 26, Pembroke Dock M.I., shipwright—Arith. (1st), with the first prize of £5
62—Owen, James S., 25, Ashby-de-la-Zouch Young Men's Mut. Imp. Soc., baker—Bkpg. (3d)
856—Owen, William A., 19, Manchester M.I., clerk—French (3d)

748—Painter, William, 21, Tonic Sol-fa Teachers' Assoc., clerk—Th. of Mus. (2d)
574—Parkinson, Thomas, 20, Liverpool Inst., clerk—Arith. (2d)
753—Parrock, Thomas, 23, Tonic Sol-fa Teachers' Assoc., brass-finisher—Th. of Music (3d)
969—Parry, John H., 19, Salford W.M. Coll., clerk—Bkpg. (1st)
827—Parry, Margaret A., 25, Manchester M.I., schoolmistress—Bkpg. (1st)
335—Paterson, Robert H., 18, Glasgow Ath., clerk—Arith. (3d)
280—Paterson, William, 26, Glasgow Anderson. Univ. Pop. Evg. Classes, blacksmith—Th. of Music (3d)
351—Paton, James, 37, Glasgow M.I., constable—Bkpg. (2d)
140—Pawson, Richard, 16, Bradford M.I., clerk—Arith. (1st)
648—Pearce, Herbert J., 21, City of London Coll., clerk—Bkpg. (2d)
921—Pearce, Joseph H., 16, Penzance, clerk—Eng. Hist. (3d): Eng. Lang. (1st)
742—Pearce, William, 18, St. Stephen's Evg. Sch., Westminster, clerk—Arith. (2d)
431—Pearson, Henry W., 16, Halifax W.M. Coll., printer—Eng. Lang. (3d)
1020—Pearson, William, 24, Wakefield M.I., clerk—Arith. (1st)
814—Peddie, William, 18, Manchester M.I., clerk—Arith. (3d)
1182—Penniston, Joseph, 36, Leeds Young Men's Chr. Assoc., book-keeper—Bkpg. (1st)
73—Pentecost, Horace, 19, Ashford M.I., engine smith—Arith. (1st)
116—Perkins, Henry G., 21, Birmingham and Mid. Inst., clerk—French (3d)
201—Petrie, William, 25, Dundee Young Men's Chr. Assoc., hacklemaker—Arith. (3d)
117—Phillips, Arthur, 19, Birmingham and Mid. Inst., clerk—German (1st)
443—Picken, Fanny, 18, Hertford Lit. and Sci. Inst., pupil teacher—Arith. (3d); Eng. Lang. (3d)
476—Pickering Albert, 28, Hull Ch. Inst., clerk—Bkpg. (1st)
475—Pickering, John H., 34, Hull Ch. Inst., maltster—Bkpg. (2d)
524*—Pickford, William B., 18, Hyde M.I., clerk—Arith. (2d)
953—Pierce, Samuel, 21, Salford W.M. Coll., book-keeper—Arith. (3d)
690—Pike, Thomas, 24, Royal Polytechnic Inst., jeweller—Bkpg. (2d)
144—Pinder, William, 16, Bradford M.I., piece-hooker—Arith. (2d)
490—Plummer, George, 17, Hull Young People's Chr. and Lit. Inst., clerk—Arith. (3d)
966—Pogson, Joseph, 20, Salford W.M. Coll., book-keeper—Arith. (3d)
1176—Pohse, Sophie C., 24, Birkbeck Lit. and Sci. Inst., governess—French (3d)
63—Poole, Thomas T., 21, Ashby-de-la-Zouch Young Men's Mut. Imp. Soc., cabinet-maker—Bkpg. (3d)
763—Potter, Albert, 17, Manchester M.I., pupil teacher—French (3d)
688—Pratt, Emma A., 29, Royal Polytechnic Inst., schoolmistress—Eng. Lang. (3d)
1192—Preston, George, 17, Leeds Young Men's Chr. Assoc., book-keeper—Eng. Lang. (3d)
353—Priaulx, Charles E., 16, Glasgow M.I., clerk—Arith. (3d)
652—Price, Henry W., 18, City of London Coll., clerk—Logic (2d)
1187—Prince, George A., 16, Leeds Young Men's Chr. Assoc., bookbinder apprentice—Eng. Lang. (3d)
653—Prior, Samuel J. B., 25, City of London Coll., clerk—French (2d)
955—Probert, Frederick, 24, Salford W.M. Coll., clerk—French (3d)
363—Pullar, James T., 16, Glasgow M.I., clerk—Spanish (3d)
147—Purchon, Samuel R., 22, Bradford M.I., lithographic printer—Arith. (3d); Pol. Econ. (3d); Eng. Lang. (2d)

697—Quick, John H., 23, Royal Polytechnic Inst., solicitor's clerk—Arith. (3d); Eng. Lang. (2d)

1201—Raby, John, 18, Leeds Young Men's Chr. Assoc., pupil teacher—Arith. (1st); Eng. Lang. (2d)
1189—Rae, Charles J., 16, Leeds Young Men's Chr. Assoc., apprentice—German (1st); French (2d)
529—Rand, Charles W., 18, Ipswich W.M. Coll., clerk—Bkpg. (2d)
135—Rawsthorn, Thomas, 18, Bolton Ch. Inst., clerk—Arith. (2d)
573—Rea, Philip V., 19, Liverpool Inst., in an office—Bkpg. (2d)
654—Read, Charles H., 26, City of London Coll., clerk—French (2d)
818—Redfearn, Abraham, 19, Manchester M.I., clerk—Eng. Hist. (3d); Eng. Lang. (3d)
548—Redick, Mary, 22, Leeds Ch. Inst., no occupation stated—Th. of Music (2d)
230—Reid, David, 23, Dundee Young Men's Chr. Assoc., grocers' assistant—Eng. Lang. (3d); Arith. (3d)
347—Reid, David H., 25, Glasgow Ath., warehouseman—French (3d); Bkpg. (2d)
655—Reid, John A., 25, City of London Coll., clerk—Bkpg. (1st)
897—Reid, Robert, 18, Paisley Artisan's Inst., pattern-maker—Th. of Music (1st)
656—Renaut, Frederick W., 22, City of London Coll., clerk—Bkpg. (1st)
657—Reynolds, Charles A. J., 17, City of London Coll., clerk—Arith. (3d); Eng. Hist. (2d); French (3d); Eng. Lang. (2d)
1095—Reynolds, Herbert, 19, Birkbeck Lit. and Sci. Inst., clerk—Pol. Econ. (2d)
658—Reynolds, James, 19, City of London Coll., shorthand clerk—Eng. Lang. (1st)
1217—Richardson, Frederick, 24, Leicester W.M. Coll., elastic braid weaver—Arith. (3d); French (3d)
565—Richardson, James A., 17, Liverpool Inst., in an office—Bkpg. (2d)

705—Rickards, Josephus, 20, Royal Polytechnic Inst., clerk—Arith. (1st); Eng. Hist. (2d); Eng. Lang. (1st)
7—Riddell, John, 22, Aberdeen M.I., clerk—Arith. (3d)
1108—Riorden, George J., 22, Birkbeck Lit. and Sci. Inst., engraver—Eng. Hist. (2d)
17—Ritchie, Peter, 17, Aberdeen M.I., clerk—Arith. (3d)
138—Ritson, James T., 17, Bolton Ch. Inst., pupil teacher—Arith. (2d); Eng. Lang. (2d)
834—Roberts, Daniel, 26, Manchester M.I., letterpress printer—Bkpg. (1st)
433—Roberts, George H., 20, Halifax W.M. Coll., wiredrawer—Bkpg. (2d)
569—Roberts, Renrick S., 20, Liverpool Inst., clerk—Bkpg. (3d)
1090—Roberts, Robert A., 20, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)
387—Roberts, Robert W., 22, Glasgow M.I., Bible-reader—Eng. Lang. (3d)
660—Roberts, William W., 19, City of London Coll., clerk—Bkpg. (2d)
216—Robertson, David, 17, Dundee Young Men's Chr. Assoc., apprentice clerk—Arith. (3d)
281—Robertson, Robert, 27, Glasgow Anderson. Univ. Pop. Evg. Classes, warehouseman—Th. of Music (2d)
1007—Robinson, Benjamin J., 16, Swindon M.I., erector apprentice—Arith. (3d)
575—Robinson, Frederick, 16, Liverpool Inst., in an office—Arith. (2d); Eng. Lang. (3d)
1064—Robson, Thomas, 17, York Inst., attorney's clerk—Arith. (3d)
500—Rodmell, George, 20, Hull Young People's Chr. and Lit. Inst., corporation sworn meter and weigher—Arith. (3d)
803—Rogers, Stephen, 19, Manchester M.I., clerk—Arith. (3d); Eng. Hist. (3d); Eng. Lang. (2d)
826—Roscoe, James, 16, Manchester M.I., warehouseman—Arith. (1st); Bkpg. (1st)
662—Rose, John H., 25, City of London Coll., clerk—Logic (3d); Pol. Econ. (2d); Eng. Lang. (2d)
374—Ross, Andrew, 17, Glasgow M.I., clerk—Bkpg. (2d)
878—Ross, James J., 19, Newcastle-on-Tyne Ch. Inst., clerk—Arith. (2d)
806—Rothwell, Hamlet, 21, Manchester M.I., clerk—Bkpg. (2d)
987—Rushton, Cephas M., 23, Stockport Sund. Sch. Imp. Soc., clerk—Arith. (3d)
880—Rutherford, George, 22, Newcastle-on-Tyne Ch. Inst., clerk—Arith. (2d); Bkpg. (3d)
128—Rutherford, Thomas K., 24, Blackburn Sci. Sch., schoolmaster—Arith. (2d)
38—Ruxton, John, 17, Aberdeen M.I., pupil teacher—Arith. (2d)

42—Sanderson, James, 21, Accrington M.I., book-keeper—Arith. (1st)
367—Sands, David, 46, Glasgow M.I., bookseller—Th. of Music (2d)
118—Saville, Sarah A., 19, Birmingham and Mid. Inst., pupil teacher—Eng. Lang. (3d)
869—Schofield, John, 20, Mossley M.I., book-keeper—Arith. (3d); Bkpg. (3d)
872—Schofield, Joseph, 17, Mossley M.I., cotton piecer—Bkpg. (1st)
775—Schofield, Mark, 16, Manchester M.I., salesman—Arith. (3d)
282—Scott, Henry, 20, Glasgow Anderson. Univ. Pop. Evg. Classes, clerk—Th. of Music (2d)
297—Scott, Hugh, 19, Glasgow Ath., writer's clerk—Bkpg. (1st)
45—Scott, James, 29, Arbroath Local Board, flax spinner—Th. of Music (3d)
163—Scott, Joseph, 16, Carlisle M.I. (no occupation)—Arith. (2d)
283—Scott, William, 22, Glasgow Anderson. Univ. Pop. Evg. Classes, draper—Th. of Music (3d)
743—Scrimgeour, John, 17, St. Stephen's Evg. Sch. Westminster, clerk—Arith, (2d)
663—Scriven, Alphonso T., 20, City of London Coll., clerk—Bkpg. (3d)
972—Seal, James, 20, Stockport M.I., clerk—Bkpg. (3d)
1177—Seary, Thomas C., 23, Birkbeck Lit. and Sci. Inst., draughtsman—Th. of Music (3d)
37—Selbie, Joseph, 21, Aberdeen M.I., clerk—Eng. Lang. (3d)
835—Sessions, Thomas W., 26, Manchester M.I., cashier—Bkpg. (1st)
308—Shanks, John B., 18, Glasgow Ath., clerk—French (3d)
450—Sharp, Samuel, 17, Huddersfield M.I., clerk—French (3d)
1091—Shaw, Arthur H., 16, Birkbeck Lit. and Sci. Inst., clerk—Arith. (2d)
434—Shaw, Edwin, 21, Halifax W.M. Coll., packer—Arith (2d)
302—Shaw, William, 19, Glasgow Ath., bookseller's assistant—French (3d)
1096—Shearer, John R., 24, Birkbeck Lit. and Sci. Inst., warehouseman—Pol. Econ. (2d)
89—Shepherd, James, 16, Bacup M.I., weaver—Arith. (3d)
78—Shillito, James, 19, Bacup M.I., tinner—Arith. (3d); Bkpg. (3d)
1156—Shirley, Joseph H., 19, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (2d)
454—Shorten, Frank, 16, Hull Ch. Inst., engineer's apprentice—German (3d)
156—Sibson, John, 18, Carlisle M.I., student—Arith. (1st)
792—Sidebotham, John J. 17, Manchester M.I., clerk Logic (2d)
862—Silvey, Samuel, 16, Manchester M.I., clerk—Bkpg. (1st)
284—Simpson, James, 23, Glasgow Anderson. Univ. Pop. Evg. Classes, engineer—Arith. (2d)
377—Simpson, John, 20, Glasgow M.I., clerk—Eng. Lang. (2d)
120—Sims, William, 19, Birmingham and Mid. Inst., clerk—Arith. (1st)
187—Sinclair, Allen, 31, Derby M.I., police inspector—Eng. Lang, (2d)
168—Skelton, John, 18, Carlisle M.I. (no occupation) Arith. (2d)
493—Slack, Henry, 22, Hull Young People's Chr. and Lit. Inst., clerk—Arith (2d)
780—Slater, John T., 16, Manchester M.I., clerk—Arith. (3d)
159—Slater, Joseph, 19, Carlisle M.I., (no occupation stated) Eng. Hist. (2d); French (3d); Eng. Lang. (3d)
728—Slingo, William, 17, St. Stephen's Evg. Sch. Westminster, telegraphist—Arith. (3d); Eng. Hist. (3d)
527—Smith, Alfred, 27, Ipswich W.M. Coll., carpenter—Bkpg. (2d)
989—Smith, Frederick P., 19, Stockport Sund. Sch. Imp. Soc., mechanic—Arith. (3d)
664—Smith, George, 18, City of London Coll., clerk—Arith. (1st); Eng. Lang. (2d); the third prize of £1 for Writing from Dictation, and the first prize of £5 for Handwriting.
528—Smith, George F., 17, Ipswich W.M. Coll., clerk—Bkpg. (1st)
1175—Smith, George F., 18, Birkbeck Lit. and Sci. Inst., musicseller's assistant—Th. of Music (1st)
823—Smith, Herbert F., 28, Manchester M.I., mechanical draughtsman—French (3d)
1016—Smith, James L., 17, Wakefield M.I., messenger—Arith. (3d); Bkpg. (2d)

505—Smith, James M., 25, Hull Young People's Chr. and Lit. Inst., gardener—Floriculture (1st), with the second prize of £3; Fruit and Veg. Culture (1st), with the first prize of £5

1148—Smith, John H. A., 22, Birkbeck Lit. and Sci. Inst., clerk—French (3d)

1149—Smith, John R., 28, Birkbeck Lit. and Sci. Inst., Civil Service writer—the first prize of £3 for Writing from Dictation, and the first prize of £3 for Writing and Manuscript Printing.

665—Smith, Sidney, 18, City of London Coll., clerk—Bkpg. (3d)

141—Smith, Wheater, 20, Bradford M.I., surveyor—the second prize of £2 for Writing and Manuscript Printing.

285—Smith, William, 21, Glasgow Anderson. Univ. Pop. Evg. Classes, pawnbroker's assistant—Th. of Music (2d)

1104—Smith, William C., 17, Birkbeck Lit. and Sci. Inst., engineer's apprentice—Arith. (3d)

369—Smith, William C., 22, Glasgow M.I., clerk—Arith. (1st)

979—Smith, William J., 21, Stockport Sund. Sch. Imp. Soc., fitter—Arith. (3d)

666—Smyth, James, 29, City of London Coll., clerk—Bkpg. (2d)

539—Speight, Anthony T., 16, Kendal Chr. and Lit. Inst., pupil teacher—Arith. (2d)

747—Spencer, Harry, 24, Tonic Sol-fa Teachers' Assoc., carver and gilder—Th. of Music (3d)

874—Stanners, Thomas, 17, Newcastle-on-Tyne Ch. Inst., clerk—Bkpg. (2d)

858—Starkie, William H., 21, Manchester M.I., clerk Arith. (3d); Bkpg. (1st)

439—Starr, Henry P., 16, Hertford Lit. and Sci. Inst., printer—Arith. (3d); Eng. Lang. (3d)

831—Steele, William, 19, Manchester M.I., clerk—Arith. (3d); Bkpg. (1st)

1032—Stephens, Charles W., 35, Walsall Ch. Inst., inspector of nuisances—Arith. (1st)

26—Stephenson, John W., 22, Aberdeen M.I., clerk—Eng. Lang. (3d)

513—Steventon, Wilbert, 20, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (2d)

526—Stewart, James, 24, Ipswich W.M. Coll., gardener—Fruit and Veg. Culture (2d)

233—Stirton, James, 19, Edinburgh Watt Inst., apprentice joiner—Eng. Lang. (3d)

691—Stone, Mary A., 27, Royal Polytechnic Inst. housekeeper—French (3d)

1063—Stout, Robert, 17, York Inst., joiner—Eng. Hist. (3d)

478—Strachan, Ada M., 18, Hull Young People's Chr. and Lit. Inst., (no occupation)—Eng. Lang. (2d)

287—Strang, David B., 20, Glasgow Anderson. Univ. Pop. Evg. Classes, clerk—Th. of Music—(2d)

288—Strang, Matthew W., 25, Glasgow Anderson. Univ. Pop. Evg. Classes, book-keeper—Th. of Music (2d)

550—Strickland, Edwin, 18, Leeds Ch. Inst., clerk—Bkpg. (1st)

551—Strickland, James, 16, Leeds Ch. Inst., solicitor's clerk—Bkpg. (1st)

121—Surgey, Herbert H., 16, Birmingham and Mid. Inst., pupil teacher—Arith. (1st)

46—Sutherland, James T., 34, Arbroath Local Board, grocer and spirit dealer—Th. of Music (3d)

16—Sutherland, William, 18, Aberdeen M.I., clerk—French (3d)

568—Sutherland, William J., 16, Liverpool Inst., office boy—Bkpg. (3d)

436—Sykes, Arthur, 20, Halifax W.M. Coll., clerk—Arith. (3d); Bkpg. (2d)

437—Sykes, John H., 17, Halifax W.M. Coll., warehouseman—Arith. (3d)

286—Symington, John M., 20, Glasgow Anderson. Univ. Pop. Evg. Classes, warehouseman—Th. of Music (1st)

366—Taylor, Charles, 23, Glasgow M.I., boot-top cutter—Th. of Music (2d)

1111—Taylor, Herbert E., 18, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)

952—Taylor, James M., 17, Salford W.M. Coll., clerk—Arith. (3d)

1188—Taylor, John, 17, Leeds Young Men's Chr. Assoc., apprentice—German (1st), with the second prize of £3

833—Taylor, Joseph, 21, Manchester M.I., clerk—Bkpg. (1st)

866—Taylor, Samuel, 18, Mossley M.I., cotton-piecer—Bkpg. (3d)

518—Taylor, William H., 22, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (1st)

122—Taylor, William H., 26, Birmingham and Mid. Inst., clerk—Eng. Hist. (3d); Pol. Econ. (2d); Eng. Lang. (1st)

849—Teggin, William, 17, Manchester M.I., stationers' assistant—Bkpg. (1st)

1060—Temperton, Frederick N., 19, York Inst., joiner—Arith. (3d)

509—Templeman, William H., 22, Hull Young People's Chr. and Lit. Inst., wholesale grocers' assistant—Bkpg. (2d)

194—Tenney, John, 17, Devonport M.I., solicitors' clerk—Bkpg. (3d)

1056—Tenniswood, Walter, 19, York Inst., student—Th. of Music (1st)

464—Theaker, William D., 23, Hull Chr. Inst., clerk—Bkpg. (1st)

907—Thomas, Edgar O., 18, Pembroke Dock M.I., draper—Arith. (1st)

245—Thomas, James W., 16, Aldershot (no occupation)—Arith. (2d)

20—Thompson, Charles F., 20, Aberdeen M.I., clerk—Eng. Lang. (3d)

516—Thompson, Edward, 28, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (1st)

901—Thompson, Thomas, 17, Parsonstown Young Men's Chr. Assoc., pupil teacher—Arith. (1st)

39—Thompson, William, 22, Aberdeen M.I., shopman—Eng. Lang. (3d)

24—Thomson, Alexander, 18, Aberdeen M.I., clerk—Arith. (2d)

737—Thorn, Frederick H., 16, St. Stephen's Evg. Sch. Westminster, writer—Arith. (2d)

817—Thorpe, Charles, 18, Manchester M.I., clerk—Arith. (1st); Bkpg. (1st)

290—Threshie, James, 26, Glasgow Anderson. Univ. Pop. Evg. Classes, writer—Th. of Music (3d)

64—Timms, Robert J., 17, Ashby-de-la-Zouch Young Men's Mut. Imp. Soc., bookkeeper—Bkpg. (2d)

150—Tirbutt, John C. B., 16, Bromsgrove Lit. and M.I., clerk—Eng. Hist. (3d)

239—Tomlinson, John W., 32, Aldershot, sergeant—Arith. (1st); Eng. Lang. (2d)

176—Topping, George, 16, Carlisle M.I., student—Arith. (2d)

485—Townend, Robert, 20, Hull Young People's Chr. and Lit. Inst., pupil teacher—Arith. (1st)

750—Tucker, Richard, 21, Tonic Sol-fa Teachers' Assoc., clerk—Th. of Music (2d)

67—Tunks, Joseph, 21, Ashford M.I., railway accountant's clerk—Bkpg. (1st)

913—Turl, Charles P., 17, Pembroke Dock M.I., pupil teacher, Eng. Lang. (2d)

898—Turnbull, George, 21, Paisley Artisan's Inst., clerk—Bkpg. (1st)

210—Tyndall, James, 19, Dundee Young Men's Chr. Assoc., pattern maker—Arith. (3d)

291—Ure, John G., 21, Glasgow Anderson. Univ. Pop. Evg. Classes, clerk—Th. of Music (1st)
766—Urquhart, Alexander H., 20, Manchester M.I., clerk—Bkpg. (3d)
333—Urquhart, William, 16, Glasgow Ath., clerk—Arith. (2d)

123—Vale, George, 17, Birmingham and Mid. Inst., clerk—German (2d)
232*-Valentine, William R. H., 23, Dundee Young Men's Chr. Assoc., clerk—Eng. Hist. (3d)
859—Vickers, Eli L., 18, Manchester M.I., clerk—Arith. (3d); Bkpg (2d)
861—Vickers, James, 16, Manchester M.I., clerk—Arith. (3d); Bkpg. (2d)
860—Vickers, Lot, 28, Manchester M.I., clerk—Bkpg. (2d)
785—Vickers, Robert F., 22, Manchester M.I., clerk—Eng. Hist. (2d)
862*-Vosper, Henry, 22, Manchester M.I., buyer—Logic (3d); Pol. Econ. (1st), with the third prize of £2; Eng. Lang. (2d)
963—Voyce, Samuel, 19, Salford W.M. Coll., clerk—Arith. (3d)

825—Wainwright, Thomas, 19, Manchester M.I., clerk—Bkpg. (1st)
1084—Walkden, Young, 22, Bolton M.I., clerk—Arith. (3d); Eng. Lang. (3d)
1003—Walker, Duncan M., 20, Swindon M.I., clerk—Arith. (3d); Bkpg. (1st)
715—Walker, Philip G., 21, Royal Polytechnic Inst., clerk—Bkpg. (2d)
360—Walker, William W., 16, Glasgow M.I., clerk—Arith. (3d); Bkpg. (1st)
1181—Walton, Oliver, 17, Birkbeck Lit. and Sci. Inst., solicitor's clerk—Bkpg. (2d)
1068—Ward, John, 16, York Inst., book-keeper—Arith. (3d)
124—Ward, John W. 18, Birmingham and Mid. Inst., pupil teacher—Arith. (1st); Th. of Music (1st); French (3d); Eng. Lang. (2d)
980—Ward, Thomas W. T., 16, Stockport Sund. Sch. Imp. Soc., warehouseman—Arith. (3d)
506—Warden, John, 16, Hull Young People's Chr. and Lit. Inst., engineer's clerk—Bkpg. (2d)
801—Wardle, John, 21, Manchester M.I., clerk—Eng. Hist. (3d); Eng. Lang. (2d)
971—Waterhouse, Benjamin, 17, Stockport M.I., assistant bookkeeper—Arith. (3d)
899—Waters, William, 23, Paisley Artisans' Inst., clerk—Th. of Music (2d); Eng. Lang. (3d)
8—Watson, Alexander, 16, Aberdeen M.I., draper's apprentice—Eng. Lang. (2d)
11—Watson, Alexander G., 21, Aberdeen M.I., clerk—Th. of Music (2d)
670—Watson, Alfred, 23, City of London Coll., clerk—Bkpg. (2d)
125—Watson, Edmund W., 18, Birmingham and Mid. Inst., clerk—French (3d)
48—Watson, John, 34, Arbroath Local Board, boottop maker—Th. of Music (3d)
235—Waugh, Percival, 18, Edinburgh Watt Inst., clerk—Arith. (1st); Eng. Hist. (1st), with the second prize of £3; Bkpg. (3d); and the second prize of £2 for Writing from Dictation
1099—Weatherley, George, 19, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)
1199—Weaver, Henry, 35, Leeds Young Men's Chr. Assoc., inland revenue officer—Arith. (3d); Bkpg. (1st)
883—Weddle, John, 24, Newcastle on-Tyne Ch. Inst., clerk—Bkpg. (1st)
924—Wenn, William P., 25, Richmond Parochial Library, gardener—Floriculture (2d); Fruit and Veg. Culture (3d)
1015—West, Henry, 27, Wakefield M.I., mat maker—Arith. (3d)
1134—Wharhirst, John, 27, Birkbeck Lit. and Sci. Inst., chaser—Bkpg. (2d)
671—Wheeler, Edward J., 27, City of London Coll., in civil service—German (2d); French (2d)
471—Whitaker, Samuel, 18, Hull Ch. Inst., clerk—Bkpg. (1st)
1184—Whitaker, Thomas, 19, Leeds Young Men's Chr. Assoc., compositor—Eng. Lang. (3d)
812—White, Arthur M., 21, Manchester M.I., clerk—Arith. (3d)
672—White, Henry G., 22, City of London Coll. (no occupation stated)—German (2d); French (2d); Bkpg. (1st)
822—Whitelow, Edward T., 18, Manchester M.I., engineer—Arith. (3d); Spanish (3d): Eng. Lang. (2d)
706—Whiteman, Frank G., 29, Royal Polytechnic Inst., clerk—French (1st), with the first prize of £5
468—Whiteside, Walter C., 25, Hull Ch. Inst., clerk—Bkpg. (1st)
405—Whitley, Phineas, 21, Halifax M.I., teacher of music—Arith. (2d); Eng. Hist. (2d); Eng. Lang. (1st)
999—Whitton, Charles, 17, Swindon M.I., clerk—Arith. (2d)
673—Wiggins, Alfred, 24, City of London Coll., leather manufacturer—Bkpg. (2d)
962—Wigley, Jeremiah, 31, Salford W.M. Coll., engineer—Arith. (3d)
702—Wilkins, Charles, 26, Royal Polytechnic Inst., clerk—German (3d)
718—Wilkins, Robert W., 28, Royal Polytechnic Inst., clerk—German (1st); Italian (1st), with the first prize of £5
1097—Wilkinson, Jeannette G., 29, Birkbeck Lit. and Sci. Inst., upholstress—Pol. Econ. (1st), with the first prize of £5
92—Wilkinson, John, 17, Bacup M.I., weaver—Arith. (2d)
85—Wilkinson, John F., 17, Bacup M.I., operative—Arith. (3d)
1070—Wilkinson, John R., 17, York Inst., pupil teacher—Arith. (2d)
675—Willey, Octavius D., 19, City of London Coll., clerk—Bkpg. (1st)
686—Williams, Arthur R., 20, Royal Polytechnic Inst., photographer—Pol. Econ. (3d)
954—Williams, John, 16, Salford W.M. Coll., clerk—Bkpg. (1st)
740—Willis, George W., 16, St. Stephen's Evg. Sch., Westminster, writer—Arith. (3d)
676—Willoughby, William H., 31, City of London Coll., clerk—German (3d)
438—Wilson, Arthur, 16, Halifax W.M. Coll., apprentice in wool trade—Bkpg. (3d)
875—Wilson, Thomas, 21, Newcastle-on-Tyne Ch. Inst., clerk—Arith. (2d); Bkpg. (1st)
494—Wilson, Thomas, 16, Hull Young People's Chr. and Lit. Inst., pupil teacher—Arith. (2d)
927—Wing, William, 19, Rotherham Lit. and M.I., clerk—Bkpg. (1st), with the first prize of £5
677—Winwood, Edward, 18, City of London Coll., clerk—Arith. (2d); Eng. Hist. (1st); Bkpg. (3d)
678—Withers, Edmund, 39, City of London Coll., clerk—Bkpg. (2d)
537—Witton, James C., 23, Kendal Chr. and Lit. Inst., teacher—Logic (2d)
857—Wood, Henry, 18, Manchester M.I., book-keeper—Th. of Music (2d)
791—Wood, Henry, 21, Manchester M.I., clerk—German (2d)
679—Wood, John W., 19, City of London Coll., clerk—Bkpg. (1st)

853—Wood, William, 21, Manchester M.I., clerk—Bkpg. (1st)
710—Wood, William, 25, Royal Polytechnic Inst., pianoforte tuner—German (3d)
1180—Woodford, Richard J., 19, Birkbeck Lit. and Sci. Inst., law clerk—Pol. Econ. (2d)
322—Woodrow, James, 24, Glasgow Ath., clerk—French (3d)
680—Woodrow, James J., 17, City of London Coll., clerk—French (3d)
726—Woolley, William J., 16, St. Stephen's Even. Sch., Westminster, clerk—Arith. (3d)
681—Wootton, John J., 19, City of London Coll., clerk—Arith. (2d); Eng. Hist. (3d); and the fourth prize of £1 for Handwriting
928—Wright, Albert T., 18, Rotherham Lit. and M.I., clerk—Arith. (2d)
1197—Wright, Richard, 27, Leeds Young Men's Chr. Assoc., joiner—French (2d)
1008—Wright, Theophilus, 17, Swindon M.I., fitter—Arith. (3d)
1157—Wright, William H., 18, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st); Eng. Hist. (1st), with the first prize of £5; Bkpg. (1st); and the second prize of £3 for Handwriting.
863—Wrigley, Andrew, 22, Mossley M.I., clerk—Bkpg. (1st)
313—Wyllie, John R., 18, Glasgow Ath., clerk—French (3d)

1061—Yates, John, 17, York Inst., clerk—Arith. (3d)
132—Yates, Nathan, 16, Bolton Ch. Inst., book-keeper—Arith. (3d)
390—Young, Alexander, 18, Glasgow M.I., grocer—Eng. Lang. (2d)
208—Young, Edward, 23, Dundee Young Men's Chr. Assoc., clerk—Arith. (1st)
214—Young, Frank W., 21, Dundee Young Men's Chr. Assoc., assistant chemist—Arith. (2d)
292—Young, Robert, 21, Glasgow Anderson. Univ. Pop. Evg. Classes, yarn salesmen—Th. of Music (1st)
345—Young, William, 22, Glasgow Ath., clerk—French (2d); Bkpg. (3d)
837—Younghusband, Edward, 18, Manchester M.I., clerk—Bkpg. (2d)
15—Youngson, John, 18, Aberdeen M.I., printer's compositor—Eng. Lang. (3d)

The number of locomotive engines in the United Kingdom increased from 9,379, in 1870, to 10,490, in 1871; and the number of carriages, waggons, &c., exclusive of locomotives, increased from 285,994, to 311,427; giving an increase in locomotives per mile from 0·60, for 1870, to 0·68, for 1871, and an increase from 18·38, in 1870, to 20·25, in 1871, as regarded other vehicles.

A Bill has been proposed in the New York Legislature which stipulates that every room above the second floor in the hotels or inns of incorporated cities of the State shall be provided with a rope or chain-ladder that will reach to the ground, as a means of escape in case of fire.

Amongst the objects of interest exhibited at Wigan were two coal-cutters, one made by Messrs. Ommaney and Tatham, of Salford; the other patented by Messrs. Elliott and Copely, and manufactured by R. and G. Railton, of Blackburn.

Colonel Andrew Derrom, of Paterson, U.S., has taken out a patent for forming bricks into very large blocks, to be used in the erection of buildings in sections. This work is to be done by boys, aided by mechanical power.

It is found by Dr. Walz that glacial acetic acid forms an excellent solvent for iodine, certainly not inferior to alcohol.

The forest produce of the United States, of all kinds, amounts in value to at least £200,000,000 annually.

Nearly every vice-royalty in Turkey has now its official paper in Turkish and the other vernaculars.

ANNUAL INTERNATIONAL EXHIBITIONS.

The Council, having been informed that her Majesty's Commissioners do not intend to publish Reports on the different departments of the Exhibition of the present year, and looking to the great importance to Arts, Manufactures, and Commerce that these annual displays should not pass away without some record, have decided to undertake that duty, and for this purpose have engaged the services of gentlemen specially skilled in the subjects of the several sections, to prepare such Reports for publication in the Society's *Journal*. The Council, however, desire it to be understood that, in publishing these reports, they do not necessarily adopt all the views expressed in them, which must be taken as those of the writers only.

The following report is the fourth that has been issued. The remainder will appear as soon as they are complete.

REPORT ON DRIED FRUITS.

By Richard Witherby.

At the first sight of the case of dried fruits shown in this section, Food Department, the idea arises that what are generally accepted as such productions are currants, raisins, almonds, figs, and dates, and that the specimens taking the lead in this case are rather extraneous to the subject than otherwise. Upon further inspection, however, it is evident that the samples are intended to bring to the knowledge of the public the great perfection to which some fruits can, by simple artistic preparation, be so preserved that the colour and true natural flavour are retained. All crystallised manufactures are such as are known as green fruit in their original state, and these fruits can only be furnished to our use out of season by such a mode of preparation.

The South of France excels any other foreign country in the preservation of some fruits; and the care, labour, and expense bestowed upon the manufacture, and upon their delivery in good condition into the English markets, cannot be overestimated. We can trace the trade back to the year 1851, when a few specimens of productions till then unknown were brought to notice, and stimulated our English confectioners to a marvellous degree, so much so, that in the greatest portion of this manufacture in a good fruit season we now far surpass the French. A few sorts may be particularised.

In the first place, we excel and stand first in the make of West India pine-apple preserve, both for delicacy of flavour and appearance, as well as in an economical point of view. In the same way, we stand first as regards cherries, greengages, and strawberries; but, as has been said before, everything depends upon the season here, for if we have to rely on imported fruit, it is considered, that although the transit is so rapid, still the freshness is impaired, and the fruit more or less broken and bruised.

Our French neighbours carry away the palm from us in apricots, green figs, and chinois, or French oranges. The specimens of all crystallised fruits shown in this case, and in fact of all dessert articles, such as ginger in syrup or dried, are of the best order; it is seldom that so fine a show can be seen, and it would be almost impossible to improve upon it.

We now pass from the view of these more attractive fruits to raisins and currants, and descriptions of fruit which are better known for culinary purposes; and there is probably no article of produce, the consumption of which has generally so largely increased during the last half century as that under review.

The demand about the commencement of that period was limited; and the use of the various growths was looked upon almost as a luxury, the great consuming classes hardly knowing their value, except at Christmas time. But the gradual reduction of duty in England put fruit on a different basis; the public benefited greatly, and the increased consumption stimulated the growers in Greece, Spain, and Turkey to cultivate and improve their vineyards. In the year 1834, there were some attempts made in the Ionian Islands to monopolise the sale of currants, but the legislative acts of those then dependencies on the British Crown neutralised the attempt, and the cultivation was steadily promoted.

During the last 20 years, the vast increase of emigration has spread our national taste far and wide, and at the present moment the use of dried fruits in the colonies is enormous. Germany and America likewise are large competitors with us as buyers in the producing regions.

The system known as "ring-cutting," or peeling a circle off the vines while they are in blossom, is greatly practised in Greece. It is considered to aid the secretion of a portion of the sap of the tree in the young forming berry, producing a heavier and more delicate fruit, with a thinner skin. The quality of currants is judged by size and colour, which should be of a purply blue. The red berries are either unripe, or else the produce of young vines. Vines do not yield profitably after seven years.

The weight of currants produced last year in Greece was 82,000 tons, of which about 45,000 tons were consumed in the United Kingdom; and as there is no use for this fruit other than for culinary purposes, it proves the very large service into which it enters.

Raisins are known in many forms; the greatest production is in Spain. Here we see the ordinary pudding raisin (Valencia), which finds such favour with all classes of English people. London, however, is the great emporium for this fruit, the use of which is perpetually going on. A few years ago, a crop of 12,000 tons, for the supply of the world at large, was considered heavy, whereas now (1872-1873) London alone receives 12,000 tons out of a total of 20,000 tons that are grown. As is the case with currants, so we have for Valencia raisins a very strong competitor in the American, and more especially Canadian buyers. The improvement in the article most observable of late years is in the matter of the stalk being picked off before shipment.

Formerly stalk and fruit were hurriedly pressed into boxes of 56 lbs. each, whereas now the Spaniards are careful to see the fruit better cured and packed into more handy cases. For the stalks no use has been found, and they are generally burnt.

Muscatels, or table raisins, from Malaga, are an article of large use, and have a more extensive range of quality than any other fruit. They are known as layers, bunch, and loose, the last description being, as the word implies, picked off the stalk. This sort is largely used in Scotland, but again the Americans have an ever-increasing demand for this as well as for all other fruits. The finest growths of Muscatels come to this country, and shippers spare no expense in decorating the boxes with coloured papers and lace edgings, thereby, it is said, adding to the cost £25 per ton.

Sultana (Turkey) raisins show a vast improvement in quality during the last few years, which is shown by a brighter colour and greater delicacy of skin. This, and many other sorts of Turkey fruit, are cured in the sun, a slight sprinkling of oil being employed to prevent the too great evaporation of the moisture, and also to give the fruit, when packed and shipped, a better chance of preservation.

Sultanas are mostly used in the manufacturing districts of England, and during the continuance of the cotton-famine, which caused a great reduction in the consumption of this fruit, there was so great an accumulation of stock in the United Kingdom and elsewhere, that they had almost to be given away. The Germans are large consumers, and the fruit is a source of great trade between Smyrna and Trieste. Eleme (Turkey) raisins are, as the title implies in the Turkish language "picked," and are used chiefly for export to our distant colonies, and for ships' stores. They are packed specially with this view, and are chiefly from the vines of

Carabourna and Vourla, districts in Asia Minor.

The greater proportion of the raisins from Smyrna are known as "Chesme," the name of an island near the mainland. These are the Turkey grape, pure and simple, without selection, picking of stalks, or any manipulation whatever. They find ready use in our eastern counties, but are the special feature of fruit-trading between Turkey and all German ports. In London they are not in favour.

There are vast districts in Persia where raisins are cultivated, but the difficulties of transit are so great, and the expenses of bringing them to the coast so heavy, that they do not pay to send to England, consequently they are used for distilling and other local purposes. The Cape wines having failed to become popular, the grapes are greatly used for drying into raisins; and although they chiefly find their way to Australia, they are sometimes imported into this country in small quantities.

Distillation from fruit is annually increasing, and for this purpose we look to Turkey once more for black raisins. These are small grapes, cultivated without much care, but full of saccharine. It is much valued by British wine-makers, and forms the stock on which much of that delightful beverage is founded. Much also is used in the manufacture of spirituous drinks at the place of growth. It has even been used of late years in the wine districts of France and in Paris for the creation of *boisson*, for the large proportion of saccharine facilitates the process of fermentation.

We pass to the last and not least important article received from Turkey—namely, figs. The growth is immense, and Europe and America seem never to tire of eating this fruit And here one word upon a fiscal matter; the levy of £7 per ton on figs is very heavy on the consuming price, and it sends to other countries much that might come to this. These remarks apply more specially to Spanish and the lower classes of Turkey fruit, which might be utilised much more in England.

But a few remarks on Turkey figs (a very fine specimen of which is exhibited) will be interesting. It is a matter of doubt by some whether the cultivation of this fruit is as careful now as it was some ten years ago. The merit of a good fig is a thin skin; the seeds should be visible through the skin, and the fruit inside should be dark and luscious. In packing of figs there is no preparation, and the popular idea of sugaring is erroneous; in fact, the sugar would cost more than the fruit. The figs of Aidin used to be celebrated, but the extension of growth has now brought all under one common character. The system of packing figs in "layers," that is to say, of flattening each fig to give it a larger appearance, is one that has, in some respects, passed the bounds of prudence; for if the fruit once be split, it naturally occurs that the strength departs, and, with the strength, the exquisite flavour, which now is so frequently lost for appearance' sake. The old-fashioned style of "drum" packing is entirely exploded.

Figs are grown in Italy, and also in Greece, both which countries yield fruit inferior to the Turkey produce in size, flavour, and regularity of packing, for upon this latter item much of the value depends.

Association of ideas carries us from figs to another dessert fruit, namely, dates, the produce of the North-west Coast of Africa, but chiefly from Tafilat, in Morocco, Tunis, and also from Egypt. The component parts of a date are various, and in the regions where it is cultivated it is used as a nutritious food, and is the support of many field-labourers. This fruit is entirely used for table purposes.

But we must refer to India for the date that pleases the consuming classes, and here we meet with an article that requires little or no cultivation—in fact grows nearly wild, and yet is sent to us by thousands of tons, supplying material for food, for distilling, and for confectionery purposes; it is the delight of the schoolboy, the competitor of nuts at country fairs,and the *pièce de resistance* of the London street-stall in the winter and spring, when no fresh fruits are obtainable. Dates prove what can be done with a fruit free from all Customs' restrictions, for they are the free, untaxed, produce of the earth delivered to our consumers with no charges on them beyond freight, and a moderate profit to merchants.

Of almonds there can be but little of novelty. The exhibited specimen is of the finest description of Jordan (Malaga) almonds that is grown, and is used entirely for the table. The smaller descriptions are used for culinary matters as well as for dessert. The Mogadore sweet and bitter almond, the Sicily, Canary, Alicante, Valencia almonds, are all used more or less for confectionery, and to a great extent (the African growths) for expressing oil.

Of dried fruits proper there is little more to be said. French plums (imperials) are shown in this section, and remind us of great improvements in quality and conservation. Formerly, we used to see cardboard-boxes, from which the moisture of the fruit readily escaped; but now the patent capsuled tops of the glass bottles retain both the colour, the flavour, and the freshness of the plums, and there is little or no deterioration in quality for some years after enclosure.

At the present moment the prospects of our fruits for next winter are good, the produce is yearly increasing by the high state of cultivation and enlarged knowledge of farmers. Instead of being an uninteresting and unimportant article of trade, it is now one of vast importance, both at home and abroad, while as a source of revenue the returns show that about half-a-million per annum is paid to the treasury.

The number of visitors admitted to the Exhibition on Thursday, 5th inst., was as follows:—Season tickets, 193; on payment of 1s., 4,095; total, 4,288. On Friday, season tickets, 158; on payment of 1s., 3,640; total, 3,798. On Saturday, season tickets, 291; on payment of 1s., 4,257; total, 4,538.

The number of visitors admitted to the Exhibition during the week ending Saturday, June 8th, was as follows:—Season tickets, 1,257; on payment of 2s. 6d., 1,445; on payment of 1s., 27,592; total, 30,294.

The number admitted on Monday was, season tickets, 159; on payment of 1s., 2,793; total, 2,952. On Tuesday, season tickets, 162; on payment of 1s., 3,147; total, 3,309. On Wednesday, season tickets, 210; on payment of 2s. 6d., 1,472; total, 1,682.

EXHIBITIONS.

VIENNA EXHIBITION.

The *Engineer* gives the following description of the exhibits in the "Boiler Sheds" at Vienna:—

Beginning at the easterly end, and walking towards the western extremity of the great machinery hall and behind it, we come first on a house containing at the back two boilers, and in the front, hardly yet quite finished, a pair of pumping engines intended to supply a large tank standing some 20 feet or 30 feet above the level of the ground not far off, and to furnish condensing water to a number of steam engines near the east, or Russian end of the machinery hall. One of the boilers is of the Fairbairn type, made at the Grazer Waggon and Machine Works. The other is a tubular boiler by Baechle, of Vienna. Both boilers are of comparatively small size, and do not call for special notice. The pumping engines are of rather unusual design. They are by Prunier, of Lyons. They have vertical cylinders set between vertical A frames. The pumps are below, driven by the piston-rod direct; on top of the frames is a crank shaft carrying an oval-rimmed fly-wheel at each side. The engines are quite distinct from each other—one standing at one side and the other at the other side of the engine-house. They are well finished, but the design looks to us somewhat top-heavy. The Fairbairn boiler is intended to supply them with steam. The tubular boiler sends steam to engines in the main hall.

The next boiler-house contains three big boilers by Sigl. Each of these consist of two plain cylinders set side by side, and fired by means of one hopper grate of such a width as to suffice for both tubes. Close by, but not in the same house, will be found a boiler somewhat similar in general type to those constructed by the Brunner Works, for driving their pumping engines, to which we shall refer presently, except that the water is contained in the tubes instead of being outside of them. A little further on are two return tubular boilers of considerable size by Paucksch and Freund, Landsberg, Prussia. In the same house with these will be found two very large vertical boilers of rather remarkable construction. They are fitted with a number of vertical water tubes flattened to an oval shape, and uniting a water drum below with a steam drum above. The grates are placed outside in two brick furnaces about 6 feet long, the products of combustion being delivered over a bridge right in among the flattened water tubes, round which the heated gas circulates until it escapes to the chimney, suitable deflectors being used to prevent its too speedy exit. These boilers are among the largest of the vertical type that we have ever seen, and they deserve attention for that reason. The first cost of a Cornish or double-flued boiler with the brickwork, is very much greater than that of a vertical self-contained boiler of the same power; and we are pleased to see engineers striking out a new path for themselves, and experimenting on the advisability of substituting a cheaper for a dearer type of steam generator in the face of a good deal of prejudice.

In the next house, as we proceed in a westerly direction, will be found a large double cylinder boiler by Dingler, the upper cylinder being connected to the lower by tubes, or water legs. Further on we come to the boiler house of Sulzer, of Winterthur, used in driving his fine 80-horse power horizontal engine in the Exhibition. This boiler appears to be very well adapted to fulfil the conditions dictated to the designer by the quality of the coal with which he has to deal, and that it is comparatively cheap and very simple and safe. Close to Sulzer's boiler house, the Fives Lille Company have put down an elephant boiler, which requires no special description.

Beyond this we come upon the English boiler house, which contains one boiler by Cater and Walker, of Southwark, one Howard safety boiler, two double-flued boilers by Messrs. Adamson, and two double-flued boilers by Messrs. Galloway.

The first is "Cater's patent," the construction of which is no doubt familiar to most of our readers, 50-horse power. The boiler erected by Messrs. Howard is very similar in construction to seven of 40-horse power each which were put up last year in the Austrian beet-root sugar factory. The Adamson boilers are each 40-horse power, and one is made with steel shell plates, solid welded flue rings, and circulating pipes. The boilers by Messrs. Galloway are each of 50-horse power, working easily up to 200-horse power with good engines. The two furnaces in front unite at the back in an oval flue, in which are placed twenty-four Galloway tubes and four side pockets. The workmanship of all these boilers is admirable, and compares very favourably with that of the boilers by continental makers, which, although for the most part very good and strong, are seldom so well finished as those by our first-class English makers.

Just beyond the English boiler house we come upon one in which a small cylindrical boiler by Petchin has been put down, and our walk terminates at the pumping engine house, in which the Erste Brunner Machinen Fabricks Gesellschaft have erected a very fine pair of engines and pumps for supplying the great tank which forms so conspicuous an object at the west end of the building. Meanwhile it will suffice to say that the boilers are two in number; each consists of a horizontal cylinder, at the further end of which is placed a drum standing vertically; the drum is traversed by a number of vertical fire tubes, through which the products of combustion escape. The arrangement has never been used, so far as we are aware, in this country, and it gives, we understand, very excellent results, as the tubular portion of the boiler is only exposed to a very mitigated heat, the intense flame playing first on the large surfaces of the cylindrical portion of the boiler.

The following is a list of the awards made to English exhibitors at the International Cattle Show, held in connection with the Vienna Exhibition, from May 31 to June 9, by the international jury:—J. K. Fowler, Aylesbury (shorthorns), medal for merit; H. F. Smith, Hull (ditto), medal for merit; Messrs. Dudding, Wragby, Lincoln (ditto), honourable mention; Lord Chesham (rams and ewes) (Shropshire breed), medal for progress; Lord Sondes (ditto) (Southdown), medal for progress; Lord Walsingham (ditto) (ditto), medal for progress; Russell

Swanwick, Cirencester (ditto) (Cotswold), medal for progress; R. and J. Russell, Dartford, Kent (rams) (Hampshire Down), medal for progress; Messrs. Dudding, Wragby, Lincoln (rams and ewes) (Lincoln, longwool), medal for progress; J. Treadwell, Ailesbury (rams) (Oxfordshire Down), medal for merit; T. Fulcher, Thetford, Norfolk (ditto) (Cotswold, Lincoln, Shropshire, Hampshire, and Oxfordshire Downs), medal for merit; Russell Swanwick, Cirencester (pigs) (Berkshire), medal for merit; J. K. Fowler, Aylesbury (ditto) (Berkshire small breed), medal for merit; E. Duckering, Kirton-in-Lindsey, Lincoln (ditto) (Lincolnshire large and middle breeds), medal for merit; E. Kirbell, agent to Lord Chesham, co-operators' medal; and H. Woods, agent to Lord Walsingham, co-operators' medal.

ENGLAND AND CENTRAL ASIA.

The latest proposal made with the view of facilitating our intercourse with Central Asia is that of M. de Lesseps, who has just put forward the idea of constructing a great Central Asiatic Railway from Orenberg to Samarcand, Bokhara, and Peshawur, which would complete the line of railway from Calais to Calcutta.

After the splendid success of M. de Lesseps with the Suez Canal, English engineers rather hesitate to say much against any project put forward by him, but still little encouragement has yet been given—at least in England—to the "Central Asiatic Railway." Perhaps political considerations alone are sufficient to prevent the accomplishment of the scheme; but, apart from these, it seems very questionable whether such a railway would really answer. According to a paper read at the last meeting of the Austrian Geographical Society by Colonel von Stubendorff, of the Russian army, the line would pass through Aralsk, the valley of the Sir Darya, Taschkend, and the Gates of Tamerlane, as any other route would be impracticable. From Samarcand to Peshawur the line would necessarily go through the Bamyan Pass and Cabul. The Colonel further stated that it was now pretty certain from the researches of Colonel Sbernitzky that the old bed of the Oxus extends eastward from Krasnovodsk in the direction of Bokhara, and that the construction of a line of railway along this dry river-bed from the Caspian to Bokhara and Samarcand would be comparatively easy. Such a railway would be in direct communication with Europe by means of the line of steamers from Krasnovodsk to Baku and the railway from Baku to Poti and Odessa. So far as the first portion, up to Samarcand, is concerned, there merely remains the question whether sufficient traffic could be obtained to repay the cost of construction, or, if not, whether the Russian Government would care to keep up the railway for State purposes and as a military road. When the Hindoo Koosh is reached, as has already been pointed out in an article on this subject by *Iron*, the engineering difficulties would be so tremendous, and the cost of overcoming them so great, that it is difficult to conceive how the first cost of construction could be repaid. Then, again, the traffic on this second part of the line, except the through traffic from Europe to India, would be inconsiderable, on account of the nature of the districts traversed, and it is certain that the amount derived from the conveyance of goods and passengers over the whole line from one end to the other, would be utterly inadequate for the support of the railway without the aid of considerable local traffic, much more than can reasonably be expected. Doubtless, as the trade and resources of the vast countries through which the route would lie became more developed, such local traffic would gradually arise, but it would certainly be very long before anything like a return from such sources could be expected.

So far as can be seen at present, therefore, it does not appear as if the project of M. de Lesseps offered any advantages, at least with regard to England, over the older scheme of a railway direct through Turkey, down the Euphrates valley, and along the coast line to Kurrachee and Bombay,[*] while it has, as compared with it, many serious drawbacks. Such a line would be more direct, shorter, and more easy of construction; and, if it would not help the important question of opening up this vast district of Central Asia, it would, as a highway to the East, be more convenient and direct than the new route.

Trades Guild of Learning.—A conference is to be held to-morrow (Saturday), the 14th of June, at the Society of Arts, for the purpose of establishing this guild, and determining its constitution; the chair will be taken at eleven a.m. by Mr. Morley, M. P., and at three p.m. by Mr. Mundella, M. P. It is stated that a number of gentlemen have engaged to attend, "but whether the movement is carried further will depend upon the attendance of the working men themselves at the conference." The means proposed are:—"1. The formation of classes for practical instruction in various trades, in art workmanship, and in scientific knowledge, both theoretic and practical, connected with those trades. 2. The delivery of courses of lectures, accompanied with questions to and from the students, and followed by voluntary examinations. 3. The holding periodical discussions, *conversazioni*, and social meetings. 4. The giving prizes for essays, poems, songs, &c., to be read, recited, and sung at stated festivals of the guild. 5. The formation of libraries and reading-rooms, halls, and clubs (where the classes, lectures, &c., could be conducted); the establishment of museums, exhibitions of painting and sculpture, industrial exhibitions, art-workshops, &c.; and the utilisation of all such existing agencies. 6. The institution of scholarships and exhibitions for promising pupils in primary schools, to enable them to attend higher schools, instead of being sent to work at an early age; and, in exceptional cases, to send them to college. 7. The employment of a visiting or organising agent.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Asiatic, 3.
Victoria Institute, 8. Mr. J. S. Phené, "Prehistoric Traditions and Customs in connection with Sun and Serpent Worship."
Royal United Service Institute, 8½. 1. Dr. Hamilton, R.N., "On Improved Life Buoys, and a System of Deck Rafts for Saving Life at Sea." 2. Mr. Robert Griffiths, "On his Bow and Stern Screw Ship."
Tues. ...Statistical Society, 7¾.
Anthropological Institute, 8.
Zoological, 8½. 1. Dr. A. Leith Adams, "On the Osteology of the Maltese Fossil Elephants, being a description of remains discovered by the author in Malta between the years 1860 and 1866." 2. Mr. H. J. Elwes, "On the Geographical Distribution of Asiatic Birds."
Wed. ...Meteorological, 7. Annual Meeting.
Thurs...Royal, 8½.
Antiquaries, 8½.
Linnæan, 8. 1. Dr. Hooker, "On the Subalpine Vegetation of Kilma-njaro," by J. D. 2. Dr. P. M. Duncan, "On the Development of the Gynœcium of, and the Method of Impregnation in, *Primula vulgaris*."
Chemical, 8. 1. Mr. Horace Brown, "On the Influence of Pressure upon Fermentation" (Part II). 2. Dr. J. H. Gladstone and A. Tribe, "Researches on the Action of the Copper-Zinc Couple on Organic Bodies III., and on Normal and Isopropyl Iodides." 3. Dr. J. H. Gladstone, "On Cymenes from different sources, optically considered." 4. Mr. W. H. Perkin, "On the Action of Bromine on Alizarine." 5. Mr. E. L. Mayer and Dr. C. R. A. Wright, "On some Decomposition and Oxidation Products of Morphine and Cedeine Derivatives." 6. Mr. R. Warrington, "On the Decomposition of Tricalcic Phosphate by Water." 7. Mr. J. B. Hannay, "On a New Tellurium Mineral, with Notes on a Systematic Mineralogical Nomenclature." 8. Communications from the Laboratory of the London Institution, No. XII. 9. Dr. H. E. Armstrong and C. L. Field, "On New Derivatives of Cresol."
Numismatic, 7. Annual Meeting.
Philosophical Club, 6.
Fri ......Philogical, 8¼.
Association of Diocesan Inspectors, 2. (At the House of the Society of Arts.)
Sat......Association of Church Teachers, 11. (At the House of the Society of Arts.)

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[*] See Mr. Hyde Clarke's paper on the subject in the *Journal* for Nov. 24, 1871.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,074. Vol. XXI.

FRIDAY, JUNE 20, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

FINANCIAL STATEMENT.

The following statement is published in this week's *Journal*, in accordance with Sec. 42 of the Society's Bye-laws, which provides that, at the Annual General Meeting, the Council shall render to the Society a full account of their proceedings, and of the receipts, payments, and expenditure during the past year; and that a copy of such statement shall be published in the *Journal* of the Society on the Friday before such General Meeting:—

TREASURERS' STATEMENT OF RECEIPTS, PAYMENTS, AND EXPENDITURE, FOR THE YEAR ENDING MAY 31st, 1873.

Dr.

	£	s.	d.	£	s.	d.
To Cash in hand of Coutts and Co., 31st May, 1872	552	19	8			
Do. do. Secretary	0	9	7			
				553	9	3
To Subscriptions received during the year from Members and Institutions in Union	5,783	17	6			
Life Contributions	399	0	0			
				6,182	17	6
To Dividends on Stock:—						
Consols, £4,914 6s. 8d.	144	19	6			
Reduced 3 per cents., £1,956 0s. 11d.	41	5	10			
New 3 per cents:—						
Dr. Fothergill's Trust, £388 1s. 4d.	11	9	0			
Great Indian Peninsula Guaranteed 4 per cent. Railway Debenture Stock, £2,170	85	7	0			
£2,450 Bombay and Baroda Guaranteed Railway Stock	121	9	7			
£2,460 Oude and Rohilcund Guaranteed Railway Stock	120	19	0			
2,500 dols. United States Funded Bonds 1871, cost £509 1s. 3d.	12	11	9			
				538	1	8
To Interest on Deposit Account with Messrs. Coutts and Co., £600				6	10	3
To Subscriptions and Donations:—						
Endowment Fund	200	5	0			
Memorial Window Fund	67	6	6			
				267	11	6
To Examinations:—						
The Prince Consort's Prize	26	5	0			
Royal Geographical Society's Prizes	5	0	0			
Candidates' Fees	5	9	0			
				36	14	0
To Sales of:—						
Pamphlets, Books, &c.	6	3	4			
Cantor Lectures	3	2	0			
Journals	125	16	0			
Messrs. J. M. Johnson and Sons, advertisements	278	17	0			
Jury Reports	3	0	0			
				416	18	4
To Committees:—						
Musical Education	50	0	0			
Drill Committee	219	17	7			
Food Committee	30	0	0			
Technical Examinations	147	16	0			
				447	13	7
To Exhibitions:—						
Annual International				63	10	6
To House and Office	24	8	6			
To South Australian Institute	650	0	0			
To Barry's Etchings	10	10	0			
				684	18	6
To Bequest:—						
By Thomas Howard				500	0	0
				£9,698	5	1

Cr.

	£	s.	d.	£	s.	d.
By House and Premises:—						
Rent, Rates and Taxes	594	14	3			
Insurance, Gas, Coal, and House Charges	205	17	0			
Repairs and Alterations	357	1	0			
				1,157	12	3
By Office:—						
Salaries, Wages, and Commissions	1,814	10	4			
Stationery and Printing	312	10	10			
Advertising	51	18	11			
Postage Stamps and Parcels	146	9	7			
				2,325	9	8
By *Journal*, including Printing, Stamps, and distribution to Members	1,949	7	10			
Library, Bookbinding, &c.	116	18	10			
Conversazione	223	7	11			
				2,289	14	7
By Union of Institutions, including Examinations, Prizes, Postage, Printing, &c.	549	10	10			
Prince Consort's Prize	26	5	0			
Technological Examinations	45	2	3			
				620	18	1
By Society's Albert Medal	21	7	6			
,, Medals	48	14	5			
				70	1	11
By Exhibitions:—						
Annual International	96	15	0			
East London Museum	0	10	11			
				97	5	11
By Committees:—						
General Charges	37	7	3			
Cab	4	10	1			
Channel Steamers	0	9	0			
Drill	328	14	0			
Food	129	7	4			
Indian	92	0	1			
Musical Education	19	4	6			
Life-boat	0	4	6			
Postal	13	15	2			
Stove Competition	1	10	6			
Silk	3	16	0			
Steel Prize	0	5	0			
Premiums General	15	12	8			
				646	16	1
By Memorial Window Fund (postage, &c.)	7	0	8			
Barry's Etchings	52	6	0			
Law Charges	15	18	8			
				75	5	4
By Puchase of £680 4s. 11d. Reduced 3 per Cent. Stock	627	6	0			
Purchase of 2,500 dols. United States 5 per Cent. Funded Bonds, 1871	510	9	5			
Deposited with Messrs. Coutts and Co.	255	0	0			
				1,392	15	5
By South Australian Institute	237	12	4			
Blenheim Institution	13	15	5			
Cantor Lectures	275	8	9			
				526	16	6
				9,202	15	9
Cash in the hands of Messrs. Coutts and Co., 31st May, 1873				478	3	9
,, in the Secretary's hands				17	5	7
				£9,698	5	1

Liabilities.

	£	s.	d.	£	s.	d.
To Sundry Creditors:—						
Sir W. C. Trevelyan (for Prize)	100	0	0			
Memorial Window Fund	321	13	9			
Prince Consort's Prize	26	5	0			
North London Exhibition Trust	7	9	9			
Examination Prizes (Society's)	130	0	0			
Do. Mrs Harry Chester's Prize	5	0	0			
Examiners' Fees	133	7	0			
Rents, Rates, and Taxes	28	10	0			
Tradesmen's Bills	961	9	8			
South Australian Institute	446	1	3			
Blenheim Literary Institute, New Zealand	1	2	7			
Musical Scholarship	50	0	0			
Technological Examinations Fees	52	10	0			
Do. to Balance of Subscriptions*	50	3	9			
				2,313	12	9
By Excess of Assets over Liabilities				£5,484	13	5
				£7,798	6	2

Note.—*The return of Prizes awarded has not yet been received.

Assets.

				£	s.	d.	£	s.	d.
By Society's money invested in—									
Reduced 3 per Cent. Stock, £1,956 0s. 11d., at 92⅓ less reserved to meet trusts stated below				1,436	0	0			
Consols, £146 19s. 5d., at 93½ per cent.				135	18	11			
Great Indian Peninsula Railway 4 per cent. Debenture Stock				200	0	0			
Oude and Rohilcund and Bombay and Baroda Guaranteed Debenture Railway Stock				355	2	7			
Deposit Account with Messrs. Coutts and Co.				600	0	0			
Subscriptions of the year uncollected	£1,570	0	0						
Less 15 per cent.	235	10	0						
				1,334	10	0			
Do of former years unpaid	2,103	0	0						
Less 50 per cent.	1,051	10	0						
				1,051	10	0			
Barry's Pictures and other property				2,000	0	0			
Prince Consort's Prize				26	5	0			
Royal Horticultural Society				16	0	0			
Mrs. Harry Chester's Prize				5	0	0			
Journals, by Advertisements and Sales				142	10	4			
							7,302	16	10
Cash in hands of Messrs. Coutts and Co, 31st May				478	3	9			
Do. in hands of Secretary, petty cash				17	5	7			
							495	9	4
							£7,798	6	2

P. Le Neve Foster, *Secretary.*

Stock and Cash Standing in the Name of the Society.

	£	s.	d.
Consols	£4,914	6	8
New 3 per Cents.	388	1	4
Reduced 3 per Cents.	1,956	0	11
Great Indian Peninsular Railway 4 per Cent. Guaranteed Debenture Stock	2,170	0	0
Oude and Rohilcund ,, ,, ,, ,,	2,460	0	0
Bombay and Baroda ,, ,, ,, ,,	2,450	0	0
Cash in hand of Messrs. Coutts and Co., on deposit	600	0	0
United States 2,500 dols. five per Cent. Funded Bonds, 1871, cost	509	1	3

Trust Funds included in the above.

	£	s.	d.	
Swiney's Bequest	£4,500	0	0	Consols, chargeable with a sum of £200 once in five years.
John Stock's Trust	100	0	0	,, ,, ,, the Award of a Medal.
North London Exhibition Trust	167	7	3	,, ,, ,, Award of the Interest as a Money Prize.
J. Murray, Esq., in aid of a Building Fund	50	0	0	Invested in Reduced 3 per Cent. Stock.
Subscriptions to an Endowment Fund	226	7	0	Do do do.
Dr. Aldred's Bequest	90	0	0	Do do do.
Thomas Howard's Bequest	500	0	0	Do in United States 5 per Cent. Funded Bonds, 1871.
Fothergill's Trust	388	1	4	New 3 per Cents., chargeable with the Award of a Medal.
Dr. Cantor's Bequest	5,049	9	7	Invested in Bombay and Baroda and Oude and Rohilcund Guaranteed Railway Debenture Stock.
Alfred Davis's Bequest	1,800	0	0	Invested in graat Indian Peninsular Guaranteed Railway Debenture Stock.
Memorial Window Fund	321	13	9	Deposited with Messrs. Coutts and Co.
Sir W. C. Trevelyan's Prize	100	0	0	
Musical Scholarships	50	0	0	
Technical Examinations Prizes, &c.	50	3	9	

The Receipts of the Society set forth above have been credited by Messrs. Coutts and Co.
The Payments set forth above have been made by authority of the Council.
The Assets, represented by stock at the Bank of England, and securities, and by cash balanee at Messrs. Coutts', have been duly verified.

James T. Ware } *Auditors.*
Edward Brooke }

Society's House, Adelphi, 17th June, 1873.

ANNUAL GENERAL MEETING.

The One Hundred and Nineteenth Annual General Meeting, for the purpose of receiving the Council's report, and the Treasurers' statement of receipts, payments, and expenditure during the past year, and also for the election of officers, will be held, in accordance with the Bye-laws, on Wednesday next, the 25th of June, at four p.m.

The Council hereby convene a Special General Meeting of the Members of the Society to ballot for members, such meeting to take place at the close of the Annual General Meeting.

By Order,
P. Le Neve Foster, *Secretary.*

Society's House, Adelphi, June 18, 1873.

CONFERENCE.

The Twenty-second Annual Conference between the Council of the Society and the representatives of Institutions in Union, will take place at the Society's House, on Friday, the 27th June. The chair will be taken at 12 o'clock, by Major-General

F. Eardley-Wilmot, R.A., F.R.S., Chairman of Council.

Secretaries of Institutions and Local Boards are requested to send, *immediately*, the names of the Representatives appointed to attend the Conference; and early notice should be given of any subjects which Institutions or Local Boards may desire their representatives to introduce to the notice of the Conference.

CONVERSAZIONE.

The Society's Conversazione will be held at the South Kensington Museum, next Friday evening, 27th June.

PROCEEDINGS OF THE SOCIETY.

EXTRAORDINARY MEETING.

An extraordinary meeting of the Society was held on Friday, June 13th, at 12 o'clock, the Right Hon. the Earl of Derby in the chair.

The Paper read was—

ON THE PURCHASE OF THE RAILWAYS BY THE STATE.

By William Galt.

In 1844 the legislature considered it desirable to pass an Act enabling Government to purchase, on certain specified terms, all the railways in the United Kingdom that from that time forward should be constructed. To protect, however, the interests of the shareholders, and give ample time to the nation and the legislature to obtain sufficient experience of the working of the present system, it was enacted that twenty-one years from the passing of the Act should elapse, before any change should be effected, or the rights of proprietorship in any way interfered with. The Act came into operation, or, more correctly speaking, might have been brought into operation, in 1865, and the subject we have this day to consider is, whether or not it is desirable, in the interests of the nation, to carry out the object for which this Act was passed.

Before we proceed, however, to consider our immediate subject, it is necessary to give a sketch of our railway legislation previous to 1844, It was not at first supposed that railways to a great extent would supersede the ordinary turnpike-roads and canals in the conveyance of passengers and merchandise, and consequently no special provision was made against such a contingency. The companies were merely bound to admit the engines and carriages of other persons on their lines; it being presumed by the legislature that there would be no difficulty in carrying out such an arrangement, and that the public would thus derive all the benefit from competition on railways that hitherto they had been accustomed on the common roads.

In 1839 a Committee, which included among its members the late Sir Robert Peel, reported in the strongest terms that this sort of competition was not only impracticable but undesirable, and that the owners of each line must hold it as a monopoly. "It will be found," said the report "to be the opinion of some of the witnesses that the interests of the several companies and the public can never be at variance, and that the managers of these great establishments, acting with an enlightened view of their own interests, will always have a due regard to the general advantages of the community. A main object which the directors of a company must have in view is to obtain a good return for the capital expended, while it is the primary interest of the public that the intercouse should be regularly maintained with the greatest safety, speed, and economy. Cases have already arisen in which the interests of private companies and the public have been found to be opposed to each other, and it appears probable that, in proportion as this new system shall supersede other modes of travelling, other inconvenient consequences will ensue, unless some authority be established to watch over and protect the interests of the public. The fear of a rival line may in some instances be a check on the conduct of a company, but there are few districts in which the public will have any opportunity of selection, and obvious and serious difficulties must arise of carrying this means of control into execution." Such was the opinion of Sir Robert Peel and the Committee of which he was a member, on the relative position of the companies and the public, when of course the supposition of competition on a railway by rival carriers and others had long previously passed away.

The next idea that took possession of the public mind was that by having "competing lines," as they were called, competition between the companies would necessarily follow, and that device no doubt for a time partially succeeded. These lines, many of them quite unnecessary, were constructed at a vast outlay of capital; violent competitions, by fits and starts, at exceedingly low charges, took place, but the companies soon became aware of the folly of such proceedings; amicable arrangements followed, and amalgamations into large groups, comprising some twenty or thirty companies each, dissipated the dreams for ever of those who imagined that any possible scheme could be devised by which competition among railway companies could be maintained, or the railway traffic of the country be anything else than a monopoly, in whatever hands it might be placed.

Let us now direct our attention for a moment to the Continent, and contrast the principles on which the people of Belgium established their railway system with that adopted in England. Belgium was the first of the Continental kingdoms to recognise in a practical manner the good results to be derived from a well-estabished system of railway communication throughout the country. Lines were accordingly laid out by eminent engineers throughout the most populous districts, and constructed at the expense of the State, under the immediate control of government. The end aimed at was, not the gain of the speculator—for there was no speculator—but the extension of the traffic and communication of the country to the utmost limits of the public capability. The project undertaken by the government was an establishment which was intended should neither be a burden nor a source of revenue, and required merely that it should cover its own expenses, and pay government interest on the invested capital.

When the project, which afterwards became law, was introduced into the Belgian Chambers in 1834, there were not wanting advocates to recommend the course that we were pursuing in England, and leave the whole traffic of the country to what was called "competition." M. Rogier, the Prime Minister, stated in a very few words the determination which government had come to on the subject, and the reasons for that determination. "The state of affairs," said he, "in which competition corrects the evil does not apply here; whoever holds the railways holds a monopoly, and that should only be allowed to exist in the possession of the State, subject to the responsible advisers of the Crown." Now, if a volume had been written upon the subject, it could not have more clearly expressed than in that brief sentence of the Belgian Prime Minister, the subject-matter of what we are called on to discuss this day. It will, I think, be universally admitted, that 40 years' experience of the working of our railway system confirm the truth of his first proposition, that the traffic on railways must be a monopoly; how far the alternative proposition that they should be in the possession of the State would be an improvement, is with us an open question.

Now, I freely admit at the outset that the advocates of this great organic change in our railway system are called on to make out an overwhelming case in support of their views, before they have any right to ask the country to adopt them. It cannot be denied that what they demand is wholly opposed to the traditional policy of this country; as much so as that of free-trade is to the commercial policy of the Continent, or of the United States of America, or of our own colonies. But it does not necessarily follow that our railway system is sound because it is in accordance with our traditional policy, nor that free-trade is wrong in principle, because in almost every nation but our own the doctrine of free-trade is considered altogether fallacious. We are accustomed in this country to follow the wise policy of leaving our great industrial works to private enterprise; but, in the present case, the question at issue is, whether or not railways, which have become the high-roads of the country, belong to an exceptional class of industrial works of such a nature, that it is only when they are in the possession of the State the public can realise all the advantages which such a rapid and economical means of communication is calculated to afford.

I propose to consider this subject under the following heads:—

First.—The complaints against the working of the present system, and then the benefits which the advocates of State ownership and management contend would be gained by the public if the former system was abolished and the latter substituted in its stead.

Second.—To discuss the arguments generally used in opposition to what is commonly called "Government management."

Third.—To examine the clauses containing the compulsory powers of purchase in the Act of 1844, with a view to consider how far they are effective.

Fourth.—If they should be found ineffective, to discuss the probability of a voluntary agreement being come to with the Companies.

Fifth.—To consider if the extension of the Irish railway system by the State might be the means of enabling the British public to come to a practical conclusion as to the desirability of the State purchasing the British railways.

Sixth, and last.—Assuming for argument's sake that it would be found desirable that the State should become the owner of all the railways in the United Kingdom, and that they cannot be obtained on what the legislature should consider equitable terms, what resource, if any, would be left to the legislature?

The two first divisions have reference to the theory of State purchase, and the four latter to its practical application.

Now, if I fully understand the object of this meeting, I think our discussion should be confined to those subjects I have specified, and that we should not wander into extraneous matters. The theory of State purchase may possibly be shown to be unimpeachable, and the arguments advanced in its support unanswerable; but, on the other hand, it may be proved that the enormous difficulties that would attend such a gigantic operation are of such a nature as to render hopeless any attempt to overcome them. Our object is to discuss the principles of political economy, and statistics in reference to the ownership and management of railways alone, and above all things to endeavour to obtain figures and calculations as nearly accurate as possible, as regards the sum for which the railways could be purchased; for that matter is quite as important as the soundness of the theory of purchase. It is, no doubt, true that political and social relations enter largely into the general question, but I trust that you will agree with me that this is neither the time nor the place to entertain such matters. Above all, I must strongly deprecate attacks being made on the management, and consequently the directors and managers, of our railways. There is not, I believe, a more able body of men in the kingdom than the managers of our great railway companies, and speaking of them as a body, I have no doubt they are desirous to meet the wishes of the public, so far as that is consistent with the interests of their employers. They are quite capable of defending themselves if attacked, and if charges of alleged mismanagement, in regard to accidents or other matters of complaint—which will happen under the best management—are permitted, rejoinders, of course, must follow, the discussion will be turned from its legitimate object, and we shall altogether fail to accomplish the object for which we are here assembled. We shall now proceed with our subject.

In 1843 there were 2,200 miles of railway completed, at an expenditure of about 90 millions, and even at that early period of our railway history great dissatisfaction existed in the public mind, as regards railway management. "The *laissez faire* system," said Mr. Porter, in his "Progress of the Nation," "which is pursued in this country, to such an extent that it has become an axiom with the government to undertake nothing, and to interfere with nothing, which can be accomplished by private or individual enterprise, or by the associated means of private parties, has been pregnant with great loss and inconvenience to the country in carrying forward the railway system. Perhaps there never was an occasion in which the government with equal propriety could have interfered to reconcile the conflicting interests involved, and to prevent public injury arising from the false steps so likely to be made at first in bringing about a total revolution in the internal commmunication of the country."

It was at this time—in 1843—that, so far as I am aware, the idea was first mooted, that the railways should be purchased by the State, and be managed under the direct supervision of Government. A few individuals, of a rather speculative turn of mind, and having the example of the working of the Belgian system before them, thought that it was not too late to retrace our steps, and adopt that of Belgium, by the State purchase of the railways. These gentlemen had a great deal of zeal, but very little practical knowledge of the subject on which they undertook to enlighten the country. They formed, of course, a railway reform association, made speeches generally to each other, held meetings which, I am afraid, very few attended, and issued tracts and pamphlets by the score to all whom they considered should be instructed on railway management. Their programme was very bold and decided. Government should at once pass an Act, without asking the directors' or shareholders' leave or license, take the railways into their own hands, pay the shareholders the market price of the day, lower the third-class fares to half-a-farthing a mile, and every other class in the same proportion; and so the association struggled on for about a year, until government determined to deal practically with the matter, and their brief existence came to a close.

There was considerable anxiety manifested in the railway world in the early part of 1844, when it became rumoured that government intended to introduce a sweeping measure in reference to the purchase of the railways. The expediency and policy of such a prospect was much discussed in the press, and then, as now, opinion was much divided on the subject. The *Quarterly Review* of April of that year had a powerful article on railway management, in which it truly and forcibly alluded to the Imperial dimensions the question would one day assume, and the manner in which the writer believed it would have to be dealt with. After summing up all the arguments in favour of government purchase, the writer thus concluded:—"It is impossible not to see that the system, by developing itself to such an extent, penetrating all districts, superseding all other communications, affecting every species of public and private interest, and acting as the life-blood arteries of the empire, as to render it probable almost to certainty that the time must come when this great public trust can no longer be left to the management of private companies scattered over the face of the country. In truth, it seems only a question of time; railways must be made subject to some unity of management, and, through whatever intermediate process it may pass, that management must finally be vested in the government of the country."

Now, what was the first popular outcry in the country against the companies? It was the alleged ill-treatment of the humbler class of passengers, and I cannot better illustrate this complaint than by reading a leading article in the *Times*, which appeared in December, 1842. It was as follows:—"We have received communications from several correspondents, imploring us to maintain an advocacy for the poorer class of railway travellers, who have to avail themselves of the stinted accommodation afforded by the leading lines, and desire us to urge the necessity of more comfort and facility in their transit than they at present enjoy. It would appear, from the facts stated in the several letters received, that little choice exists in one more than another, and that all the great lines are as parsimonious as they possibly can be in providing comfort or convenience for those having the misfortune to travel in third-class conveyances. The manner in which the Great-Western treat this class of passengers is described as worse than any other pursued, the only trains by which they forward them being used for the transit of coals, cattle, and merchandise of all descriptions. For instance, it is stated that a third-class passenger leaves Paddington in an open carriage, no difference being made to counteract wind or weather, at half-past four in the depth of winter. When he arrives at Swindon, he is detained upwards of an hour, and at last gets to Bristol, if the train keeps its time, in nine and a half hours, while the first and second-class carriages make the journey in less than half the time. If a third-class passenger wish to go on to Taunton from any place east of Bristol, it is alleged to be still more inconvenient, since he is detained from four to five hours in Bristol, and is kept on the road, at a moderate calculation, from fourteen to sixteen hours; whereas, on the other hand, first and second class passengers arrive at the same destination in six and a half hours. These are strong statements, and, unless satisfactorily explained away, must sooner or later come within the managerial scope of the Board of Trade, the authorities of which body would do well to see that fair and adequate provision is made by all the railway companies for the conveyance of the poorer classes during seasonable hours of the day. Railway directors have at present the exercise of too much irresponsible power, and therefore imagine they can deal with the public as they choose. They must, however, be mindful not to carry it beyond proper bounds; for though much good may have been achieved by the construction and successful competition of intercourse by means of this system of communication, it remains to be seen what will be the actual results of this description of management, should it, without some superintending power, be left entirely to the judgment of the persons who have the whole exercise of this power. It may possibly prove a useful hint to have said this much on the subject, without pressing more severely on the attention of the several railway boards the necessity existing for some amelioration of the plan at present adopted in the conveyance of third-class passengers; for, regarding them in the light of national improvements, raised on the foundation of the nation's wealth, they must be considered as intended to furnish a comparative convenience to one class of the public as well as the other." Such was the article in the *Times*, and it fairly represented the feelings of the entire nation on the subject.

Let us, however, look now to the other side of the question. If the shareholders in the railway companies professed to be a body of philanthropists that had constructed the railways for the public benefit, quite regardless of profit, and whose special vocation was to provide for the travelling wants at fares which they did not consider remunerative, nothing could be more reasonable than this appeal to their feelings; but the companies made no pretensions of the kind, they were composed of hard-headed men of business, who had made a contract with the State to provide for the wants of the public—a duty which the latter had declined to undertake—and the public, consesequently, had no right to appeal to them *ad misericordiam*, and beg them to do something not in the contract, and threaten them with pains and penalties—like the beggar in "Gil Blas," when he presented a gun in demanding alms—if their prayers, or rather their demands, were not complied with. What right could be urged in favour of such a demand? The companies' contract was to carry passengers at three-pence a mile, and they had, of course, a right to enforce that charge on every passenger who travelled on the railways; but they were actually, at the time when this piteous appeal was made to their charity and their fears, carrying those passengers at less than half the price they were authorised by Act of Parliament to charge.

The next grievance complained of was that first and second class passengers were charged high and arbitrary fares. It was at one time a matter of some nicety, and gave considerable anxiety to a board of directors and their manager to fix the fares, when their line was opened, at the exact point that would best pay. That knowledge was only to be gained by adopting a sliding scale, and by going through the process of alternately raising and lowering their fares till those that would pay best were ascertained. Now the difference in profit to a company between high and low fares, as we shall hereafter see, is not much. On some railways it is more profitable for companies to carry many at low fares, than the comparatively few at high fares, on other railways it is just the contrary; all depends on the nature of the traffic and the localities through which a line may pass. With railways that paid fair dividends, the changes in fares were not very great, seldom exceeding ten or twenty per cent.; but it was very different with the unfortunate class that paid very low dividends. The directors, attributing, perhaps, their want of success to not having charged high fares, made the most extreme and sudden changes in order to discover the best paying rates, and the tariff would be raised thirty, fifty, or one hundred per cent., as the case might be; or should they have been of opinion that the original fares were too high, reductions would be made accordingly; however, all these changes made but comparatively little difference in the profits of the companies—as fares increased passengers decreased, and as fares decreased passengers increased, though not in exact proportion. By this means each company was able to ascertain and fix the best tariff for its own interests, and as a matter of course, without any regard to the interests of the public. Nevertheless, these changes in an upward direction caused great dissatisfaction, although the proceedings of the directors were perfectly legal. As a general rule, however, throughout the country the directors came to the conclusion that what was called "moderate fares" paid best, and that two-pence, three-halfpence, and one penny per mile, for the several classes, yielded the largest profit.

I may notice here incidentally, that there existed at that time the erroneous belief, that charges in this country could never be reduced to a low scale on account of the great cost of our railways. In reviewing a work of mine, published in 1843, advocating the adoption of the Belgian tariff, the *Quarterly Review* observed:—"Let us look at the expense of making the respective lines, as stated in Mr. Laing's Report—

	Cost of construction per mile. £
Average of the 71 railways of England..	34,360
Average of Belgium..................	17,120

Will any one pretend to say, that a thing which costs £40,000, ought to be furnished in detail to the public as cheap as if it had cost only £17,000? But is it not curious to find that the average expenses of the Belgian lines turns out to be so exactly the one-half of the average of the British lines, as are the fares on the railways?" It is scarcely necessary to observe that not the most remote connection exists between the charges that will pay best on a railway, and the cost of the line. The fact of a railway costing £10,000, or £100,000, or half a million per mile, has not the slightest consideration with the directors in fixing their charges. If in some cases a company, whose line cost £100,000 per mile, would make as high charges as on other lines that only cost £10,000 a mile, they would be soon ruined.

What, then, is the present complaint against our railway system, as regards the conveyance of passengers? It is this; that the public do not derive the full benefit from the existing low rate at which they can be conveyed by railway. The cost of conveying passengers, under favourable circumstances, is less than the twentieth part of the cost of conveyance on ordinary turnpike roads. It is no part of the duty of directors to consider if it would be for the public advantage to carry the few at high fares, or the many at low fares; not only so, but they would be departing entirely from their duty if they allowed themselves for a moment to be influenced by such a consideration, to the detriment of their shareholders. A railway company is simply a trading company, authorised by law to make certain charges to the public for specified work to be done, and the duty of the directors towards their shareholders is, while keeping within the limits of the law, to obtain the largest return for the invested capital. With the public loss or gain they have nothing to do. Under such a system, with a monopoly of the conveyance of passengers throughout the country, it must be obvious that the national interests are entirely subservient to private interests, and until the system is abolished, the evils which it entails must necessarily be continued.

The working of our railway system as regards the conveyance of merchandise, is bitterly complained of throughout the whole of the country by almost every class engaged in mercantile transactions. The main charges preferred against the companies are—1st. Excessive charges compared with the cost of conveyance. 2nd. Arbitrary and exorbitant rates imposed upon some towns in comparison with others. 3rd. Refusing to separate the rates for carriage from terminal charges. 4th. The great injury to the trade and commerce of the country from the want of unity of management. 5th. The refusal to publish a list of charges from station to station of the several classes of goods. The evidence taken before the joint committee last session in reference to the proposed amalgamation of the London and North-Western, and Lancashire and Yorkshire Company abundantly bear out all the charges, and is published in a very large volume. It is of course impossible for me to enter into any details as to evidence. I shall only refer to the great port of Liverpool as a typical case; and a score of other towns, similarly circumstanced, might be named.

The Liverpool Chamber of Commerce, composed of "bankers, merchants, brokers, shipowners and others engaged in commerce," forwarded to the Prime Minister, in March last year, a memorial to the following purport:—

They stated that for many years they had been giving their attention to the question of the excessive and especially of the unequal rates levied by the railway companies on the traffic to and from Liverpool, as compared with the rates charged for the same goods for similar distances to and from other parts. They state that the trade of Liverpool is essentially a transit trade, the imports for the most part not being consumed in it, but distributed mainly by railways over the country, and that the exports are for the most part not contributed by Liverpool, but are sent for shipment from Yorkshire, Staffordshire, Lancashire, and other places, and declare that a system which obstructs the inland carriage of goods to and from Liverpool by the imposition of heavy tolls and charges, must tend to drive the trade to other places more favourably located, and must prove highly injurious to the port of Liverpool.

The memorialists further pointed out that this was no idle fear on their part, for that already, in consequence of these differential charges, a considerable amount of traffic had been diverted from Liverpool, to the injury alike of the individual trader and the port, and that the extra charges are so imposed as to force the traffic out of its natural channels, and enable the railway companies to offer a bounty to divert it into channels through which it would not otherwise flow.

The result of this policy, the memorialists went on to state, is that consumers of imports and producers of exports in the great and populous district of which Liverpool is the natural maritime centre, are burdened with a tax and restricted in their trade, in order that unprofitable extensions of railways in other directions may be made to pay; and the memorialists contended that such a system was an injustice to the consumer, an injury to trade, and a departure from those principles of public policy on which all concessions to railway companies should be based.

The memorialists further stated that they considered this question of the amalgamation of the London and North-Western with the Lancashire and Yorkshire company as one of the most vital and important to which their attention had ever been directed, that in their opinion the magnitude of the interests touched by the proposed amalgamation of the two great carrying companies referred to, divested the Bill brought into the Commons House of Parliament for that purpose of its private character, and gave it a claim to prominent consideration amongst the public measures of the session; and that a thorough revision should take place of the terms on which the railway system is allowed to enjoy a monopoly so injurious to the traffic of the country.

The result of that and similar memorials addressed to the Prime Minister is well known. A joint committee of the leading members of both houses was appointed. They sat nearly the whole of last session, took a vast amount of evidence, and ultimately came to the conclusion, *inter alia*, "that it was impossible to lay down any general rules determining the limits or the character of future amalgamations." They drew up a most able and valuable report, giving a very full history of our railway legislation, and recommended the appointment of a Board, "to enforce the harmony, working, and development of the present railway and canal systems." An Act of Parliament has been passed in accordance with the recommendation of the committee, and the Board has been appointed. So far as their powers go, this Board will, no doubt, be of some use. But the main grievances referred to in the memorial are untouched, viz., high rates and differential charges, as the committee could not recommend Acts of Parliament, in which the companies were interested, to be altered or partially repealed without their assent, which of course they refused to give. The Bill for amalgamation, as you all know, was unanimously thrown out by the committee to whom it was referred a few weeks since, without calling a single witness opposed to it. The committee, no doubt, considered that it would be better to forego for the present all the vast advantages which the extension of amalgamations is calculated to confer on the public, rather than create an enormous monopoly which would confer on the company uncontrolled power, and yield them increased profits, without the slightest guarantee that Liverpool, and other great towns similarly situated, not only might receive no benefit whatever from the change, but be liable to have their position made still worse by the united power of the two companies amalgamated into one. But, passing all this by, are the companies liable to censure for the course they adopted before the joint committee? Was it from any animosity they felt against the town of Liverpool, or a desire to injure its trade? No such imputation was ever made against the directors, all of whom are men of the highest position and character, and several leading merchants in the town, deeply interested in the extension of its trade and commerce. Nor was it from private individual interests; no such imputation was made against any member of their body. They acted merely as other trading companies would act under similar circumstances. The law gave them the right to impose a heavy tax on Liverpool and other towns similarly situated, by doubling or trebling the rates in their district; such impositions in their opinion yielded a profit to the company, and consequently their duty to the shareholders required them to maintain their rights. Now, if the companies had been content to let the matter rest on that plain, common sense footing, I must confess that I consider their vindication would be complete; but some of their advocates, with more zeal than knowledge, contend that their policy confers a great benefit on the country generally, "by giving protection and encouragement through low rates to distant towns, whereby they are able successfully to compete with other towns more favourably situated, greatly to the public advantage." There always are two ways of stating a proposition, and the Liverpool merchants would probably formulate the same proposition something like this—"The railway companies carry merchandise at rates which yield them good profits to Lancashire, Yorkshire, and Staffordshire from very distant towns, but we, who are favourably situated for communication with these surrounding districts, are charged three times the ordinary rate at which merchandise is carried to and from other towns; thus our trade is greatly injured, and as these extra charges necessarily fall upon the consumer, the public in consequence heavily suffer."

A very intelligent witness from Liverpool, Mr. C. Clark, after describing the manifold grievances under which the town suffers, and in reference to one especially, thus sums the matter up:—"The idea, I believe, at the bottom of it all is this—there are three great places which compete for our sugar traffic—three great centres of the refining interest; one at Bristol, the other at Liverpool, and the third at Greenock. As regards Liverpool, Providence has put us considerably nearer most of the large towns where sugar is consumed than is the case with Greenock and Bristol, and I think the railway companies have got an idea that it is their mission to redress this inequality, ordained by Providence, by making the same rate, or pretty nearly the same rate, for the long distance as they make for the short one, to deprive the consumers of sugar of the advantage which they would naturally derive from being able to obtain it from the place which is nearest to them, and where sugar could be most cheaply carried. I really believe that that theory is at the bottom of it." Without exactly concurring in Mr. Clark's opinion as to the motive which influences the companies in dealing with the several towns so differently situated, there can be no question that they are carrying out "protection" in its worst form. The "protection" which was part of our policy in days gone by was directed against the "foreigner," who threatened to bring cheap corn into the country, but the "protection" in the present case is made use of against our own countrymen, and in a manner equally injurious to the producer as to the consumer. In Liverpool there are, perhaps, fifty merchants who compete with each other for the trade of these districts, and the fallacy that lurks at the bottom of the company theory is that there is only one trader there who has a monopoly of all the traffic.

To illustrate this more clearly, let us put a hypothetical case. Suppose that extensive coal-fields were discovered within some twenty miles of London, of good quality and sufficient extent to supply all the inhabitants with abundance of fuel; there would, no doubt, be rejoicings at the prospect of the great reduction in price that would naturally be expected from such a supply so close at hand. Paterfamilias would calculate that as the carriage of coal from the North costs seven shillings a ton, the six shillings saved would go into his pocket, but Paterfamilias would be grievously disappointed; the same protection that is now given to the districts about Liverpool would be extended to London, competition would be maintained by charging to the coal market the same carriage for the 20 miles as the 200, and thus the public would derive no benefit by the discovery.

Among the remedies for railway grievances suggested by several of the witnesses examined before the joint committee, a limitation of the companies' dividends appeared to find most favour. In the minds of many people there seems to exist a connection between moderate dividends and moderate charges, and they believe that if companies were restrained from paying dividends beyond a certain per-centage on their capital, the public would have the benefit of the surplus. It was recommended by these gentlemen that in order to prevent the companies from avoiding reduction of rates by not declaring the whole of their actual profit as dividends, that it should be the duty of a government department intrusted with the revision to see that the actual profits, however employed, did not exceed the legal amount. That would, in fact, give the government officials the complete control of the expenditure, with the right to decide how expenses should be charged as between revenue and capital. This, to be effective, must extend to every department of a company's business, and give government a complete control over the expenditure. Such an arrangement would be altogether inadmissible. It is no part of the duty of a government to employ its officers in managing the finances of a company, or in otherwise interfering with their business. But as regards railway companies, from the time they obtained their first Act till the other day, when a commission was appointed to regulate their affairs, committee has been appointed after committee, and commission after commission, to regulate railway companies. "The cry is still they come." There has been a constant interference on the part of the legislature, urged on by a dissatisfied public, to an extent that never has been thought necessary with any other class of joint-stock companies; but if the companies are discharging a delegated trust without any of the moral responsibilties that should attach to the office—if their position is such that in giving to the public the full benefit that might be derived from low fares and equitable rates on railways, they would sacrifice to a greater or less extent the interests of their shareholders, it is surely time for the nation to consider the desirability of taking back the railways into its own hands, and it is for us now to consider what in such case those benefits would be.

As railways have superseded to a great extent the highways of the country, it will not, I presume, be questioned by any that the greatest possible facility of transit for passengers and goods should be afforded to the public, and that the fares for passengers and charges for merchandise should be reduced to the lowest possible rate consistent with the payment of working expenses and interest on the capital invested in the construction of the lines. I have endeavoured to show that under the present system the public are deprived of many benefits it otherwise might enjoy, and we have now to consider in what respects the transfer of the railways to the State would be advantageous.

I directed your attention a little time ago to the very important fact that within certain limits, and so far as our experience goes, there exists very little difference in the dividends of a company, whatever may be the fares adopted within these limits. I was examined before the committee of 1844, and gave examples of about a dozen cases in which companies in search of the best paying fares made all sorts of experiments, varying from ¾d. to 3d. a mile for first class, ½d. to 2d. for second, and ¼d. to 1d. for third, and that in no case would the difference in money received amount to one per cent. on the dividends. In later times, till within the last ten or fifteen years, we have had some long and violent contests between some of the great companies, in which they suffered considerably, but I only know one case in which the dividend has decreased to the extent of 1½ per cent. During the summer of 1857 we had the London and North-Western and the Great Northern Companies carrying first and second class passengers between London and Manchester, giving return tickets, and allowing four clear days in Manchester; the distance was 400 miles, and the fares 7s. 6d. and 5s., equal to 3s. 9d. and 2s. 6d. each way. These trains must have interfered to a great extent with the general passenger traffic of both the companies to all the large towns in the north of England. Although the excursion traffic to Manchester paid *per se* exceedingly well, yet it was said that by its interference with their other traffic the companies lost fully one per cent. dividend.

Let us stop for a moment to inquire into the cost of these excursion trains. They were, it is needless to say, well filled, and carried, I have been told, on an average, about six-hundred passengers —say two hundred first, and four hundred second-class passengers, the fares for the double trip amounting to £175. The cost of a train that year per mile was two shillings and sevenpence. The whole expense of each train, both the direct expense and its proportionate expense for management, came to fifty guineas, leaving a profit of about two hundred and fifty per cent. on the conveyance of passengers by each train. On ordinary trains the profit is about 100 per cent., which may not amount to as much as to pay a dividend of five per cent., yet we see that in this case the fares of the passengers were, for first class, each hundred miles one shilling and nine pence, and for second-class, in carriages comfortably cushioned, one shilling and two-pence, or a penny for seven miles ! Many other cases might be quoted of long contests between companies for passenger traffic at very low fares, in which all suffered more or less. One of the most memorable of these was the contest about twenty years ago between the Caledonian and the Edinburgh and Glasgow Companies, in which the latter suddenly reduced their fares between Edinburgh and Glasgow for the three classes from 8s., 6s. and 4s. to 1s., 9d. and 6d. This foolish contest was continued for a year and a-half, and cost the Edinburgh and Glasgow Company nearly 1½ per cent. in their dividends.

It is scarcely necessary to say that to ordinary traffic such low fares do not apply; they only show the very low rate at which passengers can be conveyed, and the comparatively little difference in profit between high and low fares.

Let us see how this knowledge would be practically applied if the railways were in the possession of the State. We will assume that the legislature wished to reduce the fares one-half. What would be the extra expense for conveyance of the increased number of passengers ? Mr. Stewart, who was for twenty years secretary to the London and North-Western Company, gave very valuable evidence before the Royal Commission in 1865, regarding traffic arrangements. He said that the passenger trains were not on an average more than one-third filled—two-thirds of the seats being empty ; and that the additional expense to the company would be very trifling if all the seats were filled. Indeed, it must be obvious that whether an omnibus carries three passengers or six, the additional expense is very small, and so with a train that is only partially filled. Under these circumstances the additional expense would be very trifling. But a company would naturally prefer carrying three passengers at sixpence each to six at threepence each, and that fact makes the difference in position between Government and the companies.

The witnesses examined before the Royal Commission and the Joint Committee agree that there would be an enormous saving in working expenses by the amalgamation of the companies. Mr. Stewart stated that if the whole traffic of the country was worked harmoniously together, there would be a saving of 20 per cent. in the working expenses—in the London and North-Western they would be able to save £600,000 a-year. Other competent witnesses calculated it at 25 per cent.

In addition to this great saving, if the railways were bought at a fair price, and the shareholders were paid in Government stock, there would be a very large profit to the State, inasmuch as a £100 railway share paying 3 per cent. is worth only £60, but Government stock paying the same interest is worth £92. That is a matter, however, to be discussed when we come to the Act of 1844, and in the meantime it is as well not to count the chickens before they are hatched, or to estimate yet the profit to be derived from the purchase.

It would be almost impossible to over-estimate the value of the boon that would be conferred on the mercantile community by the abolition of those heavy grievances of which they complain, and of which we have such abundant testimony in the evidence given before the Joint Committee. The establishment also of a low, and to some extent uniform tariff, for parcels and packages throughout the kingdom, somewhat similar in principle to that of the Post Office, would also be of the greatest advantage to the country.

Gentlemen connected with railways could give us very useful practical information in regard to the increase of passengers that might be expected, assuming that the fares were reduced to one-half their present amount, and what loss they would calculate on if their respective companies made that reduction. Would it be a permanent loss or temporary, and to what extent would it affect the value of their property ?

As regards what is called "Government management," that of the railways, like the telegraphs, I should imagine, would undergo little change. There would, no doubt, be a board, or commission, or council, whatever the name might be, composed of a few of the leading directors and managers of our great companies, who might feel inclined to accept such an office, presided over by a responsible Minister. Why such a board should not well and ably manage the railway property of the kingdom I am unable to conceive. The gentlemen who would undertake the office, instead of spending half their time, as their duty calls on them to do now, in concocting schemes of attack on or defence against their neighbours, would be able to devote that time to a much better purpose in concerting measures with their old opponents, and extending the trade and commerce of the country by reducing charges, and, so far as possible, equalising rates, and thereby satisfy all classes of the community. Or the railways, amalgamated into one system, might be managed under the direction of a board somewhat similar in its constitution to that of the joint committee of last year. On that committee were men of the highest administrative talent, well versed in the management of railways.

The political bearing of the question I don't think we are called on to discuss. That we may leave to others. Should the railways ever be purchased by the State, we may rest quite assured that the country and Parliament will take good care to settle it on such a basis as to deprive it of all political significance.

We have now to consider the Act of 1844. It is not generally known that this Act was passed after encountering the most violent opposition from the railway companies, who opposed the Bill in every stage of its progress through Parliament; and when it ultimately became an Act it was quite a different measure from that originally introduced by Mr. Gladstone. The object of the companies was to render the Bill totally inefficient for the purpose intended, and accordingly they put forward Captain Laws, then manager of the Lancashire and Yorkshire Railway, and a most able man, as a witness before the Committee, and he ultimately succeeded in having everything pretty well his own way. His recommendation was that the companies should have "a sum equal to 25 years' purchase on their annual divisible profits, estimated on the average of the then next preceding years, but if a company should be of opinion that the said rate of 25 years' purchase is an inadequate rate of purchase of such railway, the company shall be entitled to require that the rate of purchase, instead of being calculated on such average rate of profit, shall be taken at a valuation, to be determined, in case of difference, by arbitration." In this short extract I have embodied the several clauses bearing on the purchase of the railways, and by the interpretation of these clauses is to be determined the manner in which the value of railway property is to be assessed, and the payment which the companies, in the event of purchase, have a right to demand. I may, perhaps, mention here that I was examined as a witness before the Committee, and, at their desire, furnished them with a return of the then existing railways, and the cost of each, with their market value, so far as that could be ascertained, as many of them were not finished or quoted in the "Share List." I divided them into two classes. The first contained all the principal railways in the kingdom; they were forty in number, they had cost £59,630,000, and their market value was £76,734,000. The second list contained all the railways in course of construction, and nearly completed, and cost then £8,160,000, and their value was £11,613,000. So that all the capital at that time invested in railways amounted to £67,790,000, and its market value might be taken at £88,347,000. In the course of examination before the Committee, I gave it as my opinion that the market value of the railways, whether to become the property of the State then or at any future time, must form the basis on which the terms of purchase should be settled. The Committee, however, were not of that opinion.

1st. We shall now consider the terms of purchase by which the State is to purchase a property that has cost nearly £600,000,000. When the Act of 1844 was passed, Consols were at par, and railway property was worth in the market 23 years' purchase. In recommending 25 years' purchase on the average dividends, the committee, no doubt, intended that the companies should have a bonus of 10 per cent. on the market price, but at that time government stock was exceptionally high, and railway stock was in the same position. When government stock fell, railway stock naturally fell with it to its normal average rate of 20 years' purchase, and assuming the principle of valuation to be correct, the companies would receive 25 per cent. instead of 10 per cent. above the value of their property. 2nd. Assuming that the value of the property could be estimated by the profits alone, extending the average over three years would introduce a disturbing element, and make the calculations utterly useless—a railway, for instance, that for the three preceding years had been increasing in value, and had paid each year respectively three, four, and five per cent., would only be paid at the rate of four per cent., although, at the time of purchase, it would be paying five per cent., and on the other hand, a railway that had in the three preceding years been decreasing in value, and paying five, four, and three per cent., would be considered of the same value—that is, two railways, one paying five and the other three per cent., the shareholders of each would each be paid the same price! 3rd. The Act says that the companies shall be paid 25 years purchase on "the divisible profits," and the general opinion is that "divisible profits" is only another term for dividends, but that is a great mistake; the strict meaning of "divisible profits" is the surplus a company has in hand after paying its working expenses; but before the ordinary shareholders receive their dividend all other charges must be first paid, guaranteed stock, preferential stock, debenture stock, and loans, on all of which the interest or dividends must be paid at present out of the "divisible profits." Now poor companies, with bad credit and a narrow surplus, must, on loans especially, pay a very high, and in many cases exorbitant rate of interest, which necessarily keep their dividends very low, but as original shareholders would have all the benefit of the 25 years' purchase on the divisible profits, many companies would be paid at the rate of three or four per cent. out of their profits, who never as shareholders received half that percentage in dividends. 4th. The theory that the value of railways, or, indeed, any other kind of property, can be estimated by the interest or dividend which it pays is altogether erroneous, although it is a very material element in the calculation; but the intrinsic value of the stock of two railways may be just as different in credit, and consequently in value, as the Government Stock of two countries. It would be a very easy matter to confirm the truth of this statement by a reference to the share lists, showing the position of the several companies, but that, of course, I am not going to do. There is nothing I have stated on this subject but every gentleman present connected with railways is as well or better acquainted with as I am; but it is not so with the general public, who are under the impression that there exists an Act of Parliament by which Government, with the assent of the legislature, can purchase, on equitable terms, the railways of the country, and that there exists no difficulty with the shareholders.

But, it may be asked, what reason can be assigned for the proceedings of railway companies so that, with the perfect knowledge that the scheme of purchase was utterly worthless and could never be carried into effect, their representative, Captain Laws, not only acquiesced in it but actually suggested it? The answer is obvious. The railway directors, as I have before stated, were bitterly opposed to any measure that, either at the time or prospectively, could in any way interfere with their monopoly, and they were enraged to the last degree when not only that was threatened, but a law was about to be passed which might take that monopoly eventually out of their hands. They knew that it was impossible to successfully oppose the bill and prevent an Act being passed, and they considered that the wisest policy—and they were wise in their generation—was apparently to acquiesce in the inevitable, but at the same time so concert their plans that the object for which the Bill was to pass could not be effected. Lest, however, it should be supposed that I have in any way exaggerated the violent opposition the Government had in the first instance to encounter from the railway interest, permit me to read a short extract from the close of Mr. Gladstone's speech in moving the second reading of the Bill:—"I do not," said he, "shrink from the contest. This Bill has been represented as an attack on railway property. I contend that this measure, so far from being a measure of violence of an extreme or doubtful character, is a measure of the utmost importance; and that the option of revision or purchase is characterised by the utmost temperance and moderation, and feeling that we have right and justice on our side, I say that, although the railway companies are powerful, I do not think they have mounted so high, or that Parliament has yet sunk so low, as that at their bidding you shall refuse your sanction to this Bill."

The Royal Commission, in their Report of 1867, and the Joint Committee in their Report of last year, state that the railways cannot be purchased under the Act of 1844, and it may one day be worth considering if the market price can, with justice to both parties, be made the standard of value. Even if an Act had been passed authorising government to take the railways at their market price at a date previous to the time of purchase, with whatever bonus the Legislature might have thought proper to add, other matters besides determining the market value of the shares would have been necessary to provide for; the books of the companies must have been examined, and it should also be ascertained if the prices quoted were genuine, and not the result of stock-jobbing operations.

How an Act could now be framed to meet the necessities of such a case we need not discuss, for the companies would protest against any Act being passed that would supersede the Act of 1844, on the faith of which they would assert they invested their capital. Now, what are the words of one clause in the Act:—"It shall be lawful for the company, if they shall be of opinion that the said rate of twenty-five years' purchase of the said average profits is an inadequate rate of purchase of such railway, reference being had to the prospects thereof, to require that the rate of purchase, instead of being calculated upon such average rate of profit, shall be taken at a valuation, to be determined in case of difference by arbitration." We have heard something of late years about "consequential damages," and now we shall learn for the first time what is meant by the term "consequential profits," and the amount at which they might be assessed. It would be impossible under this Act for government to purchase a single railway with the knowledge at the time of purchase of the sum that ultimately they might be called on to pay, as each company, in addition to the 25 years' purchase of the profits, would, of course, make a large demand for their "prospects." So we may dismiss entirely any idea of compulsory purchase.

Is there any probability of the companies being willing to accept moderate terms for their property? The discussions that have recently taken place on the subject afford good grounds for forming an opinion of what their demands would be.

Taking the returns of 1871—the principle is precisely the same whether applied to the figures of that year or to the larger figures of 1872—it is seen that the railways cost £553,000,000, of which sum £323,000,000 is debenture and preference stock, and £230,000,000 ordinary stock, and that the sum distributed in profits that year was £25,740,000, or about £4 13s. per cent. on the invested capital. The market value of the property, according to Mr. Martin, who appears to have made a very liberal estimate, is £607,000,000. Now, according to the best authorities, we could not purchase this property for less than one thousand millions sterling. Mr. Allport says it could not be purchased even for that sum; and several other gentlemen, of equally good authority, agree with him in that opinion, or, in other words, that the shareholders would not be satisfied with the payment of four hundred millions sterling in lieu of "consequential profits," so we may dismiss at once the idea of purchase on such terms; and it must be remembered we are not in a position to enforce any terms inconsistent with the Act of 1844.

We can well remember the sudden rise that took place, a few years since, in telegraph shares, when it became known that Government intended to recommend to Parliament the purchase of the telegraph lines. They suddenly sprang up to such a price that it became a question whether or not the project of purchase should be altogether abandoned. If the market price is a test of value, the telegraph lines were bought at the rate of fifty to one hundred per cent. beyond what they were worth ; but, under the particular circumstances of the case, perhaps to close the bargain was the wisest thing that Government could do. Even with the exorbitant prices that were paid, the investment, under Government management, has turned out most profitable and advantageous to the nation. How much better, however, would it have been if the property could have been obtained at a fair price.

We can well imagine, after our experience about the telegraph share market, the effect that would be produced upon the Stock Exchange by an authentic announcement that Government intended to recommend to Parliament the purchase by the State of all the railways in the United Kingdom. Taking the price paid for the telegraphs alone, their market value, as a fair standard to regulate the price that should be paid for railways, a bonus of four hundred millions would certainly be required. Although Mr. Allport and his friends assert, in effect, that the railways could not be purchased for a thousand millions, that sum, it must be remembered, is very large, and I cannot help thinking that the Government, with proper management, might obtain them on those terms. The payment for "consequential profits" would, in that case, be no greater than the claim from our American cousins for "consequential damages," and not more unreasonable, and exactly double the sum agreed upon, and now nearly paid by France to Germany for the war indemnity.

It is assumed, however, throughout the whole of the discussions that have taken place in reference to this subject, that the nation must either submit to any demands, however exorbitant they may be, to obtain possession of the railways, or be obliged to allow the present system to remain as it is. Now, that is the special matter to which I wish to direct your attention. The railways of this country may one day be purchased by the State, but if ever that day should come, it will be when the position of parties is changed, when the directors of the companies must come to the government, and not when government would be obliged to go to the directors. The companies are now masters of the position, and until more advanced opinions are held throughout the country, the ownership of of railways must remain in the same hands.

In the examination of witnesses before the Committee of 1844, one of them was asked by a member the following question: "It would be perfectly possible, would it not, that the Government itself might undertake to make a competing line in such a way as to effect a reduction of charges upon the public, both upon the old line and the new one?" The answer was: "Certainly; there would be nothing to prevent it." The next question was: "Assuming that to be the case, and assuming that would be the proper remedy for excessive rates and charges, do you think that would be the best plan that could be adopted under the circumstances?" The reply was: "I would much rather see a competing line in the hands of the Government than in the hands of a private company." It no doubt occasionally happens that some member of a committee may ask questions not very pertinent to the matter under consideration, and the witness who answers them may be totally unqualified to give a proper answer, but these objections do not apply to the present case. The member who asked these questions was Mr. Gladstone, chairman of the committee, and the witness who answered was Mr. Glyn, for many years chairman of the London and North-Western Railway.

Now, whatever mistake the legislature may have made in their dealings with the companies, they have been always clear and distinct in maintaining their right to permit the construction of competing lines, and they have of course the same power to permit such lines being constructed by government. Mr. Glyn made a very judicious answer in saying he preferred that an opposition line should be in the hands of government in preference to those of a private company, because in the former case they would have a moral right to ask the legislature to take the railway off their hands at its market price, and in the latter case they might be ruined without any compensation whatever.

It is generally known that a universal feeling prevails throughout Ireland that her railways should be purchased by the State, amalgamated under one system of management, and that a low and uniform tariff should be established throughout the country. The capital invested in the Irish railways is £27,000,000, and pays at present about 4¼ per cent; on the English railways it is about a half per cent. more. Government has, however, lately expressed a decided opinion against the policy of, under any circumstances, becoming a trader, and therefore declines to be in any way a party to the purchase of the Irish railways. But it would be hard to say whether the feeling in Ireland in favour of the purchase of the railways by the State, or the extension of the railway system, is the stronger of the two. No one can question the right of the Legislature to authorise Government to construct railways, and the assertion of these rights, in a modified form, is particularly applicable to the state of Ireland. Ireland does not want competing lines. There are 2,000 miles of railway completed, and it would take about 1,200 more to complete the Irish railway system. These lines cannot be constructed under a commercial system, because there is no present probability of their paying 5 per cent; but the counties through which they would pass would only be too happy to be supplied with railways and give a guarantee on the county rates that Government interest would be paid; in that case we would establish in Ireland a mixed system, as in Belgium and Germany, by which the public mind in England would be directed to the subject in a much more demonstrative form than is the case at present.

The English people possess the abstract right to construct their own railways, and when that right is practically asserted, the claim of £400,000,000 for consequential profits will disappear. But to obtain this end, the proper means must be used. In 1839, Lord Melbourne, then Prime Minister, declared that "the man must be mad who declared the corn laws could be repealed." Yet within seven years from the time of that declaration being made, the corn laws had ceased to exist. But how did that come to pass? The merchants and traders of Manchester, who felt themselves specially aggrieved by the operation of the corn laws, organised a great league, and promulgated their grievances and the grievances of the public through the length and breadth of the land, and so the tax upon bread fell. The merchants and traders of Liverpool have their special grievances to complain of, in regard to the tax specially imposed on their trade and commerce, and if they adopt the same means to abolish that imposition, the like success may be expected to attend their efforts. We may look with confidence to other quarters for support.

The late Mr. W. Bridges Adams, an engineer of great eminence, directed the attention of the London and North-Western Board, some years since, to the great desirability of constructing a line for passenger traffic only between London and Liverpool. He stated that there was a constantly increasing number of people, to whom time is exceedingly valuable, and to whom expense is comparatively no object, and who wish to travel at the highest rate of speed that can be attained. A speed of fifty to sixty miles an hour, he said, could be attained with perfect safety and with no excessive cost, if only a clear and well-conducted line, and well-constructed trains were used. In short, the lines must be passenger lines, and not goods lines. Goods, he said, did not pay well, except in heavy trains drawn by heavy engines, and at comparatively slow speeds; and if passengers are to travel on goods lines, they should travel at the same rates of speed, in order to ensure safety. Duplicating the main lines will not get over the difficulty, by keeping the fast trains to one pair of lines, and the slow to the other pair. Goods need warehouses, and sidings, and crossings, and a great number of porters; and, whether the passenger lines be side lines or central, the goods lines will interfere with the traffic. Passenger trains actually travel at speeds from fifty to sixty miles an hour on rails in inferior condition. This rate involves considerable risk from bad points and from collisions with goods trains; the great majority of accidents on railways occur through such collisions, which cannot be absolutely provided against. If light engines and light trains be used with corresponding rails, in thorough order, and with no impeding traffic, these rates of speed might be maintained without any risk, and without any immediate evil. But it would not do to permit any heavy, destructive goods traffic on such lines. If light goods were permitted during the night, the engines and waggons should be equally well constructed with the passenger trains, with no greater load per wheel and with less speed.

"But would it pay the London and North-Western Company," asks Mr. Adams, "to have distinct passenger lines of great speed?"

That, he says, must depend upon the wealth or commercial importance of the district. If the expenditure in law were light, and the land could be rented at its agricultural value on a lease of 999 years, lines of double railway might be constructed for fast light trains, at the rate of £10,000 to £15,000 per mile, including locomotives and rolling stock of the best quality. The convenience of humanity would be studied at the same time in the construction of the carriages; they would be lofty enough to permit standing upright; they would be ten feet in width, with a central passage-way, to permit the guard to pass from one end of the train to the other, thus getting rid of the great difficulty of want of communication between guard and driver. On either side the passage would be inclosed cabins, or apartments for four persons each, for passengers wishing to be private; and open saloons would be provided for the gregariously disposed. The seats of the passengers would be arranged to fold up against the partition, so that each passenger might sit or stand at pleasure. Arrangements would be made to provide tea, coffee, and similar refreshments whilst travelling, and also for efficient warming, ventilating, and lighting; and by fitting construction, easy movement, without vibration or oscillation, would enable the traveller to read or write at pleasure. In this mode a constant speed of from 50 to 60 miles per hour could be maintained, without the necessity of the traveller alighting, or injuring his nerves by vibration of the train, or his digestive organs by swallowing food in too great a hurry, or at too distant intervals of time.

Such was Mr. Adams' scheme for constructing a passenger line between London and Liverpool; and when such a line is constructed by government—if ever such an event takes place—it will be time enough to settle the terms on which the State shall purchase the railways.

The passenger fares that Government would adopt would naturally require the greatest consideration, but they should be no more tentative than the adoption of the penny post was tentative. Low fares should be at once adopted. Every class, and every section of the community, would equally benefit from a large reduction of fares—to be uniform throughout the country. The fares I suggested to the Royal Commission that should be adopted by Government were, for 1st and 2nd class, by express trains, 1½d. and 1d. per mile; by ordinary trains first, second, and third, 1¼d., ¾d., and ½d.; by slow goods, or excursion trains, ¾d., ½d., and ¼d. The Irish Railway Commissioners recommended that uniform fares of 1¼d., ¾d., and ½d., should be adopted throughout the country.

The working of the system of Government purchase would be very simple, if the principle was recognised and the practice carried out, of Government constructing such lines as the legislature approved of; if there were individuals or districts particularly interested in the construction of any railway not in itself objectionable, let them be called on to give security to the Treasury against loss, as frequently is done now in Ireland to companies, by security on county rates or otherwise.

As regards the companies, the value of their property could not be depreciated, for they should have a right to call on Government to purchase their lines—if they found their profits decreasing—at its fair market value, previous to that decrease in traffic having commenced. So that even if the value of their line was reduced by Government competition, the shareholders would still receive the full value, and the money market would not be in the least disturbed.

I suggested to the Committee of 1844 that it would be desirable by an arrangement with some of the companies which had no competing lines, to carry passengers at very low fares, and thus ascertain the extent to which passenger traffic could be increased. If such an experiment, for instance, by an arrangement with the companies, could be tried on the underground lines of the metropolis, the result would throw great light on the subject.

To many of our legislators, in their individual capacity, we are indebted in no small degree for those great reforms, constitutional and commercial, that in the course of the last forty years have brought about such a wonderful change in the state of this country. It would be impossible to refer to any great measure of reform without identifying it with one or more members of our legislature, to whose unwearied exertions—it may be for many years—we are indebted for the creation and formation of that public opinion through which those measures became ultimately the law of the land. To overcome the *vis inertiæ* of mankind has been in all ages and countries a matter of the greatest difficulty; and it is only when the attempt to do so proceeds from an influential quarter, that there is much likelihood of its being successful. Every word spoken by a man of eminence, either in Parliament or elsewhere, on public occasions, is noted down and circulated through the length and breadth of the land. All newspapers, without distinction of party, give currency to his opinions, expressed in his own words; those opinions are made the subject of comment, favourable or otherwise, as the case may be, and thus commences the growth and formation of what we call public opinion. So, in regard to a reform of our railway system, it is scarcely arrived at the first stage of existence; but one day it may become a living principle. Now it is a mere idea, but in the course of time that idea may be developed into a great plan, recognised by the nation, adopted by the legislature, and working for the benefit of the whole community through all classes of society.

DISCUSSION.

Mr. C. B. Vignoles, F.R.S., said for the last forty years he had been intimately acquainted with the railway system in the United Kingdom, and had long considered this question and the steps taken by the legislature. In England the feeling was so strong, that everything possible should be left to private enterprise, that public opinion revolted against the idea of Government interfering, except in special cases. The argument had always been that the great communications of the country should be in the hands of the Government, and, in looking to the future, he thought it possible, and even probable, that the railways might eventually come into the possession of the State. But that could only be done by the force of public opinion. There were many arguments and facts bearing on this question which had not been discussed in the paper, but nevertheless it would be valuable as a matter of history. Allusion has been made to the Irish railways. Some forty years ago the Government were anxious to develope the resources of that country, and, in order that the railways might be carried in a proper direction, a Railway Commission was established; the conclusions that they came to were that the average of railways in that country, good and bad, would not pay more than 4½ per cent., and they recommended certain lines which would yield that return. The Government published the report and circulated it, but it did not meet with much general acceptance, and the project of railways being made by the State was abandoned, the whole matter being left to private enterprise. Private enterprise immediately seized upon all the profitable lines, especially the one to the south of Ireland, on which, after some twenty years, about five per cent. dividend was now paid. The other lines proved as nearly as possible, in proportion to their length and traffic, exactly what the commission had predicted. In consequence, the great body of Irish railway proprietors, when they found their hopes disappointed, came knocking at the door of Government, and asking that the railways should be purchased; but the Government very properly declined to accede to their request. In his opinion the State should not take over the railways until the railways came and offered themselves, though, no doubt, if public opinion insisted upon their being purchased, as the telegraph system had been, no doubt it would be right to do so. With respect to foreign railways, the general practice had been to retain them in the hands of the State, or, at all events, to give Government the control; and the last advantage the State had reserved to themselves was the right of purchase. In France, it was endeavoured, first of all, to get railways made entirely by the State; failing that, they endeavoured to get them made by companies, and failing that also, the Government offered to construct the works and let them to the companies, on condition of their laying down the permanent way and providing rolling stock. The German system was too complicated to be stated at such a meeting, but they all retained the ultimate right to purchase upon terms fixed beforehand. The English legislature thought it would be more encouraging to capitalists to give them the right, or monopoly, as it turned out, in their own hands; and now the question arose, whether it was or was not politic to purchase the railways. The result of his experience and reflection was that this time was not yet come, and that Government should wait until the companies came and asked to be purchased.

Mr. F. J. Bramwell, C.E., said the reader of the paper had commenced by stating that he must make a most overwhelming case before the Government could be called upon to purchase the railways. But so far from doing so, he appeared to have made an extraordinarily feeble one. With regard to the passenger traffic, in order to get to any source of complaint, he had had to go as far back as 1842, and even then the complaint was simply that third-class passengers were ten hours going to Bristol, and were not in enclosed carriages. But it was only twelve years previously that the first working passenger railway had been commenced, and that stage coaches and waggons were still in existence. Was not, then, the condition of third-class passengers, who got to Bristol in ten hours, and at least with a roof over them, better than that of gentlemen who rode outside a stage-coach, without any roof at all, and did not do the journey in ten hours? Two years afterwards Parliament protected the third-class passengers by regulating the speed and the fares at which they should be carried. Then, with regard to goods, the only instance brought forward was the complaint of Liverpool, an important town, no doubt; but still it only appeared to be that some other towns were better used. He presumed that the railways were only acting within their parliamentary power, and charging within the limit. Admitting that this might be a real source of complaint, and remarking that Mr. Galt had not at all shown that the public were better served on the Continent, with regard either to goods or passenger traffic, he wished to point to one or two matters which made it appear to him absolutely disastrous to contemplate railways being in the hands of the State. If this were accomplished, the State would be expected to make a great reduction in passenger fares and in the rates of goods, and to make these fares as uniform as possible. It was also suggested that the railways should do no more than cover their working expenses, and pay a moderate interest on the outlay. Now, if there were no other mode of communication throughout the kingdom it might be practicable, but was the Government to become the possessors also of all the coasting trade and of all the canals? If not, what would be the effect? These trades would be in the hands of private individuals —certainly the coasting trade—who would have to compete with the Government monopoly, under which, of course, they could not survive. Then there was the difficulty as to making new lines. It was said long ago there ought to be trunk lines, and branch lines connected with them. But the system would never answer practically. When the first line was made from Birmingham to Warrington, connections were made from Warrington to Liverpool, on the one side, and to Manchester on the other, but it was many years after that before even the private companies found it to their advantage, under pressure, to make the diagonal lines from Crewe to Manchester, on the one side, and they had since made one to Liverpool on the other. Now, if things were in the hands of the Government, it would be impossible, he feared, to get anything in the way of extra accommodation, and when it was got, it would be very often given for political purposes. All these were matters he had not intended to touch upon when he came into the room. But there was one other point more within his own sphere—viz., influence on mechanical engineering. He believed that to put the railways into the hands of the Government would be one of the greatest misfortunes for the advance of mechanical engineering and the future of railway locomotion which could possibly be. At the head of the department there would probably be an engineer officer, who would have under him some men who really understood the subject, but who had not been very prosperous. Amongst them they would devise a typical locomotive, and that being fixed, it would never be changed. No one would dare to do so, and this in itself would be a great bar to improvement. Then another thing would happen. Occasionally even Government locomotives would explode; there would be a great outcry, and he presumed Government would not pay for those who were killed, as the railway companies now did. The result would be, it would be said, "we must be more saving, we must take off the pressure." Then there would be sometimes collisions, and it would be said, "we must be more careful, we must have lower speed." In this way it would be endeavoured to cure these matters. But this would not be in the interest of the public, for he did consider it was for the interest of the public that a few persons per annum should be killed, rather than that the whole nation should be forced to travel slowly.

Mr. F. C. Cotterill said the subject naturally divided itself into two parts. First, that of general amalgamation; and, secondly, whether it should be undertaken by the Government. With regard to the first point, in 1849 public opinion was most decidedly in favour of competition. At that time he was in communication with some of the leading statesmen of the day, who all agreed that amalgamation was most desirable, but that it would be ridiculous to propose it at that time. Since then the principle of competition had been applied most perniciously by the State; in fact he did not believe history recorded anything so serious as the pernicious consequences which followed from that doctrine. He agreed cordially in the general principle of the great advantage of amalgamation, but he differed from the reader of the paper with respect to the State purchasing the railway property. He believed any such proposal would make all Chancellors of the Exchequer rise in mutiny at the idea of anything so preposterous. But, at the same time, he believed it was the duty of the Government to originate new lines, and to control and supervise the whole system of railways. If there were a Central Board appointed, to carry out, in the first instance, a general amalgamation of all the railways, equitably apportioning the stock amongst the existing owners, and in the next place controlling the management, and originating new undertakings when required, he thought that would meet all the requirements of the case.

Mr. Elliott remarked that he took rather a special view of the matter, and one which he feared would not be altogether in accord with the mode in which these matters were generally discussed. Much had been said about the financial part of the question, but that he thought was of very small importance, for it only amounted to this, that capitalists would advance the money to the Government instead of to boards of directors. No doubt they would get 5 per cent. from the Government, which would very well satisfy them. But the advantage which would accrue to the public was quite another thing. What evidence was there that any advantage would accrue? They had heard a great deal about Belgium, but nobody had yet said that the management of railways there was better than in this country, and those who had had long experience there told him it was not so, and, more than that, the system was used for political purposes. It was said that travelling was cheaper on the Continent, but it was not right to talk about the tariff in Belgium and France unless their whole scale of salaries and expenditure were reduced in the same proportion. The Postmaster-General in Belgium, who was also manager of the railways, received £600 a-year, and other officials in the like proportion, and he apprehended Englishmen would not submit to that sort of thing. Let them keep up their own profits and wages, and keep up the prices of the railways, and not bring anything down to the low level of foreign habits and manners. The subordinates on English railways were paid quite little enough already, and there would soon be an outcry if any attempt was made to reduce them. But if the Government were to take railways into their own hands, why, on every principle of reasoning, ought not the steam-boat traffic, or even the making of bread, to be undertaken by the State? But all these considerations, serious as they were, were but as a feather in the balance, compared with the most important part, namely, Government power and patronage. He saw nothing in what was called the progress of public opinion to lead any thinking man to suppose that there was a higher sense of morality and greater accountability to the principle of utility in all this. He saw the contrary, and he believed that placing such enormous power in the hands of the Government would be another of those fatal steps which were now being taken in the course of national decline. The jobbery, stability, and forgetfulness of the public interest shown in railway management at the present time, bad as it sometimes was, would be nothing compared to the incapacity and dishonesty which would be developed by Government management. They heard about quicker transit, greater safety, and so on, but was the human mind a different thing when the man had a Government uniform on than when he had a railway uniform on? Were those who selected these men more to be trusted when they were Government officials than when they were railway directors? He thought not, nor was there any evidence to the contrary. It was even said some years ago that the Crimean war would have been conducted by a joint-stock company with much less sacrifice of life and money, and he believed there was a great deal of truth in the statement. Would the Peninsular and Oriental Company have sent the *Megæra* to sea in the state she was, or would any trading company have constructed and sent out such a vessel as the *Captain* to the Bay of Biscay? Then, look at the immense power such a matter would put into the hands of the Government. There was an example now going on in Canada, where there was a railway being constructed by the Government, which would not be finished for 16 years, and a gentleman, who had lived there many years, quite free from all political bias, told him that that was a test case, and the power which they had, in consequence of the construction of the railway and their command of the labour market, was most formidable. Again, having at their command an army of some 300,000 men, in addition to the present standing army and navy, would be, in his opinion, most dangerous to the public liberty. On the whole, therefore, he strongly deprecated any such step as was advocated by Mr. Galt.

Mr. E. Lawrence observed that there was another matter, but which had not been touched upon by the last speaker, which was very important to be borne in mind. Only a few days ago, in the leading journal, a strong contrast was drawn between the state of society in France and this country, and it was contended that France owed its present position largely to the fact that the education and talent of the country looked to the Government for place and position, rather than to private enterprise; whereas, in this country, the same parties, so far from looking to Government employment, in many cases despised it. He thought it would be anything but an advantage for the number of Government *employés* to be so largely increased. There was one other point to be borne in mind, namely, that so long as the country went on prosperously, and the railways made a profit, things would go on smoothly; but times would come when the country would not be so prosperous as at present. In those times ministers would have difficulty in raising taxation, and the trade of the country would also fall off, and the railroads, instead of being a source of profit, would show, perhaps, ten millions deficit. In what position would a Chancellor of the Exchequer then be, in having to raise that large amount of taxation to pay the interest owing for the railroads?

Mr. Edwin Chadwick, C.B., having moved the adjournment of the discussion,

The Chairman said he would not be able to be present at the adjourned meeting, and he would, therefore, briefly state his views upon the important question before the meeting, though he came prepared to listen rather than to lay down any propositions of his own. He had not the slightest doubt that if the public really wanted the railways purchased by the State it could be done; the question of price would not present any insuperable obstacle. It would be a very serious question, and, no doubt, as in the case of the telegraphs, it would be very advantageous to the sellers, but not so much so to the purchasers. He did not, however, lay very much stress upon that difficulty, nor would he say how far State management was better or worse than that of individuals or companies. A very curious change had taken place in public opinion with regard to that subject within the last 15 or 16 years. At the time of the Crimean war anybody would have been hooted down who ventured to propose that anything which was in the hands of private individuals or public companies should be taken over by the State. There was at the time a tendency greatly to exaggerate the weakness of State management, and to magnify the advantages of private management. Now the tide had turned, and there was a danger of running to the opposite extreme. What were the difficulties which would really have to be faced before any such gigantic change as that which had been proposed could be made? In the first place, was it wise, without the strongest necessity, to make the State responsible for six or eight hundred millions of debt more than at present? If anybody were to say that the time might come when the railways would be superseded, it would, no doubt, be a bold assertion; but it was very difficult to fix a limit to the inventive powers of mankind; and the present form and manner of railway communication could hardly be adopted as altogether final. There might be great differences of gauge, and possibly a general adoption of locomotive power on common roads. Changes which could not now be foreseen might exceedingly diminish the value of the capital now invested in railways. What would have happened if the State, yielding to arguments of the kind now brought forward, had bought up all the canal property, and had undertaken all the coaching business of the country? There would have been an enormous loss occurred, and not only so, but the State would have been under the strongest possible inducement to check and prevent any alteration in the existing mode of communication. No doubt if a change took place now which to any extent superseded the present railway system, it would be a very serious misfortune to a large class of the community; still it would be a misfortune which would fall only on individuals. Then, as had been said by Mr. Lawrence, it was all very well for the State to go into these speculative enterprises as long as a continuous upward movement could be reckoned on; but if, at any time, he would not say of national decline, but of national difficulties—railway receipts were to fall off, the national receipts would also be falling off; and the responsibilities which the State was now asked to take upon itself in a time of prosperity would tend to diminish its resources just at the moment when that loss would be most seriously felt. But, apart from that question of loss, was it wise to have so large a portion of the public revenue as would be required devoted to paying off interest on debt? National debts all over Europe and the civilised world were growing; every ten years there was an increase of the indebtedness of the great governments of the world. He was apprehensive that in other countries—he did not say it would be so here—this would produce an awkward result. Questions might arise, not very easy to deal with in an abstract and speculative way, about the right of the legislature to tax posterity, and possibly all over Europe schemes of partial repudiation might be discussed, and it would be held out to the people suffering under the pressure of taxation that they might relieve themselves by reducing the interest on the debt. He was not seriously afraid of such a feeling arising here, partly because Englishmen in many things had more sense than their neighbours, and partly because the burden was comparatively little felt; but if questions of that kind were being raised it would not be any advantage, in discussing them, to have to deal, not with a debt, excluding terminable annuities, of about 700 millions, but of 1,200, 1,300, or 1,400 millions. The relations between the State and labour must also be considered. The number of persons employed under the State, supposing the State to take over the railways, would undoubtedly be several hundred thousands, and consequently the State would be by far the largest employer of labour in the country. Now, questions of capital and labour had never been more keenly discussed than during the last few years; but hitherto the State had always kept itself absolutely impartial as between employer and employed. Was it, then, a prudent thing, at a time when these questions are more likely to be raised than before, that the State should abandon that position of neutrality, and itself become a deeply interested party on the side of the employer? Railway servants, constituting an exceedingly powerful body, would probably demand higher pay and shorter hours. If those demands were resisted, the State would be exposed to great unpopularity, while, on the other hand, if they were complied with, a large hole would be made in the profits to be derived from the railways. The really serious part of the question, however, was this—how would it be possible for the State to avoid exercising enormous local patronage which would affect every district and town throughout the country. He did not refer to the minor question of the appointment of railway servants, though there would be a great deal of small patronage in that way, and he did not believe that it would be possible to dispose of it under the theory of competitive examination, in case of employments which required little but mechanical and manual labour. That was a very small part of the question of patronage; what he feared was the position of dependence into which every town would be brought towards the railway board or administrative body with which the decision would rest as to what new lines, stations, or extension of railway communications should be made. Every town in the country might ask at the same moment for extended railway communication, and it was quite clear the request of all could not be complied with at the same time. It would be necessary that a choice should be made, and that choice might be governed by political preferences—at any rate, whether it was so or not you would never get it out of the heads of the people that it was so. This was a control, not over individuals, but over the constituency as a whole, which no extension of the franchise, and no manner of taking the votes would affect in the slightest degree. In France every public work, every road, every bridge, every public building, had been constructed by, or with the assistance of the State, and, whether truly or falsely, it was continually said in the days of Louis Philippe, and had been continually said from that time to this, that those who returned members in favour of the Government got their works executed, and those who did not got nothing. That was corruption wholesale, and he feared it could not be avoided. It would be very difficult to constitute the Railway Board in such a way that it would not be dependent on the minister of the day. An administration controlling a property of 600 or 700 millions, and employing several hundred thousand persons, would make itself felt in every corner of the country; if detached from the executive it would be an *imperium in imperio*, and if attached to it, it would not be easy to detach it from political party. There was an important question touched upon by Mr. Bramwell, as to its being the interest of the State to discourage the making of new lines. Of course, if the same returns could be obtained without giving increased accommodation, it would be to the advantage of the Railway Board not to make these new lines. At present, imperfect as the system might be, there was, to some extent, a remedy for that danger. If a company absolutely refused to provide the accommodation required, some other company would grasp at the chance, and whether it carried its bill or not, at any rate the wants of the district made themselves felt, and a good deal of accommodation was given in that way, which, without fear of competition, would never be given at all. If the whole thing were in the hands of one central management, there would be an end of that, and the public in general, expecting to profit by the railway system, would be directly interested in not giving that accommodation to any particular district, unless it were clearly made out beforehand that the line would give a good return. The same argument applied to all questions of machinery and engineering improvements, as to which there would be a strong tendency to settle down into one type, from which it would be very difficult to induce those who managed the matter to deviate. The question of canals or steam-boats, and of docks, was also a serious one. It would never do to have the railways worked by a Central Board, while the canals, which competed with the railways, were in private hands, and he always assumed that if the State had to buy the railways it must buy the canals also. Then, again, where there was competition between steam-boats and railways, the owner of a steam-boat would complain grievously of being brought into competition with the State; and there would be a strong pressure to take these steamboat companies also. The same rule would apply to docks, for whoever had the control of the railway system had an enormous power of carrying traffic to docks in one place and of diverting of it from docks in another. It would very soon be said that if the whole internal communications of the country were in the hands of the State, it would not do for docks to be left in private or local hands. He would not go into what has been said about the experience of foreign countries, but with regard to passenger traffic he did not think they need envy their foreign neighbours. The general conclusion at which he arrived was, that although the objections he had mentioned might be capable of receiving an answer, up to the present time they had not received an answer, and therefore he thought it—"Better to bear the ills we have than fly to others that we know not of." If the process of amalgamation continued, and the whole railway system got into the hands of six or seven great companies, it would alter the question so far, and necessitate a greater amount of supervision by the State than had hitherto been desirable, because in that case all semblance of competition would cease. At present, however, he did not think such a case had been made out, either against the actual system, clumsy and imperfect as it might be, or in favour of that proposed to be substituted for it, as would justify the nation in embarking upon such an important undertaking as the doubling of the national debt, and placing the whole railway system in the hands of the State. In conclusion, he begged to thank Mr. Galt for the very able and suggestive paper which he had read, and to observe that sound argument was never lost, whether on one side or the other. You sometimes did not know how strong your own case was until you heard the other party's case fairly and strongly put.

The discussion was then adjourned until the following Wednesday evening, the 18th inst., at eight o'clock. On that evening the chair was taken by the Marquis of CLANRICARDE, and the discussion was resumed by—

Mr. Edwin Chadwick, C.B., who spoke as follows:—The noble lord who did us the honour to preside at our last meeting concluded his summing up of the discussion of that day by declaring that, in his opinion, it was "better to bear the ills we have than to fly to others that we know not of." Now, those who have paid special attention to the subject will, I think, agree that, by his lordship, the ills we have were not duly recognised and estimated, whilst the ills that we know not of, by any experience from any change of the kind required, will, on impartial examination, be found to be exaggerated or illusory. I will endeavour to enumerate the chief evils we have. In the first place, the chief trunk lines of communication, which ought, for economy and efficiency, to be under unity of system, are under one hundred and ten independent bodies, administering them separately, entirely for a trading profit instead of mainly for the cost of the service, which is a large organic economic distinction. By this disunity the transit of goods from one end of the kingdom to the other is obstructed, often by varying rates, which are fixed without reference to any common principle, and are only to be known upon inquiries, which cost valuable time. By this disunity, combined with the severance of the trading bodies from the public service, the use of twelve thousand postal establishments, as receiving and delivering houses, for larger parcels than letter parcels, as in Germany and Switzerland, is lost, and a large trade prevented. By this disunity the transit of passengers is obstructed, especially in cross traffic, to their constant annoyance, and frequently to the loss of time to the extent of one-third. By this disunity, attended by differences of signals and practice, additional dangers to life and limb, and insecurity and discomfort in travelling are occasioned. By this disunity, combined with unnecessary competing duplicate and even triplicate lines, often running from the same places at the same times, necessitating additional rolling stock and establishments,—the working expenses are augmented, it is declared, upwards of 20 or to 25 per cent. By this disunity, combined with the condition in which the public means of transit is conducted by private traders, as for a trading profit, the expenses of construction are largely augmented, and also the price of capital, to the extent of the difference between the price of public and private securities. By the conditions of the railways as concerns for trading profit, needed extensions of the branch lines, to an extent nearly of the main lines, are prevented. As a general result, there is an augmented cost of transit of passengers, generally of one-third beyond those which obtain on the governmental lines, under unity of management, and also on goods the excess of cost of transit is of the like proportions, especially of the transit of small bulks. These increased charges to the public, arising from false economical and administrative principles, are attended by reduced dividends to shareholders, who having been generally inveigled to advance their capital on the promises of ten per cent.—promises implied in provisions that they should be restrained to ten per cent.—have been subjected to cruel losses, and would have generally benefited if they had kept their money in their pockets. Added to these evils are those of inferior organisation, affecting injuriously the condition of the rank and file of an army of nearly three hundred thousand persons engaged in the railway service. Now it has here been contended, at least by me, from the first, that the gains derivable from unity would constitute a capital divisible between the public and the shareholders (and it was implied the service also), affording the shareholders some improvement in their dividends, and, above all, that great gain would be derivable in the rateable value of their property arising from the substitution of a public security for the private security of traders, which would cost the public nothing for their dividends and their bond debts. On the working expenses alone, by evidence beyond dispute, the saving from unity would be upwards of six millions. Added to this is an indisputable saving of one and a-half per cent. on all the bond debts. On the last time I propounded this conclusion in this hall, the railway directorates and managers treated the then existing disunity as a final fact, and their own management as the best possible. But what have they been doing since then but making advances towards unity, only for an entire profit for themselves, which we say ought to be divided with the public? All that they have been stating to the shareholders of the advantages of sectional amalgamations is confirmatory at every point of what we have stated of the advantages of a general amalgamation, and serves as an answer to what they have before said. They are now, for their own exclusive profit, for reducing disunity, from a hundred and ten down to four. I have not been in a position to examine the recent proposals for amalgamation, but, from what I have observed of previous amalgamations, they were very badly done, and with inferior results. I have paid very special attention to administrative consolidations, as it was a duty to do, and I conceive that from results obtained I have a right to an opinion upon them. At one time the seventeen thousand separate parochial administrations were asserted to be ultimate conditions, and my proposals for consolidation were treated as wild impracticabilities. An advance was made in consolidation to six hundred unions, which, though very imperfectly done, was attended with an early annual saving of four millions of expenditure; and subsequent experience is demonstrative of the expediency of further advances in the principles originally proposed. Now I venture to assert that the work of complete railway amalgamation is really a far less difficult administrative task than that, and even if it were roughly set about, it may be accomplished in far shorter time. In vindication of this opinion, I must beg to refer to what was said of it in this room by the class of opponents to telegraphic postal reform, who were people with the like interests and like ideas to the opponents of railway reform, the case for which in principle is essentially the same. A statement—prepared by the Hon. Robert Grimston, the chairman of the International Telegraph Company—was sent to the members of Parliament, in which it was asserted, in respect to the trading telegraph system:—"It is worthy of observation that ours is the only European country in which the telegraphs are not a monopoly in the hands of the government; and it is also worthy of observation that, under a system of free competition, we have made more progress and have arrived at a higher standard of excellence in telegraphy than any country in the world." The half-franc messages of Belgium and Switzerland, and the equivalent of sixpenny messages in Germany, were set aside as of no account as against asserted inferiority in mechanical execution; just as now on the railway question the half and one-third less Continental rates are held to be of no account, as against the higher speeds obtained on some lines in England, the fact being that people on the Continent dislike those high speeds. To avoid the inconvenience of rebutting such objections, by comparisons of foreign systems, which occupy time, I will call attention to our own case as respects disunity. Addressing the directors, I say:—"Do you mean to assert that the saving of six millions for working expenses, and the other savings alleged to be derivable from unity. are of no account? And if you do, why do you now make so much account of the lesser saving from amalgamation, that is to say, from sectional unity; and why do you incur such heavy expense in conflicts for it, and how is it that your shares rise, at a remote prospect of it?" The telegraph companies' case asserted that, "in opposition to all precedent on the subject, it is now for the first time set up by Mr. Ward Hunt, as the exponent of the principle of monopoly (under the guidance of Mr. Edwin Chadwick), that a telegraphic monopoly would be advantageous to the the public. He (Mr. Hunt) believed that if they had a monopoly of the telegraph they would easily lower the tariff, and at the same time make the undertaking yield a profit." The answer to these dogmatic declarations in behalf of such competition is, that under the principle of unity the price, including the reduction of porterage, has been reduced nearly one half, and the messages, now progressively increasing, have been increased from 236,326,000, the number at the period at which the telegraphs were first taken over, to 300,843,000 for the corresponding period of the last year. "For its own part, nad for the other companies, the Electric and International Telegraph Companies deny that many important districts are without any such means of communication. They challenge the Government to prove that issue." The issue is proved by the event, that, as against the 2,932 stations belonging to the competing companies, who, like the present railways, were not in a position to make any considerable further number of extensions, as they could not make them with a trading profit,—the total number of stations now open is 5,790, and in every part of the country more are being called for. The dogmatism with which we are now met by the persons engaged in the interests of the railway companies, is the same as that with which we were met by the telegraph companies. "Messrs. Scudamore and Chadwick based their whole argument before the Society of Arts upon the facilities which the post-offices would afford for the working of the electric telegraphs in small towns and country districts. Their notion was that the village postmaster or postmistress would act as the telegraphist; that the village postman, or, as Mr. Edwin Chadwick suggested, the national or the British school children, could act as the distributors, and that there would be an ample return for the first course of construction and the annual cost of maintenance in the telegraphic correspondence of the country." "In the first place, the persons employed, as a rule, are quite unfit to be employed as telegraphists. Telegraph clerks require regular training before they can become efficient manipulators, and it is found that they must commence young, and that to keep a machine in working order requires on the part of the telegraphist some knowledge of electricity and mechanism, such as village postmasters and postmistresses cannot be expected to acquire; it follows, that in every respect they would be very unsuitable persons for the proposed duties to be devolved upon them." The answer is, that we do see village school boys neatly dressed, acting as good messengers, and that 2,600 postmasters and postmistresses are employed in telegraph work, and as only one complaint is received for every 1,379 messengers, the presumption is that they do the work in a satisfactory manner. I have appended answers obtained from the Post-office on other points, and especially on the point insisted upon by Mr. Bramwell, that government, as against the existing trading management, must check the progress of improvements in the arts. However, it is right to state that the telegrph companies did me far too much honour in ascribing to me the initiation of that measure. The fact is, it had been initiated in the department years before it was taken up here, and at a time when the companies' interests, for which the public have had to pay seven millions, might have been bought for two. The cost of the long official inattention to the subject, the direct cost of false economical doctrines, such as have been advanced on this railway question, was at the least half a million a year from the time the subject was taken up here. The present cost to the public of that delay is shilling messages instead of sixpenny messages, which would bring the telegraph within the reach of small traders and the working classes; and of more than a quarter of a million of surplus revenue. The present cost of the like inattention is, as respects the ocean telegraphs, upwards of half a million a year to the public, and to the mercantile community charges extensively prohibitory, as we have shown, four shillings a word, instead of one shilling a word messages. The cost of the delay from interested and false economical and administrative doctrine in respect to the railways is indisputably some ten millions a-year of excessive expenditure, derivable from unity, by the shareholders and the service; and to every traveller an excess of fare of a third, at the least, of the fare he pays for every journey, and also an excess of risks of life and limb, from proved mismanagement in the great majority of cases. To every manufacturer or merchant the cost of delay is an excess of rates of at least one-third on all the goods he sends. If I am asked on what ground I assert that these reduced railway fares would be equally productive, I answer on the same grounds on which we asserted that, if fair play were given to them, the third-class passenger rates of a penny a mile would be the most productive, which the railway directors declared would be their ruin, but are now proving to be their best fortune; and on the same grounds that the reduced telegraph rates, which the directors declared would produce a loss, are now producing an increased profit. The fact is that there is a great amount of interest-begotten prejudice and opinion, that has been allowed to pass current as impartial public opinion on this question. I remember an early student's instruction from Locke on the conduct of the understanding, that might be well remembered on this subject. He said, "When you come to examine any question with a view to any conclusion, the first thing you ought to do is to consider the state of your interest on the question, and take it into account." I remember when I went to give evidence before the Railway Commission, I could not but say to myself, Who is that commissioner who interrupts my exposition with a determined cross-examination on an irrelevant issue? Why, he is the chairman of a railway company. Who is he who manifests a supreme contempt for the economical doctrine of competition for the field as against competition within the field, and the inapplicability of competition to the case in question? Why, he is the chairman of a company for an enterprise which, in a field fully occupied by one capital, and not receiving a high dividend, desires a second to divide it and be bought up. Who is that commissioner who displays such apathy and listlessness to the doctrines interfering with private enterprise? Why, he is the head of a great banking house having immense railway accounts which would be swept away by a public system. And so with noble lords whose rent-rolls have been largely increased by the private enterprise, very much at the expense of the shareholders. Delicacy of feeling should have prevented them occupying such positions. Wishing to put the best construction on such an arrangement, it may be surmised that the commission may have been so packed in order to see how much concession might be got from representative men of the hundred and twenty-four railway directors in the House of Commons, and the fifty-eight railway directors in the House of Lords—a formidable body of one hundred and seventy-two members, for a prime minister to think of dealing with, unsupported by public opinion for disestablishment. The electric telegraph directors were particularly shocked, as the railway directors are, at additional patronage getting into the hands of the Government! "Why, it would equal the patronage of the Inland Revenue, or of any other department except that of the Customs itself!" It were better, in their views, for the public to bear the ills they had (of dear and restricted communication) than to fly to others of which the directors knew, though the public knew not. So the railway directorates in Parliament are clearly of opinion that the patronage of the force of three hundred thousand men is best in their keeping. The men themselves, however, are, I venture to say, from inquiries I have made of them on occasions, in different parts of the country, will be glad to change masters, and as shown by open manifestations at Derby and elsewhere, will now cast their ballots in the direction of the interests of the public as well as themselves, for a change of system. On this point, as to the patronage, I would particularly appeal to Lord Derby, who has set a most distinguished example in the promotion of open competition for first appointments for the public service; which, despite of all the opposition of patronage hunters, is acting very well. Does he not think the principle may be applied, in this case, by improved methods, to obviate the dangers he apprehends? Again, he presided at a meeting, at the United Service Institution, to promote civil appointments to deserving soldiers, an object in which I concurred. Would not the railways afford useful aid in that direction? Beyond that, would not a drill, given to a large proportion of the men, as an occasional relief, and as a holiday,—and, indeed, would not a good drill, as a qualification for first appointments to the ranks, serve as a valuable addition to our defensive force, and as a means of important military economy? Good military authorities are decidedly of opinion that it would. But the railway protectionists assume that the change of system can only be made according to their own notions. "Government" means, with them, the distracted attention of a changing political chief, commonly destitute of special aptitudes, and leaving office before he can acquire them, after presiding over a sham board like the Board of Trade. They assume their own price, and that the whole money is to raised by loan, and that all the *personnel* is to be changed, and that the modes of appointment are to remain much the same. But is contract management to have no place? Is not the working of the contract system, which, besides postal packet service, yet includes three-sevenths of the postal conveyance by land, notoriously better than the railway contract system? At last a principle of contract service has been introduced into the postal service, under which a district postmaster agrees to do the work of a district for a given sum, he providing such subordinate service as he thinks fit, and being responsible. Sir Rowland Hill, as well as his brother, Mr. Frederic Hill, has fully considered the objections to the important points of State management as to the employment of labour, and has disposed of them. If that principle had been applied when it was proposed, probably a quarter of a million of saving would have accrued to the public in that department alone. And why should not that principle, the principle of contract service, and payment by results, be extensively applied under unity, in railway administration? Lord Derby apprehends that there may be public inconvenience in making additions to the national debt. Why the railway reforms proposed are eminently calculated to yield profit, to augment prosperity, and strength to bear that burden, and eventually to reduce it. Some ten millions of annual relief from working expenses and high interest, and fifteen millions of reduced transit rates would constitute an amount of saving greater than the charge of the debt itself. Mr. Hammond Chubb, the secretary to the Bank of England, has dissipated the thick fogs raised by the railway financiers, whose financing shareholders have such good ground to deplore and distrust. He has shown that not loss, but gain, is derivable from the transfer of the income of the disunited companies to the State. He says that "up to the end of the last year the purchase of telegraphs had cost £6,678,000. The interest on this sum at 3½ per cent. amounted to £217,000 per annum. But the income of the telegraph companies, which they divided in profits, was over £350,000. Therefore, for £217,000 a year the government had purchased an income of £350,000." Just so; and, be it borne in mind, we have urged the acquisition of more profit to the public by the purchase of the ocean lines, and the completion of the system. Mr. Chubb observes, "that the principle on which to calculate the purchase of the railways was not what was the gross sum necessary to buy them, but would it involve a greater sum in the shape of interest to the State than the companies were now distributing as dividends?" May we not contemplate a proportionate surplus to the revenue, a million or so, from a properly-conducted transaction on the same principle, and is that, together with all the other demonstrated gains, to be foregone from year to year for an imagined contingent—financial contingent—inconvenience, which the gains are powerfully calculated to prevent. His Lordship has a forecast, beyond what men of science have, that we may sometime hence get cheaper means of transit than by railways. Are we for this promised cheapness to another generation to sustain all the present dearness of disunity to the present generation, for the sake of nursing a future loss to shareholders; and will not unity and immediate cheapness be the best to meet any change? His Lordship forbodes future manufacturing distresses and disturbances of the labour markets, and discontents. Why, the measures proposed for freeing and cheapening intercommunication, and thence promoting arts, manufactures, and commerce, are just the measures calculated to avert them, and when they arise to relieve them. One great means of relieving congested labour markets and of steadying them is cheapness of transit. He cannot have been informed of the grievous obstructions, created by high railway charges, to the relief of the working classes during the cotton famine by the removal of themselves and their families to places of demand. On the whole, the chief evils pictured, as the evils "we know not of," when examined, will turn out to be mere illusions; and when they are to any extent possibilities they will be best met by conditions of augmented strength, by greater cheapness and freedom of transit, and better internal as well as of external communication. I am glad that Dr. Farr, after a study of the subject, concurs with us that the question of free railways is of infinitely greater importance than the old question of freedom of trade in its narrow sense. That related to the burden of a million or two of import duties on corn. This system is of many millions of railway directorates, export as well as of import duties, on all commodities on persons as well as of things. It would be for the shareholders as well as the manufacturers to consider whether a railway reform league is not more needed than the old corn law reform league, to inform and advance public opinion against sinister interests, misrepresentation, and opposition.

Mr. Botly remarked that a discussion on the same subject had taken place in 1865. In reference to that debate, he wished to call public attention to two letters which had appeared in the *Journal* of the Society on the 7th of February, 1866, and the 18th of May in the same year, written by Mr. Sydney Smith. The reading of those letters and other circulars which had come to his attention, as well as the powerful arguments of Mr. Chadwick on the present occasion, had thoroughly altered his opinion on the matter, and he was now quite convinced that it would be a judicious thing for the railways to be acquired by the State. It must be remembered also that the purchase and control of railways were two different things, and, though the last few paragraphs in Mr. Galt's paper appeared to be lost sight of, they were really very important. He referred to the suggestion that it was quite open to the public authorities to make any railways for themselves, if the present proprietors of railway stock did not come to reasonable terms; and he believed that two or three trunk lines laid out in this way would be of great service to the country, and, in fact, to all parties.

Colonel Strange, F.R.S., said he was encouraged to say a few words on this subject from having taken part in somewhat similar proceedings, leading to the enunciation of what he would venture to term the same fallacies as beset the discussion of the present question, namely, the aid of Government in the advancement of physical science. This matter was one which nobody expected would be settled soon; it would have to be discussed, and a great deal of nonsense talked before the true bearings of the question were discovered. To get a clear view of the subject it was necessary to sweep away some preliminary obstacles, one being that it was inexpedient that the Government should interfere with private enterprise. Whenever the sentiment was expressed by one who felt it in his own breast—which he (Colonel Strange) did not—it was always well received. It had lately been uttered by Mr. Gladstone and Mr. Lowe, in the presence of those best able to see the hollowness of the sentiment, men of science, and yet it was well received. There seemed to be something very attractive about it, though he could not see what it was. Those who used the expression seemed to forget what they were arguing against—they were simply arguing against civilisation. That word, like all others, was open to a great many definitions, but the one he proposed to give was this:—Civilisation was that which interfered with individual enterprise and individual liberty—for there could be no civilisation unless individual liberty and enterprise were interfered with. He said that boldly. The principle of barbarism was to let every man do as he pleased—to scalp his enemy, and to eat him—but civilisation stepped in and said, "You shall not scalp your enemy and eat him; your enemy shall be killed, but you must not kill him. We will kill him for you, and you shall be deprived of part of your property to pay for the trouble we take in the matter." Let them ask themselves where would they be if Government did not interfere with private enterprise in such matters as the post-office, the police, the army and navy, and so on. Was civilisation to stop at a certain point, or had anybody yet indicated the point at which it was to stop? No; it must progress, and he felt certain there would yet be a further augmentation of central authority, and a further diminution of the freedom of individuals in certain matters. Then it became a question what those matters should be. This preliminary objection, that they were not to do this that or the other thing, because it was an interference with private enterprise, thus appeared quite untenable. Another prejudice, as he would venture to call it, was that if the State took possession of the railways it would be equal to a doubling of the National Debt. He contended it would not be a debt at all, but simply an investment, the details of which could be arranged and settled very easily. The railways were held by the moneyed classes of England, and if they were transferred to the State the capital would still be held by the same persons; in fact the transaction would simply amount to this, that a certain set of gentlemen were going to sell themselves their own property, and it would be very strange if they made a loss by it. The third fallacy was that Government management was not as good as private management. He did not think the meeting would endorse that sentiment; no one supposed they would have abler men than at present to conduct the railways, but they would have intellect concentrated and applied to a system of unity instead of being scattered and diffused thoughout the country—the agency would be more concentrated. Another fallacy was that if the railways were in the hands of the Government there would not be the same tendency to improvement as at present. Having had something to do with railway matters and contracts, and having been a little behind the scenes, he did not think there was any such intense desire for improvement as they had been told existed. He had spoken to one of the most eminent engineers on the subject, who agreed with him, to this extent at any rate, that there was no tendency to improve in the direction of economy of construction. It certainly was not the tendency for engineers to cut down the first cost of their works. They repudiated the idea of fixed salaries, their idea being a commission on the cost, and consequently it was not to their interest to introduce such contrivances as should make railways, canals, and docks cheaper. The larger and more expensive the undertaking the more commission they received. He did not say this with the slightest idea of any imputation upon their integrity; but there could be no doubt they were powerfully interested in making the cost of engineering works as large as they conscientiously could? That kind of thing would not exist to the same extent if matters were in the hands of the government, because the engineer would receive a fixed salary. Mr. Galt was charged with having stated that the case required to be made an overwhelming one before the purchase could be adopted, and that he had not done so. He agreed that Mr. Galt had said so, but he did not attempt to make out that case. He only put before the meeting various considerations why the State should purchase the railways, and there left it. He thought, however, that Mr. Galt was mistaken in saying that the Government must not go to the companies to purchase the railways, but that the railways must come to the Government. He thought the time would come when the public, having got excited about this question, some politician would see his way to making a political cry of "buy the railways," and that it would be done in that way, and not by any other means. That was how most great measures had been manipulated of late years, and that would probably be the case with this. Public opinion itself would not suffice until some man saw his way to use it, so as to increase his own position, and to satisfy his own ambition.

Mr. Frederick Hill said the speech of Lord Derby at the previous meeting caused much matter for comment, but the noble lord himself had stated that perhaps his objections were capable of being answered, and he believed two of them at least were completely answered in the *Times* of the following morning. Mr. Chadwick had also replied to some of the objections raised very ably, and so had Col. Strange, and he now wished to lay before the meeting a few considerations of a somewhat different character to those which had as yet occupied their attention. No doubt Government interference, as it was termed, was a great bugbear to many people, and it might seem rather difficult to know where to draw the line. Everybody admitted that Government only could act in some matters, such as protection to life and property and so on, and on the other hand it could not be disputed that there were many things which it would be very unwise for Government to interfere with. He believed the true line of demarcation was this, that Government might advantageously undertake the management of anything which upon sufficient trial should prove in its hands more productive than it would if left to private enterprise. If Government required a monopoly, he, although a Government servant, should say unhesitatingly, "Do not give it;" but if with a fair field and no favour Government could beat private enterprise, in such a case they were justified in taking the matter up. This rule was well exemplified in the case of the telegraphs, and, though a monopoly was there secured to the State, he contended that it was not at all necessary—nor did he believe it was even in the case of the Post-office—and as the Bill was originally proposed no monopoly was suggested. There was no necessity in the case of the railways for going headlong into the matter; let it have a fair trial on a moderate scale, and if the country were found to be benefited, and no injury done to railway proprietors, it could easily be extended. On the other hand, if the management by the Government was less successful, let it be given up. It was now nearly twenty years since he had first taken up this question. He attempted to show, as was now very generally admitted, after millions of money had been wasted, that in railways, as in anything else where the number of competitors was necessarily small, competition was merely a delusion. Sooner or later in such cases—and general sooner rather than later—there would be a union of interests, and even the semblance of competition would vanish. He had also asserted from the beginning that railway amalgamation would be beneficial to the public interests, and ought not to be discouraged, and he contended that the experience of the lines in the north-eastern part of the country fully bore out this argument, having been beneficial both to the shareholders and to the public. Now, every partial amalgamation was a step to complete amalgamation, and the latter would only be completed by the State possessing the railways. It had been very generally assumed that State possession meant State management, but this was by no means the case, and it was an error to suppose that either he or his brother Sir Rowland had ever advocated the latter. His own claim to speak with authority on this question was small, but considering the clear manner in which his brother had put forward his views upon the matter, and considering his position as the originator and successful administrator of one of the greatest financial experiments of the age—the penny post—he really thought the facts and arguments he had adduced with regard to the railways deserved more consideration than they had received. What he proposed was this, not that Government should undertake the management, but that following the principle glanced at by Mr. Chadwick, of contract management, the railways which had become the property of the State should be divided into convenient groups and put up to public competition, in the following form. Government having undertaken to pay a certain fixed sum, per annum, to the former proprietors, the basis of the contract must be that that sum should be paid by the contractor, the Government thus simply having the duty of receiving the money with one hand and paying it with the other; and the competition would be simply who, on that basis, would undertake to work the railways at the lowest tariff, and generally on the most advantageous terms for the public, of course giving proper security for keeping up the plant in good order, providing against accidents, and so on. In this way, for the first time in the history of railways, would competition really be brought into play, and that in its most healthy form. It would be open to the whole world, and those who had an aptitude for administration and powers of organisation would, by and bye, make it their profession, and either at the head of companies, or otherwise, would undertake these concerns and work them in a way which no body of amateurs could ever hope to imitate. If this plan were adopted, all the fears which had been expressed about political influence, financial jobbing, patronage, &c., would fall to the ground; and there would also be this great advantage, that Government would not be exposed to constant applications and pressure of all kinds to lower the rates beyond the point at which they ought to stand in order to make the railway self-supporting. The contractors would stand between the Government and the public, and nobody would think of asking a contractor any more than a baker to sell his goods at half-price. All the official staff required would be a small body of thoroughly competent men to see that the covenants of the lease were properly fulfilled. As to the price to be paid for the railways, a great deal of misconception seemed to prevail. Mr. Martin, in his paper read at the Statistical Society, estimated the present market value of the railways at about 600 millions; but then he added some immense sum for what was called prospective advantages, which he contended was a mere illusion. All future contingencies, whether advantageous or the reverse, were included in the calculations made by clever men on the Stock Exchange who settled the market price of the day. No one who wanted to turn railway shares into cash would think of instructing his broker to add 50 or 100 per cent. to the market price for "prospective advantages," or if he did he would never get rid of them. He, like many others, held railway stock; for instance, he had some shares in the Caledonian Railway which were now quoted at 96½. If anybody would add ten per cent. to that he should be very glad to part with the whole of his shares, and he apprehended any other holder would also. Proceeding in that way, the 600 millions sterling would not be raised to 1,200 millions, as it had been by Mr. Allport, but to only 660 millions. There was no necessity at all for the Government to deal with this business wholesale. His brother and he had suggested that they should begin with the Irish railways, which were a compact body separate from the rest, of a moderate value, and which were suffering much more than English lines from divided management. Or any particular group of either English or Scotch lines might be taken in the same way. About 30 millions would buy the Irish railways, and even if the experiment failed, and they had to be sold again, the loss, in such a case, could not be put at more than a fourth, or say £8,000,000, which was not a very alarming sum to such a nation as England. If the matter were looked at calmly in that way, seeing with how much safety the experiment could be tried, he did not think there would be so many objections. With regard to the economy of working by contract, he might mention that that was first applied to the steamboat conveyance of mails between Bombay and Aden, on behalf of the then Indian Government; the result was that whereas the conveyance had cost the East Indian Company £120,000 a year, the Peninsular and Oriental Steam Ship Company sent in a tender, which was accepted and carried out with perfect satisfaction, to perform the same service for £20,000! That was an extreme case, no doubt, but it showed unmistakeably the tendency of competition. Mr. Chadwick was not quite correct in what he had stated in reference to the contract system lately introduced in the Post-office, though he thought it might with advantage be as that gentleman had represented. What was done, in addition to the large application of the contract system to the conveyance of mails by omnibuses, mounted messengers, &c., was to take a certain class of work in one department—that of money orders—which it was found cost a certain sum of money, and invite the clerks to say what they would do it for, finding their own assistants. The practical result had been that whereas the meritorious clerks who became the successful competitors had their income nearly doubled, the expenses of the department had been considerably reduced, the work being at the same time at least as well performed as before. Some persons preferred Government management for the railways altogether, and if that view were pressed he should say take two groups of railways and give each system a trial, and although a Government servant himself, he had not the slightest expectation that the Government management would equal that of the contractor either in economy or efficiency. In conclusion he would only say that both himself and brother were strongly of opinion that under a contract system, such as he had sketched out, not only would better returns be given to the shareholders, but a lower tariff and greater security obtained by the public.

Mr. Edwin Chadwick, in explanation, said he so far appreciated Sir Rowland Hill's views on this matter that he made a distinct effort to get them brought forward at the Statistical Society. The error into which he had fallen with regard to the contract system in the Post-office arose from having read the last report rather hurriedly.

Mr. Bass, M.P., said he was largely concerned with railway traffic, having during the last eleven months paid £14,000 for railway carriage. From various reports of committees he learnt that the charges for conveying goods in Belgium and other countries were considerably less than in England, and considered it would be much to his advantage if the State were to purchase the railways, and only make such charges as would return a reasonable profit. It had been proved, before committee, that the cost for conveying goods in Belgium was from 80 to 90 per cent. lower than in this country, and he was persuaded that if the State were to take possession of the railways in any manner consistent with equity, they would be in a condition still further to reduce those charges; and, considering how large a proportion of the cost of production was caused by the rates for carriage, it was easy to see that the general trade and prosperity of the country would be greatly enhanced by any condition of things which would insure a large reduction of railway charges. Lord Derby seemed to think that they incurred the danger of some invention being brought out which would dispense with railways, such as conveying the goods in the air; but that was a probability which they ought not to take into consideration. But supposing that, some thirty or forty years hence, the railways would not be so valuable as now, in consequence of some new invention, if the railways remained in the hands of the present proprietors they would suffer the loss, and it did not make much difference whether they lost the money or the State. It was very dogmatically stated that the possession of the railways by the State was impossible in consequence of the proposed change of government, because they would become the largest employers of labour in the country. He disputed that altogether. There was no necessity for the Government or ministry to take the management—an independent department might be constituted for the purpose; and, as to the working classes being affected, he considered they would be more benefited that anybody. Besides, the conduct of railway employés would compare favourably with that of any other body of men, and he did not at all fear their acting unreasonably if employed by the State. It had been stated by Mr. Bidder, before a committee in 1865 or 1866, that third-class passengers might be conveyed at a farthing a mile, and other authorities confirmed that view, and that a very material reduction might be made with great advantage. The number of third-class passengers were, compared with first and second-class, as five to two, and the revenue derived from third-class passengers was not very far short from that obtained from both the first and second put together; and, with regard to the cost of conducting the passengers, five third-class passengers could be conveyed for the same price as one first-class; therefore his conviction was that a public department might safely reduce the cost of third-class passengers one-half. By so doing they would make a larger profit than at present, because it would be impossible to calculate the enormous increase there would be in the number of travellers which that reduction would produce.

Mr. Hale expressed his opinion strongly in favour of the State purchasing the railways, the importance of the measure being shown by the fact that the capital invested in these enterprises had doubled itself within a very recent period. He attributed a great deal of the success of railways under private management, and the comparative immunity from accident, to the control of Government through the Board of Trade, and considered that all the arguments which had been adduced against the measure might be easily met; indeed, he did not believe those who put them forward now would hold to them themselves ten years hence.

Colonel Gore then moved the further adjournment of the discussion to Thursday evening, the 26th inst., at eight o'clock, which was agreed to unanimously.

Postal Telegraph Progress as Compared with Trading Companies' Progress.

Extract from Mr. Chadwick's Letter of Questions on the Trading Telegraph Companies' Allegations.	Answer.
"For its own part, and for the other companies, the Electric and International Company deny that 'many important districts are without any such means of communication.' They challenge the Government to prove that issue!" What was the total number of stations taken over? What the total number now?	The total number of stations worked by the old companies immediately prior to the transfer in January, 1870, was 2,932. The total number of stations opened since that date is 2,858, making a total of 5,790 now open.
"The Government Bill declares 'that the means of communication by electric telegraph are insufficient.' In what way are they insufficient? There is no country in the world which can compare with Great Britain in this respect There is no country in the world which can compare with Great Britain in respect of the speed with which telegraph messages are conveyed."	The means were insufficient, inasmuch as they did not carry telegraphic communication into the 2,858 places referred to above. It may also be remarked that whereas the average number of offices to population in Europe is 1 to 16,118, the average number in the United Kingdom is 1 to 5,495. I am not aware of any country in the world in which telegrams are conveyed at a greater speed than in this country, owing principally to the use of the Wheatstone instrument on the more important circuits. Messages are daily conveyed between London and the principal towns at the average speed of 80 messages an hour on one wire.
What was the total number of messages then (or in the first month say of the change), and what is the total number now?	The total number of messages forwarded during the first three months after the transfer was 2,326,639 The total number of messages forwarded during the corresponding period in this year was 3,843,511, being an increase of 1,516,872.
To what extent does the condition of Great Britain now compare with its condition then as respects sufficiency and speed?	The other answers generally reply to this question.
What is the comparative speed? Is it not in the reduction of porterage by the multiplication of stations?	By bringing the telegraphs nearer to the population, the time occupied in the transmission of a message is not only greatly reduced, but a large saving is also effected in the charge for porterage; and in the majority of cases no charge whatever is made, as messages are delivered free within one mile of the terminal station.
Messrs. Chadwick and Scudamore based their whole argument before the Society of Arts upon the facilities which the Post-office would afford to the working of telegraphs in small towns, villages, and country districts. Their notion was that the village post-master or post-mistress would act as telegraphists. "In the first place, the persons employed at country post-offices are, as a rule, quite unfit to be employed as telegraphists." How is it now, "as a rule;" what proportions are so employed?	About 2,800 post-masters and post-mistresses are employed on telegraph work, and judging from the fact, that only one complaint is received concerning every 1,379 forwarded telegrams, it would appear that the work is done in a satisfactory manner.
"It is worthy of consideration that ours is the only country in which the telegraphs are not a monopoly in the hands of the government, and it is also worthy of observation that, under a system of free competition, we have made more progress and arrived at a higher standard of excellence in telegraphy than in any country in the world" What improvements have been adopted, or are in process of adoption, since the system has been in the hands of the government, beyond the system in the hands of the companies?	(*a*) We have brought the proportion of telegraph offices to the population from 1 to 10,852, to 1 to 5,495. (*b*) We have given a free delivery of not less than one mile, whereas formerly it was only half-a-mile. (*c*) We have reduced the rate to 1s for 20 words for the whole of the United Kingdom, whereas formerly the rates were in some cases as high as 4s. for 20 words. (*d*) As stated in answer No. 1, we have carried the telegraph, in less than three years and a half, to 2,858 places which were formerly unprovided with it. (*e*) Where two or three competing offices were situated within a few yards of each other, sometimes next door, in the busiest portions of a city, we have separated them and distributed them to other parts of the town. (*f*) For press messages we have reduced the rate to 1s. for 75 or 100 words, as the case may be, according to whether the message be sent by night or by day. To show how much the press have availed themselves of this facility, we may mention that as many as 18 000 words have been supplied by telegraph in one night to a single newspaper. (*g*) We have also given to the public, on advantageous terms, the exclusive use of private wires, and the revenue from this source alone is upwards of £38 000 per annum. While the Post Office has effected considerable improvements in nearly every description of apparatus in use by the old telegraph companies, it has largely extended the use of the more modern and rapid forms of apparatus, and is even now engaged in testing the practicability of still further improvements. The Wheatstone automatic system, which had been little more than introduced experimentally by the Electric Telegraph Company at the date of the transfer, has become a primary system under the Post Office, and its use is being almost daily extended At the central station, forty sets of this description of apparatus have taken the place of the four sets in use by the company, while a large number of provincial offices have had its use extended to them. A new application of the system has also been introduced in the transmission of news for the Press throughout the country; and the preparation, or "punching" process, as it is technically called, has been so far improved that three slips can be produced without any increase of the labour formerly necessary to produce one. This enables us to transmit items of news for

	publication over three wires simultaneously, instead of having to "punch" it three different times. The "Bell" instrument of the late Magnetic Telegraph Company has been practically superseded by the "Morse Sounder," a much simpler and more generally applicable form of apparatus, besides being much cheaper. In a large number of cases, too, the comparatively slow and uncertain single needle instrument has been replaced either by the Sounder, or the Morse printer; while the use of the type-printing instrument of Professor Hughes has been very considerably extended. The most recent improvement, however, is the introduction of the "duplex" system, by which two messages can be sent over the same wire in opposite directions at the same time. Some ten or twelve years ago this system was tried in this country, but, owing to the then imperfect condition of the lines, the experiment was attended with little or no success. Now, however, its success has been placed beyond doubt, and there are at the present moment no fewer than eleven cases at the central station alone in which the productive capacity of a wire has been doubled by this means. To these improvements in apparatus must be added the improvements in the construction and insulation of the lines, and the provision, to a large extent, of alternative routes where only one wire hitherto existed. The Post Office has also established a special staff, and a travelling or "field" telegraph office, by means of which telegraphic communication can be established at the most remote points at the shortest notice. Carrying its own cable and "paying out" apparatus, it can be attached to the main lines of telegraph at almost any point; and among the occasions on which it is proposed to be brought into use, is the review in honour of the Shah, in Windsor-park, next week.
"In matters of telegraphy experienced and practical officers are required, and the pressure usually put upon Government members to obtain places for their supporters, without any regard to their capabilities, would scarcely be likely to operate advantageously to the telegraph companies." Are the new appointments not made under competitive examinations? What number of the old officers were retained?	Candidates are required to pass a qualifying, but not at present a competitive examination, before the Civil Service Commissioners. The majority of the old telegraph companies' officers were retained in the service of the Department; in all nearly 4,000 were retained. At the present moment the Deprrtment employs, in round numbers, about 8,500 clerks and messengers upon telegraph work.
"If the Government under this Bill obtain powers to acquire, work and maintain electric telegraphs, it must be understood that they must eventually become manufacturers and contractors." How is this matter of contracts? Do the contractors say that they get more or less now than formerly.	The Department has not become its own manufacturer or contractor, and although the contractors have not been asked the question, there can be no doubt that the enormous increase in the number of poles, wires, and telegraph instruments, now used in telegraph business, has furnished them with much more work in this respect than they would have had under the old companies The total number of instruments at the time of the transfer was 1869; at the end of the last year the number was 7,542.

ANNUAL INTERNATIONAL EXHIBITIONS.

A meeting was held on Saturday, at the Royal Albert Hall, of the Committee appointed to arrange the State reception of the Shah at the Royal Albert Hall and International Exhibition, on Monday evening, the 23rd of June. There were present:—His Royal Highness the Prince of Wales, His Royal Highness the Duke of Edinburgh, Viscount Sydney, the Earl of Carnarvon, Major-General Sir T. Biddulph, Colonel Henderson, Mr. Cole, and Major Donnelly. The programme of the State reception was arranged. His Royal Highness the Prince of Wales, accompanied by his Royal Highness the Duke of Edinburgh, will receive his Majesty at the north-west entrance to the Exhibition at ten o'clock. After inspecting the Machinery Gallery, the procession will pass through the English Picture Gallery and the upper west quadrant, entering the Royal Albert Hall by the conservatory entrance. Refreshments will be served in the Queen's Room, her Royal Highness the Princess of Wales, and her Imperial Highness the Cesarevna, after hearing the first part of the concert in her Majesty's box, will join the Shah in the Queen's Room. Their Royal and Imperial Highnesses will accompany the Shah to the dais in the amphitheatre of the hall, when the second part of the concert will commence with the Persian National Anthem, and an ode composed for the occasion by Mr. J. Barnby.

The following is the programme of the State reception of the Shah and the grand Concert at the Albert Hall, on Monday evening, the 23rd inst.:—

"1. His Royal Highness the Prince of Wales, accompanied by his Royal Highness the Duke of Edinburgh, will receive His Majesty the Shah of Persia at the north-west entrance of the Exhibition at 10 o'clock.

"2. Their Royal Highnesses, with the Royal Commissioners for the Exhibition of 1851, will conduct His Majesty through the Machinery Gallery and the English Picture Gallery of the Exhibition. The procession will then pass by the Upper West Quadrant to the Conservatory entrance to the Royal Albert Hall.

"3. The Council of the Royal Albert Hall will here meet the procession, which will proceed by the west box corridor to the Queen's room, where refreshments will be served, and then by the Royal staircase to the daïs in the Amphitheatre.

"4. The concert in the Royal Albert Hall will consist of two parts, the first part will commence at 9.30, the second part will commence with the Persian National Anthem, when the procession reaches the daïs.

"5. Her Royal Highness the Princess of Wales and her Imperial Highness the Cesarevna will arive at the Royal Albert Hall at 9.30, and be received by the Council of the Royal Albert Hall. Her Royal Highness will occupy Her Majesty's box, and at the termination of the first part of the concert join the Shah in the Queen's room. Their Royal and Imperial Highnesses will accompany the Shah to the daïs.

"6. A guard of honour will be stationed at the north-west entrance to the Exhibition to receive the Shah, and also at the Royal entrance to the Royal Albert Hall on the departure of the Shah.

"7. State Trumpeters will announce the arrival of the Shah at the entrance to the Exhibition and at the Conservatory entrance to the Royal Albert Hall. A flourish of trumpets will also be given on the arrival of the procession on the daïs.

"8. It is requested that all visitors should appear in uniform or Court dress.

"9. All persons must keep their places or seats from the time the Shah arrives at the Exhibition till after his departure. The doors of the Royal Albert Hall will be closed at 10 o'clock."

The programme of the music, &c., will be duly advertised.

His Royal Highness the Prince of Wales presided on Tuesday, at Marlborough-house, over a meeting of Her Majesty's Commissioners for the Exhibition of 1851. There were present H.R.H. the Duke of Edinburgh, H.S.H. the Duke of Teck, the Marquis of Ripon, the Duke of Buckingham, the Marquis of Lansdowne, the Earl of Carnarvon, Viscount Portman, Mr. Childers, Mr. Ayrton, Sir Anthony de Rothschild, Sir Thomas Bazley, Sir Richard Wallace, Sir Henry Bartle Frere, Sir William Anderson, Sir T. M. Biddulph, Sir Henry Thring, Sir Francis Grant, Sir Francis Sandford, Mr. Edgar Bowring, Mr. Cole, Mr. Thomas Fairbairn, Mr. Thomas Hawksley, Dr. Lyon Playfair, and Major General Scott, secretary.

On Tuesday the Earl of Carnarvon presided over a conference called by Her Majesty's Commissioners, in the Albert-hall, Kensington, to promote improvements in the silk manufacture throughout the country. There was a large attendance, including Sir Thomas Bazley, M.P., Mr. Bass, M.P., Mr. Brocklehurst, M.P., Sir Daniel Cooper, Mr. W. W. Hughes, Commissioner for Austria; Mr. Peter Gadkan, Consul-General of Turkey; Lord Alfred Churchill, Mr. H. Cole, C.B., Lady Dorothy Neville; Takeda and Tomita, two Japanese Commissioners; M. Fitz-Bovet, China, &c. The chairman congratulated those present upon the really representative nature of the conference, and said the object of the meeting was well worthy of consideration and attention. He believed the silk trade might fairly be said to be one which was, in a certain sense, connected with English history, and that the particular quality of which he sometimes boasted as being a national trait—namely, hospitality—was the occasion of the introduction of the silk trade into the country. Since its introduction, of course the trade had passed through many changes and fluctuations, and during the last century it was subject to oppressive and unwise legislation. Although he spoke with some diffidence in the presence of so many practically acquainted with the trade, he thought he might say the prospect the trade had before it might be described on the whole as satisfactory. He also referred as an amateur to the various processes, and expressing his opinion that the worms might be reared in England, and thus the trade carried out from first to last, invited discussion on the subject. Mr. Bennock saw no reason why the English should not follow the industry from the first, and suggested that the cocoons should be, in the first instance, imported from Japan. He concluded an earnest speech by calling upon all connected with the trade to be honest to themselves, to the beautiful material which they dealt in, and to the consumers. Mr. Pollock, of Glasgow, related his experience on the western coast of Scotland, where the experiment had been tried and failed. Mr. Cope, formerly in India, said the expense in England would be much too large to make it a profitable speculation. The best plan would be to encourage the natives of other countries, where labour was cheap and the climate more suitable, to do all they could to send well reeled silk to England, for that was where the defect lay. Mr Brocklehurst, M.P., spoke at some length rather adversely to the project. Lady Dorothy Neville asked permission to say a few words relative to the ailanthus worm, which, she said, if treated with care, might become a source of profit as well as amusement to many. It was perfectly hardy—feared no rain, wind, or even a slight frost. The silk was coarser and stronger than that of the mulberry worm, and would of course require different treatment. She strongly advised those to whom she had the honour and pleasure of addressing to turn their attention to the subject. The Earl of Carnarvon having to attend a meeting at Marlborough-house, the vacated chair was taken by Sir Daniel Cooper, and the discussion which followed was sustained by Mr. J. Chadwick (Manchester), Mr. Bullock (Macclesfield), Dr. Archibald Campbell, Mr. Maurice (Halifax), Mr. P. L. Simmonds (Society of Arts), and many others. The following resolution was ultimately adopted:—"That this meeting is of opinion that discussions like the present, in connection with annual International Exhibitions, will be useful to the arts, manufactures, and commerce of the empire."

The Queensland Annexe of the International Exhibition has been completed, and was recently opened to the public. The Queensland annexe is a small outbuilding situated on the same side of the building as the School of Cookery, and the very limited space which it affords for the display of the many products of a new and flourishing colony has been utilised by Mr. Daintree, the Agent-General, in the most practical manner. It has been his object so to group his exhibits as to enable the visitor to see at a glance the nature of the soil, the produce, and the mode of life in any given district. For this purpose he has ranged round the walls of the annexe a series of photographs taken by himself on dry plates prepared with native gum. Below these photographs are a number of maps showing the geological formation of the soil, and cases in which specimens of soils, rock, and quartz are arranged. The first series shows the alluvial gold country with the deep sinking, the shallow mining, and a rough mining township. Then comes the "useless country," a weary waste of sandstone, which is followed by the great Western prairies, the soil of which is equal to Cambridgeshire, and exceedingly well adapted for fattening. The next series shows the coal district, the area of which is estimated at about 24,000 square miles, the coal of which is good average household or cannel. The mining district contains lead ores, copper, mercury, antimony, and gold, and in the metamorphic district the tin is worked at the rate of 300 to 400 tons a month, the exports from Peak Down Mines alone having reached more than a million sterling. The volcanic plains and great pastures, with a climate equal to that of Southern Europe, produce almost every kind of cereal, but the most important feature of the colony is the sugar district, which extends over ten degrees of latitude, and is capable of indefinite development. The specimens of sugar shown include every kind and quality. Queensland already supplies herself and the neighbouring colonies with this useful product, and the first shipment to England will be shortly made. The scenery is magnificent, the climate almost equal to that of Madeira; in some parts coffee is cultivated equal to the best Ceylon, and the specimens of cotton, which can be sold in the English market for 9d. per lb., show that the cultivation of that plant alone holds out a prospect for Queensland of a splendid future. There is a large extent under culture, and its produce of live stock is enormous. The returns of 1871 show that there were at the end of that year in the colony 7,403,334 sheep, 1,168,235 cattle, 91,910 horses, and 32,707 pigs. So great was the excess of stock over requirements that 200,000 sheep and 1,000 cattle were boiled down for tallow.

The number of visitors admitted to the Exhibition on Thursday, 12th inst., was as follows:—Season tickets, 162; on payment of 1s., 3,695; total, 3,857. On Friday, season tickets, 170; on payment of 1s., 3,182; total, 3,352. On Saturday, season tickets, 1,662; on payment of 2s. 6d., 2,374; total, 4,036.

The number of visitors admitted to the Exhibition during the week ending Saturday, June 14th, was as follows:—Season tickets, 2,525; on payment of 2s. 6 3,846; on payment of 1s., 12,817; total 19,188.

The number admitted on Monday was, season tickets, 176; on payment of 1s., 2,867; total, 3,043. 124; day, season tickets, 215; on payment of 07; on total, 3,339. On Wednesday, season tick payment of 2s. 6d., 1,419; total, 3,026.

Mr. MacGregor, of the London School Board, has taken two or three parties of pupil teachers and children from Board schools in Greenwich to the International Exhibition, in order that they might attend special lectures on cookery.

EXHIBITIONS.

Vienna Universal Exhibition, 1873.—An International Horse Show, in connection with this exhibition, will be held at Vienna from the 18th to the 27th September next. The immediate management of the show has been intrusted to a special committee, under the presidency of His Excellency Count Grünne, Master of the Horse to His Majesty the Emperor of Austria, and with the concurrence of His Excellency Baron de Schwarz-Senborn, the manager of the Vienna Universal Exhibition. Horses will be received from the 15th till the 17th September inclusive, and will be arranged for exhibition according to the breeds and varieties found in the respective countries. All horses exhibited will be entitled to compete for the prizes, which will consist of medals, honourable mention, and testimonials, and to agricultural breeders of limited means, of money prizes. A certificate of merit will be presented with the awards. The jury, of which His Excellency Count Grünne will officiate as president, will consist of accredited authorities of all countries from which horses are sent to the exhibition. A race meeting, with various prizes, will be held on the 21st and 23rd September, of which a special programme will appear. On the last day of the horse show (27th September) a public auction will be held for the sale of any animals exhibitors may wish to dispose of in this manner, particulars of which will be published in due course. The entries of horses from this country must be sent to the secretary of the Royal British Commission for the Vienna Universal Exhibition, 41, Parliament-street, S.W., where further information respecting transport and other arrangements may be obtained on written application.

Victoria Exhibition.—The Technological Exhibition at Victoria is to open on July 1, and the examination of pupils in connection with it will commence on July 3.

OMITTED POINTS OF ART AND SCIENCE FOR A PROGRAMME FOR THE SHAH.

By E. Chadwick, C.B.

The Russian papers have described the Shah as a sovereign coming to Europe in the spirit of Peter the Great—to learn what he may take back for the improvement of the condition of the population of his dominions. If so, is it not proper that the people of this country should know something more than they appear to do what that general condition is, and what sort of informa-he stands in need? Of this condition we may recall some authentic descriptions from the "Journal of a Diplomate of Three Years' Residence in Persia,' by Mr. E. B. Eastwick, published in 1864, since when that condition has not been materially altered, unless it be for the worse, according to the accounts of a recent dire famine, more severe than the one which Mr. Eastwick witnessed in 1860.

If the Shah comes with the good disposition which, it is to be hoped, is truly ascribed to him, he might have well stayed awhile and got a lesson at the little dominion he last visited. The venerable Quetelet, preceptor in statistics and economy of our Prince Albert, Mons. Vischers, might inform him that that unpre-ting little State—Belgium—with just one-fiftieth of fe-a of his dominion, with no greater elements of had has as great a population as his own, and has four ines, has thirty times the commerce, has nearly he revenue, and has an army, one division of which might knock his own to pieces, as Outram did with less than ten thousand men.

Mr. Eastwick describes the culture of Persia as being what might be expected from the famines, as wretchedly bad, even about the Shah's capital. Mr. Eastwick says:—

> Most of the European vegetables are grown with some success, but in very small quantities, at Tehran. The potato is in general miserably undersized, which is owing to the idleness of the gardeners, who deposit the seed almost on the surface of the ground, rather than be at the trouble of scooping or "dibbling" a hole. Asparagus grows wild in Persia, but the indigenous plant is as inferior to the cultivated as a Hottentot is to a refined European.
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> The rice of Persia is bad. There are two sorts—the ambabu and champa. The ambabu has a villanous smell, whence its name; and the champa is not very wholesome. The greatest want of all is good bread. The Russians, indeed, import good flour and leaven from the Caspian, and have always some one who can bake. The English are not so fortunate, and, while I was in Persia, had for the most part to put up with the bread of the country, which resembles the Indian "chapati," thin, unleavened, and unpalatable. Yeast is not procurable in Tehran.

One of the best sights for his people that could be presented to the Shah would have been the market garden and small farm culture adjacent to Brussels, where he might have seen how a population, as numerous as his own, is sustained without famine, almost exclusively from its own soil, much of it inferior, with no natural advantages as to climate. But better lessons in production even than this might be presented to him in England. If he were taken to Aldershot he might be shown the camp farm there, as conducted by Mr. Blackburn, where a previously sterile land, worth, perhaps, not five shillings an acre, now lets for more than twenty pounds an acre, with a yield in quantity and quality exceeding even the best market garden produce, obtained by an improvement over the ancient methods of irrigation, now generally in ruins, in his dominions, by which ancient populations were sustained. He might be shown varied examples of unprecedented yields obtained at Mr. Hope's farm at Romford; and the new sewerage irrigations at Bedford would be well worth a visit from him.

Let it be considered, in pity and mercy, that the conditions of the poor people have claims for precedence over ballets and military displays, which he cannot, with his present means, possibly imitate. These conditions may be conceived, from the brief accounts given by Mr. Eastwick:—

> My first winter at Tehran was indeed a sad one. The three weird sisters, famine, pestilence, and war, combined to desolate Persia. It was impossible to go out without being assailed by the importunities of crowds of famishing people, and many an emaciated form was stretched at the corners of the streets, voiceless, scarcely breathing, and soliciting aid only with a despairing look or feebly extended hand.
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> Our ride was saddened by the piteous spectacle of bakers' shops besieged by crowds of famishing women and children, stretched on the ground in the last stage of emaciation, with none to care for them.
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> The 14th was ushered in with the disagreeable intelligence that the river had swept away twenty-two houses during the night, and that there was a bread riot in the city. The mob had plundered all the bakers' shops, and now no bread could be got. The Haji, who is a meagre, sallow, man, with cunning eyes, made his appearance, looking very miserable, and said the Governor was in great alarm, and that things were in a ticklish state. He begged us not to show ourselves in the streets, as he said the mob were so excited we should very likely be attacked.
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> The whole road was lined with people emigrating from Kazvin on account of the famine. They seemed to be people of the lowest class, with the exception of one woman, who was very respectably dressed. She carried a child of two years in her arms, while a little toddle of about five followed her. Several of the throng importuned us for alms. We passed three or four large villages. One on the right hand beyond Mahmudabad was entirely deserted.

Let it be considered what sights were presented to our royal visitor in 1860, sights which have possibly been very recently repeated, and what lessons he might be sent back with, to stay further repetitions, if, as is to be hoped, he is capable of learning. Mr. Eastwick says:—

> The distress in Tehran was now culminating, and, the roads being almost impassable, supplies of corn could not reach the city. The bakers' shops were besieged by mobs clamouring for bread. As soon as a European showed himself in the streets he was surrounded by famishing women, supplicating assistance, who were not to be kept back by any scruples of their own, or remonstrances of the men. Matters were evidently growing very serious, and on the 1st of March, as Mr Alison and and myself were sitting at Mr. Dickson's examining the Nauroz presents for the servants, the chief Persian secretary came in, pale and trembling, and said there was an *emeute*, and that the Kalantar, or mayor of the city, had just been put to death, and that they were dragging his body stark naked through the bazaars. Presently we heard a great tumult, and on going to the windows saw the streets filled with thousands of people, in a very excited state, surrounding the corpse, which was being dragged to the place of execution, where it was hung up by the heels, naked, for three days.
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> On inquiry we learned that on the 28th of February, the Shah, on coming in from hunting, was surrounded by a mob of several thousand women, yelling for bread, who gutted the bakers' shops of their contents, under the very eyes of the king, and were so violent, that as soon as the Shah had entered the palace, he ordered the gates of the citadel to be shut.
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> Next day, the 1st of March, the disturbances were renewed, and, in spite of the gates being closed, thousands of women made their way into the citadel, and began to assail the guards with large stones, being urged on by their male relatives, who, under cover of this attack, were looking out for an opportunity to effect a more serious rise. Meantime, the Shah had ascended the tower, from which Hajji Baba's Zainab was thrown, and was watching the rioters with a telescope. The Kalantar, who had been seen just before entering the palace, splendidly dressed, with a long retinue of servants, went up the tower and stood by the Shah, who reproached him for suffering such a tumult to have arisen. On this the Kalantar declared he would soon put down the riot, and going amongst the women with his servants, he himself struck several of them furiously with a large stick. One of the women so assailed ran as far as the English mission, and came in, calling out for help, and showing her clothes covered with blood. On the women vociferously calling for justice, and showing their wounds, the Shah summoned the Kalantar, and said, "If thou art thus cruel to my subjects before my eyes, what must be thy secret misdeeds!" Then turning to his attendants, the king said, "Bastinado him, and cut off his beard." And again, while this sentence was being executed, the Shah uttered that terrible word, "Tanab!" "strangle him." In a moment the executioners had placed the cord round the unhappy man's neck, and in an instant more their feet were on his chest, trampling out the last signs of life. At the same time the Kadkhudas, or magistrates of all the quarters of Tehran were subjected to the bastinado, and at sight of these punishments, the frenzy of the populace was for that day appeased, and Tehran was saved by a hair's breadth from a revolution.

His own city is a seat of pestilence, as well as of repeated famines. Mr. Eastwick thus describes its condition, in respect to the first means of salubrity—its water supply:—

> But, . . . the greatest obstacle of all to comfort and cleanliness, not only in the kitchen, but generally, is the condition of the water when it comes to be employed in the household. Fortunate it is that the use of the microscope and chemical analysis are unknown in Iran, or such things would be disclosed as would horify every one. The fact is, the Persians have an unfortunate theory that nothing can pollute running water. Filthy globules, they think, are replaced by pure ones so rapidly, that it matters not what happens a yard above the spot where you are drinking. It was so difficult for me to realise this idea that my eyes dilated with astonishment when I first beheld the practical results of this theory. I have seen a man drinking from the same "hauz," or basin, and nearly at the same spot, where another was washing his beard, and a third was scrubbing the sort of salad-bowl which so surprised Madelon when she first dined at the château of Jeffs. You have only to step out into the street for a moment at Tehran to remark a party of women washing the filthiest linen in the conduits which convey the drinking water into the neighbouring houses. Having seen that, take my advice, and look no further, or you will discover infinitely worse things a little way on. When it is considered that there are few or no wells, and that every stream, conduit, and tank is treated after this fashion, we cannot but echo the words of a German engineer, who, on my asking him about the telegraph said, "Meiner Meinung nach, in Tehran die reine Wasserleitung ist viel mehr nothwendig als der telegraph."
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> Short as my experience of Persia had been, I had some misgivings about the purity of the water to be employed in my hoosehold, and my fears were not lightened when I came to examine the *hauz* or reservoir. The water in it looked more like slime than *aqua fontis*, and the instant I approached it, a lot of obese frogs, who were singing like the chorus in Aristophanes, went down with a splash and a gurgle which set a multitude of efts and other anomalous reptiles in motion in all directions. I ordered it to be immediately cleaned out, and so got rid of the impurities of years; but I was never able to prevent my servants from performing their religious ablutions at its edge, and washing in it every imaginable vase, from a cup upwards and downward.

All the dire conditions of ignorance beneath appear to have their reflex in the conditions of ignorance above.

> At 4.30 p.m. I reached Talibabab, a village twelve miles south-east of Tehran, belonging to the Nusratu'd daulah, where we were to pass the night. If you want to learn the secret infirmities of a nation, get off the high road into the by-ways. There you see the nakedness of the land, the ugly features without a mask. This village belonged to a prince of the blood, a man, too, of great worth and dignity of character; yet the place called his house was such that any English farmer of the lowest grade would have turned up his nose at it. The tenement was of mud, the sitting-room smoked in such a way that a horizontal position on the floor was the only one practicable, and the windows in the bed-rooms yielded at once to the insolent night airs that entered without ceremony into the innermost nook of the apartments.

Filth in the inside is accompanied by filth in the outside, by horribly bad roads. This is the state of the Shah's capital:—

> European society at Tehran is neccessarily very limited, and is rendered more disjointed than it need be by the unlucky circumstance that the European missions are dotted about the town as far as possible from each other. Even this would be of comparatively small importance if carriage were available. But there are no means of locomotion in Tehran, except on foot or on horseback, and the streets are so filthy and so full of holes that a pilgrimage by night is a *corvee* not to be endured.
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> The missions, therefore, are thrown very much on themselves for amusement, and the members of each diplomatic body take their meals with their own chief, who supplies the table. This has always been customary, and is, besides, obligatory at the British Mission.

This denotes the conditions of outside travel:—

> We left Salawan at 9 a.m. on the 21st of March, and, after fighting our way through jungle and swamp for a quarter of a mile, got upon the Resht road. An excellent road it was at first, like an English one, with ditches on each side, and a wattle fence a foot high. We began to wonder at what we had heard of the swamps of Resht, but this wonder soon ceased, for the good road was only in patches, while between were veritable Sloughs of Despond. The curious feature of these places was that at regular intervals there was a thin ridge of hard ground, with deep mire on each side—in fact, a sort of mud-ripple. Thus the horses were kept in a sort of treadmill. If they missed the hard ground, down they went into the mud over their knees. It really looked as if the ground had been made into traps for breaking the legs of unwary beasts. My chestnut horse fell into a ditch, where the mud rose to his neck, and most of the other horses fell, and were dragged out with difficulty. Fane's horse was lamed by a deep cut, and altogether we were a discomfited party.

Considering the needs of his Majesty, might not the Lord Chamberlain place at his disposal Mr. Robert Rawlinson, who has recently put Sandringham to rights, with an improved drainage, and a constant supply of pure water, and a provision for the application of the sewerage to an improved garden culture, and also show him there how it is proposed to keep pestilence out of the cottage as well as the palace? Might not a visit, under such an instructor, to that new country palace, be more useful to him than a visit to old Windsor or to Buckingham Palace? Mr. Quick, the water engineer, might show him water engines, such as Tehran wants. The Lord Mayor might help too, by placing at his disposal Mr. Heywood, the corporation engineer, who would show him the new, smooth, impermeable asphalted roads of the different kinds, and how it is now proposed to cleanse them by water, so as obviate their slipperiness, and his Majesty may have the streets of his own capital made smooth and clean.

But where is the money to be obtained for such works, it may be said, from such a poverty-stricken, famishing population?[*]

On this topic the Political Economy Club might depute a professor to give him a lesson in their science in the productive as well as the non-productive association of wealth. Thus, the coat he wears is said to be adorned with jewels to the value of four hundred thousand pounds. He may be advised that if he were to leave that coat with some rich firm, a loan might be raised, with which he might bring in an improved and constant supply of water for the people of his capital, have it thoroughly well drained, and surface paved in the best manner—he would choose from what he saw in

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[*] This was written before the public announcement of the concession to Baron Reuter.

London—and also get new asphalted tramways, smooth and joltless roads for the suburbs. He might also get his miserable capital lighted in an improved manner, and provide, also, for the improved irrigation, such as those of Croydon and Bedford, probably, within the loan upon that coat; and Poole would supply him with one more *á la mode* of Western civilisation, such as he provides for our Royal Princes. In a very short time he might get from his subjects such rates from improvements as would enable him to repay the Baron his loan, with thanks for his obligingness, and get back his coat, if he chose to have it back. We would advise that he should sell the jewels for what they would fetch at Christie's, and go on with his first good work. The value of the store of jewels and wealth belonging to the Shah, which Mr. Eastwick was shown at the palace, are estimated at several millions—as much as ten millions of money,—enough, as we are assured, if capitalised, to put his chief other cities, Taures, Ispahan, and Yeyd, comprising not more than three hundred thousand of population in the whole, in the most advanced conditions with irrigation works of the highest and most productive order.

But on a view of the western arts, military and civil, the Shah might say, "But a large population of my subjects are sunk in barbarism and ignorance, and utterly incapable of using those refined implements for war or for peace, or applying those advanced processes which are shown to me. I must import western scientists and engineers to teach them, and even they will find a large proportion who are past teaching." This is undoubtedly true. To be taught, the savage must be caught, and trained young. The Society of Arts might, if it had been allowed the opportunity, have submitted to him a lesson greater than any he will have viewed in the West, of the means of advancement of a population, by training in the arts military as well as civil. He might have had displayed to him, the review of the drill of four thousand children of the half-time district schools, composed of destitute orphans, mostly rescued from being street Arabs, as bad and savage as any in Persia—and all tamed and taught self-restraint and prompt obedience, and converted into profitable and productive subjects for peace as well as for war. He might have seen some of the results of a mixed physical and mental training, which at a small cost imparts to two the efficiency of three, for civil as well as military purposes. He would see the demonstration of the great extent of military aptitudes most economically imparted in the non-productive infantile school stages, that are less perfectly imparted, at oppressive expense, in the adult stages of life. He would see military movements and manœuvres in the school drill that would compete in accuracy with those which he will have witnessed, as imparted in the adult stage, displayed to him in the States he has visited. It has been the pride of Prussia, that by the instruction given during long detention in barracks, any private may be be called out of the ranks and a military order be given to him, which he will write down to dictation. In the school drill review he would see, as the results of the half-time education imparted to between one and two hundred in schools, at the expense of keeping and training one adult in barracks, that he might call out any boy between ten and eleven to whom the like order might be dictated, which he will spell and write correctly, and who would, moreover, copy him clearly a map of his dominions.

The well-known French physicist, M. Janin, has constructed a magnet of extraordinary carrying power. Artificial magnets have not hitherto been made to carry more than four or five times their own weight, but this magnet is able to sustain upwards of 22 times its own weight. A great number of thin well-magnetised plates are used in its construction, instead of the thick plates generally employed.

GENERAL NOTES.

Trades Guild of Learning.—On Saturday two conferences were held at the house of the Society of Arts, which was lent for the purpose, convened by the provisional committee for the establishment of a "Trades Guild of Learning," for the purpose of determining the basis and constitution upon which such an institution should be established. The morning sitting was presided over by Mr. Samuel Morley, M.P., and amongst those present were Mr. Mundella, M.P.; Lord Lyttleton, Lord Edward Fitzmaurice, M.P.; Sir Antonio Brady, Mr. Joseph Dodds, M.P.; Mr. Thomas Hughes, Q.C., M.P.; Mr. Alexander Brogden, M.P.; Mr. W. M'Arthur, M.P.; Mr. John Whitwell, M.P.; the Lord Mayor, the Right Hon. W. Cowper Temple, M.P.; Lord George Hamilton, M.P.; Sir John Bennett, the Rev. Canon Robinson, the Rev. Canon Ridgway, the Rev. Henry Solly (Organising Secretary of the Working Men's Club and Institute Union), Mr. James Hole (Secretary of the Associated Chambers of Commerce), Mr. Joseph Arch (Agricultural Labourers' Union), Mr. Hodgson Pratt, Mr. G. F. Savage, Mr. J. Plummer, Mr. G. Potter, Mr. H. D. Rawlings, &c. The following resolution was passed:—"That a Trades Guild of Learning be now established, and that the persons present pledge themselves to render it the best support in their power." Mr. Mundella, M.P., presided at the afternoon sitting, at which the following resolutions were passed: First, "Object—(1) To promote technical education, including both practical and scientific knowledge of the various trades and industries practised in the United Kingdom. (2) To promote a knowledge of history, political economy, jurisprudence, literature, science, and art among the working classes of this kingdom. (3) To promote that general culture and refinement of taste which grows out of habitual acquaintance with fine works of art, cultivated society, high-class literature, good music, and similar influences." Second, "That means be used as far as possible in conjunction with the Department of Science and Art, South Kensington, the Society of Arts, the Universities of Cambridge and Oxford, the Working Men's Club and Institute Union, the City Companies, Unions of Mechanics' Institutes, trade organisations, co-operative societies, and all other bodies desirous of promoting the technical and general education of the working classes, to carry out the objects of the Guild."

NOTICES.

PURCHASE OF RAILWAYS BY THE STATE.

The adjourned meeting for the discussion of Mr. Galt's Paper on "The Purchase of Railways by the State," will be held on Thursday evening next, at 8 o'clock.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Royal Geographical, 8½. 1. Mr. C. H. Hill, "Boat Journey up the River Wami, E. Africa," with Remarks on Zanzibar, by Sir Bartle Frere. 2. Major C. W. Wilson, "Surveys in Palestine."

Wed. ...**SOCIETY OF ARTS, 8.** Annual General Meeting.
Geological, 8. 1. The Duke of Argyll, "On Six Lake-basins in Argyllshire." 2. Prof. Richard Owen, "Description of the Skull of a Dentigerous Bird (*Odontopteryx toliapicus*, Owen), from the London Clay of Sheppey." 3. Mr. J. W. Hulke, "Contribution to the Anatomy of *Hypsilophodon Foxii*, Huxley." 4. Mr. James Geikie, "On the Glacial Phenomena of the Long Island, or Outer Hebrides." 5. Prof. P. Martin Duncan, "On Fossil Corals from the Eocene Formation of the West Indies." 6. Mr. R. Etheridge, "Note on the Lignite-deposit of Lal-Lal, Victoria, Australia."
Royal Society of Literature, 8½.

Thurs...**SOCIETY OF ARTS, 8.** Special Meeting. Adjourned discussion on Mr. Galt's Paper on "The Purchase of the Railways by the State."
Antiquaries, 8½.
Royal Society Club, 6½. Annual Meeting.

Fri ......**SOCIETY OF ARTS, 8.** Conversazione at the South Kensington Museum.
Quekett Club, 8.

Sat......Royal Botanic, 3¾.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,075. VOL. XXI.

FRIDAY, JUNE 27, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

CONVERSAZIONE.

The Society's Conversazione will be held at the South Kensington Museum, this evening, Friday, 27th June.

PROCEEDINGS OF THE SOCIETY.

ANNUAL GENERAL MEETING.

The Annual General Meeting, for receiving the report from the Council and the Treasurers' Statement of Receipts, Payments, and Expenditure during the past year, and also for the Election of Officers, was held, in accordance with the Byelaws, on Wednesday, the 25th of June, at four p.m., Major-General F. EARDLEY-WILMOT, R.A., F.R.S., Chairman of the Council, in the Chair.

The SECRETARY having read the notice convening the meeting, the minutes of the last Annual General Meeting, and of the subsequent Special General Meeting, were read and signed.

The CHAIRMAN then nominated Mr. William Botly and Mr. G. Christian Mast as scrutineers, and declared the ballot open.

The SECRETARY then read the following

REPORT.

Pursuant to the bye-laws of the Society, the Council now lay before the members, in General Meeting assembled, their Report of the Society's proceedings during the past year, together with a statement of the receipts, payments and expenditure during that period, and of the assets and liabilities.

MEDALS.

The Albert Gold Medal, for distinguished merit in promoting Arts, Manufactures and Commerce, has this year been awarded to Monsieur Michel Eugéne Chevreul, the veteran Director of the Gobelins in Paris, for his chemical researches, especially in reference to saponification, dyeing, and agriculture. These researches, in their application to the arts enumerated, have exerted an amount of influence on manufactures and industries which can hardly be over-estimated. Some of his discoveries, made upwards of half a century ago, established important leading principles which still guide the manufacturer at the present time. The Council are glad to have the opportunity of marking their high sense of Mons. Chevreul's labours.

On the recommendation of the Silk Supply Committee, the Society's Gold Medal has been awarded to Dr. Hiddingh, of Stellenbosch, Cape of Good Hope, for his successful exertions in promoting the cultivation and reeling of silk in that colony.

The Council have awarded the Society's Medal to Mr. Thomas Wills, F.C.S., for his paper read at one of the evening meetings, entitled, "On some Recent Processes for the manufacture of Gas for Illuminating Purposes."

FOOD COMMITTEE.

The labours of this Committee have been, to a large extent, merged in those of the Special Committee which was appointed to aid H.M. Commissioners for the International Exhibition in obtaining a complete representation, in the present year's Exhibition, of one of the branches into which the Food Section of the Exhibition is divided. The Committee, on which the services of gentlemen representing the various classes of articles sought had been happily secured, has held many meetings, and their active support has enabled a highly-satisfactory display to be got together. The Council cannot, however, refrain from expressing their disappointment that, up to the present time, no process has yet been developed by means of which meat can be preserved in a raw state, suitable for importation into this country, from our colonies or other places where the supply is large and the price low. Sir Walter Trevelyan's prize of £100 and the Society's Gold Medal for this object still remain unawarded.

COTTON.

The Cotton Supply Association of Manchester, set on foot during the scarcity of cotton arising from the civil war in the United States of America, having been dissolved, it was suggested to the Council that, notwithstanding that the special circumstances under which it was formed had passed away, there were still many matters connected with the trade in cotton and its supply, which were worthy of consideration and attention. They have therefore formed a committee of this Society, under the title of a Cotton Supply Committee, which will be called together, from time to time, as may be deemed desirable, to discuss and concert measures for promoting the supply of this important staple. Communications have been entered into with the principal members of the late Cotton Supply Association, and the Council have the pleasure of announcing that the proposition has been received with favour, and, in nearly every instance, the parties applied to have joined the committee.

Although the supply of cotton from the accustomed sources continues abundant, yet the necessity remains for developing the culture in India and Turkey, and for promoting it in many new colonies and countries.

Silk.

The subject of silk, its growth and manufacture, has this year come specially under the cognisance of the Society, a committee having been formed under the title of the Silk Supply Committee, as was mentioned in the Chairman's opening address. The following report gives a summary of its labours :—

"This Committee have held several meetings during the year, and have been enabled to render essential service to her Majesty's Commissioners for the International Exhibition.

"From time to time the committee have caused to be inserted in the *Journal* interesting information relative to the production of silk, and calculated to diffuse useful knowledge in the colonies. On the 23rd April a paper was read, detailing the new process, carried on by Mons. A. Roland, of rearing silk worms in the open air, a method calculated to eradicate the disease which has so long endangered the best races of silkworms, and based upon the principle of the survival of the fittest.

"Mrs. Bladen Neil having determined to introduce this method into Australia, the committee accredited this lady to leading cultivators of silkworms in Italy, and assisted her to obtain all information necessary. Mons. Roland, too, has been induced to exhibit his new system actually in operation at the International Exhibition this year.

"The committee having obtained grain, and forwarded it out to Australia, have received very satisfactory specimens of the cocoons grown there. The sample of reproduced grain sent to the committee had not been so successful, owing, no doubt, to the variation of the seasons.

"The committee have given their attention to the introduction of the industry of silk-reeling into this country and the Colonies, and notice with great pleasure the success of Dr. Hiddingh at Stellenbosch, Cape of Good Hope. The specimens of raw silk reeled at his establishment were of a very high class, and ranked with ordinary Italian greges, the valuation on its arrival here being 38s. per pound.* This silk has been made into sashes, which are now exhibited by the Society at the International Exhibition, on behalf of Dr. Hiddingh. The Committee had much pleasure in recommending that the gold medal should be given to this gentleman for introducing the culture of silk, and especially the art of reeling from the cocoons, into the Cape Colonies.

"In consequence of the numerous applications from various quarters for instructions in silk rearing, the committee recommend the publication in the *Journal* of some articles entitled, 'Hints to Colonists upon the Cultivation of the Silk-worm, which appeared in the *Silk Supply Journal*, but are now out of print."

Indian Committee.

The Indian Committee have continued its labours in the past session, and the Council have given to it increased support. Among the prominent topics which have occupied the Committee has been that of trade with Central Asia. The Committee did not restrict itself to the consideration of any one route, but advocated attention to all, so as to throw open the whole of our long frontier on the north, which is closed to trade, except by distant and inadequate outlets. Having brought together those persons most competent as authorities in the various routes, the Council sought an interview with His Grace the Duke of Argyll, H.M. Secretary of State for India. Although many public bodies have addressed the India-office, the Council have reason to believe that the complete exposition of the whole subject made by them has materially assisted in its advancement. It is particularly necessary that the obstacles interposed by Chinese officials, or on their behalf, should be removed.

A very important matter was brought forward by Sir Arthur Cotton relative to the harbours of India, which has not hitherto received adequate consideration.

Another is that of the mineral resources of our Indian empire, and of their development. On this a paper was read by Mr. Blandford, of the Geological Survey of India, in which a valuable contribution to our knowledge on these points was supplied.

The question of the system of architecture to be adopted in India was brought forward by Mr. T. Roger Smith, and was profusely illustrated by designs of the various buildings of India. This subject was to some extent embraced and well illustrated in a very popular lecture by Captain Lyon.

Mr. W. Tayler, late Bengal Civil Service, brought before the conference a paper on the manufacture of rosaries in India, so that a large amount of useful and interesting information was contributed upon a branch of industry unknown here.

Mr. J. H. Stocqueler laid before the meeting a very comprehensive paper showing the vast progress which has been made throughout our Indian Empire during the last fourteen years.

These discussions as to progress in India have served to develope facts of the highest importance for the sanitary improvement of the native population, for the preservation of our army, and also for the conservation of the life of children born in India of European parents.

The Government of India has taken up the question of sanitary improvement in earnest, and sanitary commissioners have been appointed in the several provinces. Medical officers of health have also been appointed, and reports have been made on the causes leading to fever and cholera. Water from tanks, wells, rivers, and other sources of supply, has been analysed and reported upon, and in the several cities, stations, and cantonments, regular scavenging has been organised and carried out. Calcutta has received an improved water supply, and is in course of being sewered and drained. Bombay is to have its water-works put in order, and the city is to be sewered, and the sewage applied to purposes of agriculture. Madras is also to have an improved supply of water and sewerage. At this place an experimental sewage-farm has been in successful operation for some time. Sanitary improvements are, in fact, under consideration for the whole of of British India.

These Indian conferences, while of practical value, have not been without general interest, and have occasionally been largely attended by members.

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* The market for such silk in this country is unlimited.

The Council have given accommodation, in the great room, for the meetings of the East India Association as in a former year.

Musical Committee.

This Committee have, as has been stated in previous reports, and in the Chairman's address, received a very large amount of support in the way of scholarships promised for the establishment of a National Training School for Music. The Council of the Royal Albert Hall have promised the use of two of their smaller theatres, and other rooms, for the accommodation of students; and the Committee are of opinion that the time has now arrived when the establishment of a National Training School for Music on an independent basis may be accomplished, and that for this purpose steps should be taken for erecting a building to be connected with the Albert Hall, suitable for the school. This proposition, with plans, and other details which have been ordered to be prepared, will, at a later date, come before the Council for their consideration.

Colonies.

The attention of the Council has been assiduously directed to the development of the various resources of our own empire, as has been stated in reference to India and Africa, and to which the proceedings of the Silk Supply and Cotton Supply and Food Committees chiefly relate.

The rapid extension of steam communication, and of our trade with West Africa, as well as the increase of relations with East Africa, have tended to call attention to our colonies and commerce on those coasts. A very valuable paper on the Western Colonies was read by his Excellency Pope Hennessy, late Governor of the Gold Coast, and this, in connexion with political events, has brought the subject more prominently forward. It may be desirable in the next session to take more active measures by the institution of an African Committee. There are now many African merchants residing in this country, as was seen on the occasion of Mr. Hennessey's paper.

With respect to some of our colonies, Jamaica, Trinidad, and Singapore are to have improved water supplies and sewerage. A new impounding reservoir, capable of storing 74 millions of gallons of water, has recently been constructed at Hong-Kong, at an elevation of 500 feet above the sea, for the supply of the town and port of Victoria, and this volume is to be largely increased, so that it may furnish sufficient water for the population of about 100,00 inhabitants.

Melbourne and Sidney, in Australia, are to be sewered, so that it will be seen that means of health and comfort are being considered, not only at home, but also abroad.

The example set by England and her dependencies is being followed by other nations. Berlin, Vienna, Pesth, Odessa, and St. Petersburgh, are to be sewered. Main sewers are nearly completed on the English plan in Frankfort-on-the-Main.

The Northern States of America have sent over to England, as Chief Sanitary Commissioner, Dr. Verdi, of Washington, to examine into our sanitary laws, regulations, and various works calculated to improve the public health.

Fire Committee.

The numerous and extensive fires which have taken place in the metropolis during the last few years, as well as the disastrous conflagrations which have occurred in Chicago and Boston, have induced the Council to turn their attention to what are the means available to prevent the spread of such catastrophes. A Committee has been appointed, and very valuable evidence has been given before it by gentlemen of great experience in such matters. The evidence has been published from time to time in the *Journal*, and its perusal is strongly recommended to the members. It would appear that the great defect at the present time is the want of a constant supply of water; the mains are not constantly charged, and being under the control of seven separate companies, there is no means of bringing the whole supply, if needed, to one spot, the mains of each separate company having no connection with each other.

The evidence taken by the Committee reveals a large amount of accruing waste—a waste of water equivalent to the supply of between two and three millions of additional population; whilst for many purposes there is a great want of water, and also from the multiplied establishment charges of the sectional trading companies, a waste of money, which, if capitalised, would suffice to defray the expenses of the public works required for putting the metropolis in such a state of security against fire as would occasion a large saving of life as well as of property. Great opposition is made to the introduction of the system of constant supply required for sanitary purposes, and the opposition is made on the score of the expenses required for the change of the house-service pipes. The evidence taken by the Committee shows that the economies practicable under unity of administration will fully suffice to defray all proper expenses of the private as well as the public works required for the change. Under the present system it would appear that there is a great waste of water; one-half of the water pumped for the supply of the metropolis is allowed to run away unused. By the evidence it appears that the case for such a measure, especially for fire prevention, is advanced more fully and completely than by any of the numerous preceding inquiries. It is proved that, under proper arrangements, water may be brought to bear for the extinction of fires in one or two minutes, or in a fifth of the quickest time at which it is now obtained. The sustained attention will be paid to this question, which its magnitude and urgency demands.

The Committee have not yet completed their labours. If reappointed, and the investigation continues, it is hoped that some practical measures may be devised for remedying the evils of the present system.

Traction Experiments.

The increasing use of asphalte and other improved methods of paving has induced the Council to undertake, under the supervision of a committee, experiments on traction over various descriptions of paving. These experiments have been delayed, first, from the necessity of a suitable dynamometer being constructed, and next, by the illness of Mr. C. E. Amos, who had kindly undertaken the management of the trials. The dynamometer specially devised by Mr. Amos, and constructed under his superintendence, is now complete, satisfactory trial of it has been made, and Mr. Amos writes that he will be prepared, early next month, to carry out the wishes of the committee.

Memorial Window in St. Paul's.

A design for this window, commemorative of the public thanksgiving in St. Paul's for the recovery of his Royal Highness the Prince of Wales, the President of the Society, has been prepared, which her Majesty the Queen and the Prince of Wales have been graciously pleased to approve. The Council are in communication on the subject with the Dean and Chapter of St. Paul's.

Channel Passage.

The Council are glad to observe that this subject, to which in the two previous reports they devoted considerable attention, and on which two successive Committees have reported, seems attracting attention, and is in a fair way of being brought to the test of practical improvement. Colonel Strange, in an able paper which led to a discussion of three nights, reviewed carefully the several schemes now before the public for this end, Mr. Bessemer's balanced saloon ship, Mr. Mackie's, and Captain Dicey's. Of these, the first is in the course of actual construction, and a few months will bring the experiment to a practical test. Whether this, or either of the other ships, if built, will succeed in its special aim, that of preventing sea-sickness, this much it is admitted will be gained—larger vessels and increased accommodation.

Examinations.

The general examinations have this year been conducted as usual; the results have been published in the *Journal*, and full particulars will be found in the report of Mr. Critchett, the educational officer, to be read to the Conference of Institutions on Friday next.

The Council desire to draw special attention to the Technological Examinations, which they have this year put into practical operation. The members will recollect that the scheme was inaugurated at a meeting held in the Society's rooms in July last, under the presidency of H.R.H. Prince Arthur. The object of these examinations is to test the practical skill of the workman in his craft, and by requiring, as a preliminary, that he shall have shown some acquaintance with the elements of the branches of science specially connected with his trade, to give a stimulus to improvement, and enable him to meet the severe competition of his Continental rivals with greater chances of success. A commencement has been made this year in the trades of cotton, paper, steel. carriage-building, and silk; and if but few candidates have presented themselves, the Council feel no discouragement, and are quite satisfied with their progress so far. They confidently look forward to a gradual increase when the scheme is more widely known than at present. The Council have received great assistance, in the drawing up of the examination-papers, from gentlemen connected with the various trades, and they desire to record their grateful sense of the help which has thus been afforded them, in taking the first step in this important experiment. The Council have sought to interest the City Companies in this direction, and they are happy to state that the Companies generally are favourable to the movement, and some of them have liberally rendered material aid to the Society by prizes and otherwise in carrying it into operation.

Her Majesty's Commissioners for the Exhibition of 1851 are prepared to render aid, and offer as prizes to successful candidates three studentships of £50 each, to be awarded to persons who distinguish themselves in the subjects of steel, carriages, and silk respectively, those being special objects of exhibition in the present year, and this course it is understood they will be prepared to follow in future years with respect to the special subjects of exhibition.

The results of these examinations will be published as soon as complete.

School Drill.

Since the last Annual General Meeting, a review of 4,000 boys from the various District and other schools took place with marked success under the direction of the Council in the Royal Horticultural Gardens, before their Royal Highness the Prince and Princess of Wales, the boys having been first inspected in Hyde-park by His Serene Highness Prince Edward Saxe-Weimar. Banners were awarded to the schools which had acquitted themselves best, and these were delivered to the successful schools by His Royal Highness the Prince of Wales, in the Royal Albert Hall, after which a selection of music was performed by the united bands of the schools. The importance of these displays now for three years held under the organisation of the Society, has induced the Council to bring the matter before Her Majesty's Government, in the hope that they may be made national, and they believe that the time has come when they may and ought to be taken up by the authorities, and that such gatherings should be organised, not merely in London, but in various centres throughout the United Kingdom. The Council have shown what can be done, and they think that the nation should now take up the work. Drill must not be looked upon simply in a military point of view, for though no doubt the army would gain largely in the matter of healthy trained recruits, fitted by their education at once to take the place of petty officers, there is the testimony of our leading engineers and employers of labour, that this union of physical and mental training contributes largely to supply a very superior class of handicraftsmen, and adds materially to their productive powers in their various industries. These reviews are not solely of unproductive display. It is proved that they are of real value in stimulating competition, and in testing the results of the expenditure on physical training. The expenses of these trials, authorities agree, ought to be charged on the local rates, since by them a race of boys is trained up more suited for military service, and therefore less likely to cost the country large sums for their after training. It is now allowed that it is economical to defray the expenses of special training for the naval service, and it is submitted that it is also economical to incur proper expenses of efficient training for the military service. The Council will not fail to urge these views on the

Secretary for War, and they trust they may ultimately be successful.

International Exhibition Reports.

The Council have this year repeated the action they took last year, in reference to reports on the different sections of the Exhibition. Last year, however, the reports were not undertaken till after the Exhibition had closed, and their usefulness was, from this cause, materially diminished. This year, it was determined to bring them out at an early period, so as to be available by the public while the Exhibition is going on. The reports are now in the course of publication in the Society's *Journal.* It is intended to publish them in a collective form, and arrangements have been made for their sale in the Exhibition building.

Improved Cabs.

The particulars and conditions with reference to the large prizes offered by the Society have already appeared in the *Journal.* The response made shows thirteen competitors sent in to the International Exhibition at South Kensington. A committee of judges to award the prizes has been formed, consisting of Major-General Eardley-Wilmot, Chairman; the Duke of Beaufort, Lord Arthur Somerset, Lord Alfred Churchill, Captain Candy, Col. Henderson, Mr. A. Cassels, and Mr. Cole. The Committee have secured the assistance of practical coach-builders, as well as of a cab proprietor and driver not interested in the competition, who as experts will afford valuable information on technical points to guide them in their decision. The Committee have commenced their labours, and propose the following course of proceedings, viz., that the cabs should be tried in competition in their various features and in motion, in the West Annexe of the Exhibition on Friday next, the 27th of June. On a future day after this trial the cabs will go in procession to the City and back; they will then be exhibited in Palace-yard, and evidence of their merits and defects will be taken publicly at the House of the Society.

Steel in the International Exhibition.

It will be remembered that the Council have this year offered the Society's Gold Medal for the best specimens of steel shown in the Exhibition. The particulars and conditions have already appeared in the *Journal.* The Council have formed a committee of judges to examine and report on the specimens, and for this purpose sought the assistance of the Institution of Civil Engineers, the Iron and Steel Institute, the Institution of Mechanical Engineers, and the Chemical Society, each of whom has nominated one of its members to serve on this committee, which is thus constituted:—General Eardley-Wilmot, R.A., F.R.S., Chairman; James Nasmyth, F.R.S.; together with Mr. Berkeley, nominated by the Institution of Civil Engineers; Mr. F. J. Bramwell, F.R.S., by the Institution of Mechanical Engineers; Mr. F. A. Abel, F.R.S., by the Chemical Society; and Mr. J. Lowthian Bell, by the Iron and Steel Institute.

Economical Consumption of Fuel.

These prizes, which are placed at the disposal of the Council through the agency of Sir William Bodkin, by a friend of his who does not wish his name to appear, are offered under the direction of a Committee as follows:—

1. For a new and improved system of grate suitable to to existing chimneys as generally constructed, which shall, with the least amount of coal, answer best for warming and ventilating a room,—*The Society's Gold Medal and Fifty Pounds.*

2. For a new and improved system of grate, suitable to existing chimneys as generally constructed, which shall, with the least amount of coal, best answer for cooking food, combined with warming and ventilating the room.—*The Society's Gold Medal and Fifty Pounds.*

3. For the best new and improved system of apparatus which shall, by means of gas, most efficiently and economically warm and ventilate a room.—*The Society's Gold Medal and Fifty Pounds.*

4. For the best new and improved system of apparatus which shall, by means of gas, be best adapted for cooking, combined with warming and ventilating the room.—*The Society's Gold Medal and and Fifty Pounds.*

5. For any new and improved system or arrangement not included in the foregoing, which shall efficiently and economically meet domestic requirements.—*The Society's Gold Medal and Fifty Pounds.*

Although the place to which the competing articles are to be delivered, and where they are to be tested previously to their display at the International exhibition is not yet finally determined, it may be stated that her Majesty's Commissioners for the Exhibition have placed at the disposal of the Society a site on which temporary buildings may be erected for the purpose of reception and testing, and it is probable that some erections may be made on their site by exhibitors of building materials, which will be placed at the disposal of the Society for this purpose free of expense.

Prizes for Thrift.

Sir Joseph Whitworth has offered prizes of the value of one hundred pounds, to be awarded by the Society of Arts, for the best Essays on on the "Advantages that would be likely to arise if railway companies and limited companies generally were each to establish a savings-bank for the working classes in their employ." With this offer he has transmitted the following observations:—

1. Is not a good rate of interest, with perfect security, more likely to promote the habit of saving than any other plan that can be devised?

2. Sir Joseph Whitworth suggests that the interest to be paid on the deposits should be the same as the dividend, with a guarantee that it shall not be less than 4 per cent.

3. By paying the same rate of interest as the dividend earned, there is a bond of union established between labour and capital.

4. An Act of Parliament might make the deposits of the industrial classes the first charge on the estate.

5. The proprietor of a private establishment, whose profits are not made known, might undertake to pay, say 7 or 8 per cent. when the profits reached that amount or more, the proprietor giving an undertaking to pay not less than 4 per cent.

6. In the case of Agriculture, each county might have its savings bank for the savings of both men

and women in the said county, and the interest to be paid might be 6 or 7 per cent.

7. To do this there might be a rate collected along with the poor-rate, to be called the interest or industrial rate.

8. As this rate increased, no doubt the poor-rate would diminish, and if the habit of saving became general among the labouring classes, there would probably be great gain to the property-owning classes, considering the great variety of ways in which they have now to contribute for the support of the unfortunate who now make no provision for themselves.

9. In order to realise what might be the probable saving to those who encourage the savings-banks thus suggested, Sir Joseph Whitworth points to the list of charities, also institutions, such as infirmaries, hospitals, union-houses, prisons, police, &c., &c.

10. In any establishment, if only one-third of those employed deposited savings, they would have immense influence over the other two-thirds of their fellow-workmen.

11. Men who spend all their earnings are generally reckless, and become the dupes of agitators; but the man who has put by some of his earnings will be likely to exercise forethought, and will not be led away by others.

12. In South Wales is it likely there would have been the late turn-out, if the different establishments had each had such a savings bank as that proposed?

13. In the case of a man or woman falling into distress from causes beyond their control, what better proof could be given that they were deserving of sympathy and assistance from their friends, than the fact that they had put by savings at a time when they were able to do so. The rule of action should be to do as little as possible for those who do as little as possible for themselves.

14. Some of the points to be considered by the essayists will be the amount to which the savings shall be limited, and when the depositor wishes to withdraw the whole or any part of the sum deposited what notice shall be given.

15. The co-operative system is no doubt effecting much good, but if the system here sketched out were adopted, the greatest good, in the shortest time possible, might be effected.

The principal subjects which the essayists should consider are the preceding.

The Council have accepted this offer, and appointed a Committee, consisting of Earl Fortescue, Mr. G. C. T. Bartley, and Mr. H. Cole, to arrange the details for obtaining the essays.

Buckle Prizes.

Mr. Buckle, as the Society already knows by announcements in this *Journal*, has placed in the hands of the Society the sum of £100, to be awarded to the head teacher of any school, conducted on the half-time principle of mixed physical, industrial, and mental training, who shall have effectually achieved the best results in the least time at the smallest cost per head for the teaching power.

This prize tends to determine a standard of efficiency and economy in elementary, mental, and physical training, of the highest national importance.

A committee has this matter in charge, and is now engaged in collecting information and statistics with a view of testing the efficiency of those schools, and enabling them to award the prize offered.

Hall-marking of Jewellery.

It having been brought to the knowledge of the Council that what is termed "Hall-marking" of jewellery and articles of gold and silver, is inadequate to secure to the public that protection in the quality of the materials for which it is intended, they have accepted the offer of one of the members, Mr. Streeter, to place £25 at their disposal, to be awarded as a prize for an essay treating on this subject, with suggestions for an improved system. The particulars and conditions of the competition will shortly be published.

Premium List.

The Council have this year issued a list of subjects for which they offer premiums, including, amongst many others, premiums for moulds for metal casting, methods of coating vessels, applications of a vacuum, elastic tubing for gas, composition for printing rollers, chemical balance, incombustible wick, marble carving, utilisation of waste coal, coal working machinery, lighting coal mines, tunnelling machinery, freezing machinery, etching and ornamenting iron, application of printing to etching on glass, varnish for iron wire, galvanic elements, electric condenser, pocket galvanometer, preventing potato disease, new edible roots, hydraulic engines, unsinkable ships, diving apparatus, electric weaving, new gases or oils, traction power for mines, telegraphing through uninsulated wires, importation of silk cocoons, producing surface blocks, storing explosives, storing petroleum, &c., and preparation of peat for fuel.

Copies of this list have been widely circulated, and it is hoped that the suggestions which such a list affords, may lead to improvements in the arts and manufactures of the country.

Finance.

The Council append to this their report the accounts of the Society, duly certified by the auditors, showing the receipts and payments during the year, and including a detailed statement of the liabilities and assets of the Society. It will be observed that the item for rent, rates, and taxes is unusually large, but this arises from a three years' accumulation of rates, which have accrued whilst the Society was disputing its liabilities to the parish on this account, having been exempt for the last thirty years. An appeal against this charge was lodged, but the Society, under the advice of eminent counsel, abandoned it, though from the passing of the Act exempting literary and scientific societies from rates down to the present time the Society was considered to be and treated as exempt. A legacy of £500 from Mr. Thomas Howard has been invested during the year, as well as upwards of £200 received for the Endowment Fund. The Council trust that this beginning of such a fund will ultimately lead to the growth of a large amount.

Professor Tennant had much pleasure in moving the adoption of the report, which was seconded by **Mr. Wm. Smith, C.E.**

Mr. E. Chadwick, C.B., as a member of the Council said he wished to offer some explanations on one point which had not been noticed in the report of the Council, probably because no action had taken place upon it during the session, namely, the question of the purchase of the ocean telegraphs. He might state that no action was taken upon it because there was every right on the part of the mercantile community and the Council to expect that action would be taken upon it by the Government. The principles of the measure were clearly demonstrated; they were the same as those for the purchase of the inland telegraphs, which had been triumphantly demonstrated in practice, and would conduce to even greater profit, in the way of reduced rates to the public, together with as good or even better surplus revenue to the State. The reasonings of the "how not to do it" folk had been answered. The pretext that there was a difficulty with the foreign governments was answered by the fact that the foreign governments had themselves adopted the principles they advocated, and are now all in favour of low charges, and opposed to a system which imposes high rates upon them as well as upon ourselves, when they have to be passed through the British dominions. It is, indeed, an illusion to talk of the interests of foreign governments as respects the capital or the rights of the shareholders, for the fact is that the capital is, and has always been, wholly British. The foreign capital is of the most trivial amount; not at all, probably, the proportion in which capital is invested in British funds. It may be confidently averred that within a month after the passing of an Act the ocean cables might be taken possession of by the post-office; they might be put in relation with the inland telegraphs, and a process of reducing the rates to an extent the companies cannot do might have been in operation, with the advantages to commerce to which a hundred mercantile firms have testified to the Society. The case is so clear, as demonstrated in practice, as to warrant the confident expectation that the measure would be early brought forward, and, he submitted, we were justified in relying upon the action of the government, especially as the economical principles were essentially the same as those propounded by Mr. Monsell in respect to the purchase of the Irish railways by the Government. He challenged the maintenance of any substantial distinction in principle between the two measures. Meanwhile the companies had got a start upon the railway companies, and were making amalgamations for their own profit, which, with due vigilance, would have been made for the profit of the public. It is confidently anticipated that telegraphic communication by the ocean lines, which is even of more commercial importance than internal telegraphic communication, as saving time and expediting transactions, not by hours and days, but by weeks and months, must necessarily be put upon a public footing, since all delay was at great public expense. The Council would be glad to be saved further labour in the agitation of this question, but it appears that this might not be, and that they would have to ask further support during the next session. For the present is was only possible to draw attention to the matter.

Mr. Botly congratulated the Society on the variety of topics and amount of work undertaken by it, as detailed in the report they had just heard read; but he would especially refer to the great progress now making in our colonies. It was a gratifying feature in the accounts to find the Society's assets increasing. Whilst drawing attention to the increased number of the members, he strongly urged upon them the importance of each doing his best among his friends to induce them to join the Society. It was thus in their power to promote largely the influences and means of the Society for good.

Mr. Saywell thought that among the assets of the Society account should not be taken of uncollected subscriptions. He did not consider that these were properly assets of the Society. He advocated a second conversazione, in addition to the one already arranged, as well as a return to the annual dinner.

Mr. W. Smith did not agree with Mr. Saywell in his objection about assets. He considered that uncollected subscriptions were most properly included in that term. He, however, agreed with him as to a second conversazione, believing that the money spent upon such gatherings was well laid out.

Mr. R. Dawbarn, as he was connected with commercial matters, considered the uncollected subscriptions now must properly come in as assets. He approved a second conversazione.

Mr. Hale considered the item of assets was most properly inserted in the accounts, and he thought public meetings of the members, in social gatherings like the conversazione and dinner, most important, as extending the influence of the Society.

Professor Tennant referred to the bygone times when he joined the Society, an effort being then made to get a few additional members to save the Society from dissolution.

Mr. Muir thought that the influence of the Prince Consort as president of the Society had given a great impulse to education, which he thought had been somewhat neglected since his Royal Highness's death. The *Journal* of the Society he thought might be made a great educational organ, and he advocated its being sold at a low price so as to bring it within the reach of the mechanics. It should compete with the cheap weekly trash now so abundant.

Mr. W. Smith did not think the Society of Arts was the proper body to take up this matter, as advocated by Mr. Muir; it was rather the duty of the Society of Foremen Engineers.

The Chairman said that the Society's *Journal* now went to the principal Mechanics' Institutions in the kingdom, and was thus available for mechanics and others, the members of such Institutions. The suggestions which had been made by the various speakers would, he was sure, have the best attention of the Council.

The motion having been put was carried unanimously.

Lord Alfred Churchill moved, and **Mr. A. Cassels** seconded, a vote of thanks to Major-General F. Eardley-Wilmot, the Chairman of the Council, for the able manner in which he had performed the duties of Chairman during the year, which was carried unanimously.

Mr. Botly moved, and **Lord Denman** seconded, a vote of thanks to the officers, which was supported by **Mr. Hyde Clarke**, and carried unanimously.

The ballot having remained open one hour, and the scrutineers having reported, the Chairman declared that the following members had been elected to fill the several offices. The names in *Italics* are those of members who have not, during the past year, filled the offices to which they have been elected:—

COUNCIL.

PRESIDENT.

H.R.H. the Prince of Wales, K.G.

VICE-PRESIDENTS.

F. A. Abel, F.R.S.
H.R.H. Prince Arthur, K.G.
Thomas Brassey, M.P.
Edwin Chadwick, C.B.
Sir Daniel Cooper, Bart.
Right Hon. W. F. Cowper-Temple, M.P.
Major Donnelly, R.E.
Lord De l'Isle and Dudley
Major-General F. Eardley-Wilmot, R.A., F.R.S.
Capt. Douglas Galton, C.B., F.R.S.
Lord Henry G. Lennox, M.P.

Sir John Lubbock, Bart., M.P., F.R.S.
Admiral the Right Hon. Lord Clarence Paget, K.C.B.
Right Hon. Sir John S. Pakington, Bart., M.P.
Major-Gen. Sir Henry Rawlinson, K.C.B.
Samuel Redgrave
Rev. W. Rogers
Seymour Teulon
E. Carleton Tufnell
Thomas Twining

ORDINARY MEMBERS OF COUNCIL.

G. C. T. Bartley
Andrew Cassels
John Cheetham
Lord Alfred Churchill
Hyde Clarke
Colonel A. Angus Croll.
C. J. Freake
James Heywood, F.R.S.
Edwin Lawrence
Vice-Admiral Erasmus Ommanney, C.B., F.R.S.
Robt. Rawlinson, C.B.
Lt.-Col. A. Strange, F.R.S.

TREASURERS.

T. R. Tufnell | *Edward Brooke*

AUDITORS.

James T. Ware. | *I. Gerstenberg*

SECRETARY.

P. Le Neve Foster.

FINANCIAL OFFICER.

Samuel Thomas Davenport.

The Chairman proposed a vote of thanks to the scrutineers for their services, which was carried.

At the conclusion of the General Meeting a Special Meeting was held, when the following candidates were ballotted for and duly elected members of the Society:—

Banner, Edward Gregson, 11, Billiter-square, E.C.
Bremner, John A., Hilton-house, Prestwich, Manchester.
Clulow, George, 87, Caversham-road, N.W.
Cousins, Walter Cornelius Arthur, 11, Lawson-street, Great Dover-street, S.E.
Croudace, W. S., Elm-bank, Broughty Ferry, Dundee.
Curtis, Samuel, 3 and 4, Prospect-place, Walham-green, S.W.
De Losada, Don Norberto Rodriguez, K.C.I.C., 105, Regent-street, W.
Easton, Edward, 23, Duke-street, Westminster, S.W.
Eliott, Henry Charles, 5, Stamford-villas, Fulham, S.W.
Elmslie, E. W., 5, Great Winchester-street-buildings, E.C.
Farman, Edward, 21, Lion-terrace, Portsea, Hants.
Hardess, William Mantz, Sydenham-rise, Forest-hill, S.E., and 4, Coal Exchange, E.C.
Hart, Charles William, Humphrey's-terrace, Shoreham, Sussex.
Hawker, George, 5, George-place, Acre-lane, Brixton, S.W.
Kayess, James, Bourton-house, Streatham, S.W.
Lewis, William Thomas, Bute Mineral Estate-office, Aberdare.
Lloyd, Wilson, Darlaston.
Mann, Colonel R. I., R.E., of Jamaica, care of Messrs. Cox and Co., Craig's court, S.W.
McClelland, Andrew S., J.P., 140, St. Vincent-street, Glasgow.
McMurray, James, Wandle-house, Wandsworth, S.W.
Marshall, George, 1, Tamworth-road, Croydon; and 4, Mark-lane, E.C.
Mayhew, George William, 3, Gloucester-place, Portman-square, W.
Milne, Samuel, Burton Joyce, near Nottingham.
Morrison, Henry M., Longsight, Manchester.
Mosely, B. L., 55, Tavistock-square, W.C.
Mucklow, Edward, Castle-head, Grange, Lancashire.
Norfolk, Richard, Beverley, Yorkshire.
Parker, J. Spear, Cyclops Steel and Iron Works, Sheffield.
Pearse, Mountjoy, Seaton Carew, near West Hartlepool.
Polson, John (Messrs. Brown and Polson), Paisley, N.B.
Pritchett, G. E., F.S.A., F.R.I.B.A., 40, Lombard-street, E.C.
Ramsden, William G., 13, Town-chambers, Liverpool.
Ricketts, Frederick H., 3, Great George-street, S.W.
Smith, E. Fisher, The Priory, Dudley.
Snowden, William, 151, Boyson-road, S.E.
Swann, James M., C.E., Moscow, Russia.
Taylor, Rev. J. W. A., Headington, near Oxford.
Udall, Thomas, Silverdale, Staffordshire.
Verity, Benjamin, 127, Regent-street, W.
Wates, P. J., Phœnix Gas Light and Coke Company, Greenwich, S.E.
Wedgwood, Joseph James, 19, St. George's-terrace, Queen's-gate, S.W.
White, Timothy, Charlotte-street, Blackfriars, S.E.
Whitelaw, Alexander, Gartsherrie Iron Works, Coatbridge.
Whitwell, W., Thornaby Iron Works, Stockton-on-Tees.
Williams, Edward, Cleveland-lodge, Middlesborough.
Wilson, Thomas, 26, Westmoreland-street, Dublin.
Wilson, William, 21, Havelock-road, Hastings.

AND AS HONORARY CORRESPONDING MEMBER.

Abejon, Señor Don Pablo, K. Ch. III., K. St. J. J., D.C.L., Calle de la Union, No. 10, Madrid.

CANTOR LECTURES.

The second lecture of the second course of Cantor Lectures for the Session, "On the Energies of the Imponderables, with especial reference to the Measurement and Utilisation of them," was delivered by the Rev. Arthur Rigg, M.A., on Monday evening, February 10th, 1873, as follows:—

Lecture II.

The Energy of Gravity, with especial reference to the Measurement of it.

The energy of gravity is one of the most silent and all-pervading of the energies of the imponderables. Although we may not be conscious of the fact, there need be no doubt that, were this energy to cease, we should be like those whom Milton describes as

> "Upwhirled aloft
> And sent transverse, ten thousand leagues awry,
> Into the devious air."

This calamity is averted by gravity putting forth that energy allotted to it by the Creator, and the work thus done enables us now to sit at ease, and gives us houses in which to dwell.

If, then, it be asked, where do we find this energy? we may say, "Look around." In this room, gravity, inasmuch as we are at rest, produces but a static action; there is, however, a clock ticking, and there gravity is producing motion. The combined harmonious operations of the energies of gravity and vitality brought us together this evening. Thus it has been, ever since the creation of man; and yet there is good reason for the surmise that the energy of gravity, even if known, was little regarded in the earlier ages of the world. A history of observations on the energy of gravity, or even of traces of the recognition of this energy in these ages, has yet to be written. Whether, by some of the early Greek writers, gravity was supposed to be a power innate, as a living principle—a spirit in every particle of matter; or whether this power had a residence at the centre of the earth; or whether it resided in an atmosphere surrounding each particle of matter; or whether Seneca, who lived about 38 A.D., was moved, by a consideration of (to him) that mysterious principle we call gravity, to notice that the tides and the moon were somehow related, need not, this evening, concern us.

From the time of Seneca we may pass over more than fifteen hundred years, to the days of Galileo (A.D. 1600), who was perhaps the first person to notice that bodies in falling moved faster and faster. He attributed this to the effects of gravity, and considered that if he could retard speed whilst still permitting gravity to act, he might determine the law of increasing spaces in equal successive times. This he did by permitting a ball to roll down an inclined plane; friction on the plane caused the retardation, whilst gravity alone caused the motion. Thus he obtained the ratio of spaces in reference to succeeding times; but he made no attempt to measure the absolute spaces when a body fell freely.

Next to Galileo in order of time must be placed Kepler, a German astronomer, who, about 1615, in his search after certain astronomical relations, existing apparently through the mutual attraction of the planets each on the other, was led to surmises respecting the universality of the mutual influences of material bodies.

The succeeding fifty years present a blank in reference to inquiries or investigations respecting gravity. Then came Robert Hooke, who was at the same time a mathematician, an astronomer, and a mechanician. He was secretary to the Royal Society of England, and, from 1666 to 1674, seems to have frequently turned an inquiring mind to the nature of that influence which he thought he could observe to be exercised by the sun and earth upon others of the planetary system.

The great and now (1873) universally recognised law upon this subject was first laid down by observations and reasonings of Sir Isaac Newton, which, even at this day, are regarded with an almost religious veneration by the advanced and intelligent men of every nation. Although it is said that Newton began in 1670 to form more clear conceptions of the law of gravitation than had been propounded by any of his predecessors, we must remember on what surmises he had to build.

Kepler, about 1615, and Robert Hooke, about 1666, had led Newton, so early as the above-named date (1670), to form these conceptions, and it is probable that he was confirmed and directed in his anticipation by the fact that Richer noticed, in 1672, that a pendulum conveyed from Paris (lat. 48 deg. 50 min. N., long. 2 deg. 20 min. E.) to Cayenne, in South America (lat. 4 deg. 56 min. N., long. 52 deg. 20 min. W.), did not vibrate in the same time. This recorded fact was as a demonstration to the mind of Newton of the deviation of the figure of the earth from perfect sphericity, and its oblateness, or compression at the poles. It was not, however, until the publication of his *Principia*, in 1687, that the law of gravitation was fully established and enunciated.

Briefly expressed, the law, as anticipated by others and propounded by Newton, is this—that the attraction of one planet upon another depends upon the masses (not upon the "weights") and distances of the two planets; not, however, is the law of increase or decrease such, that at one half of a distance or double of any distance is the intensity of the attractive force doubled or halved. This might be a first impression. Astronomical facts refused to conform themselves to such a law. They rebelled. The parliament of planets had prescribed another code for the inter-relationships of their mutual attractiveness, and although it might perhaps have been readily inferred that, as the distance between the attracting bodies was increased, the intensity of attraction would be decreased, yet the law of that decrease was the one which Sir Isaac Newton announced. It is this—that if there be two heavenly bodies, say, the earth and the moon, and that these at a known distance are mutually exerting a certain attraction or drawing each to the other; then, if the distance be doubled, the influence will only be one-fourth of what it was. If the distance be trebled, then this influence will become one-ninth of what it was; if quadrupled, then one-sixteenth of what it was. Expressed in precise phraseology, the law of gravitation is that of the inverse square of the distances. Thus far satisfied the requirements of astronomers.

It is remarkable how much of the utilised information men possess has been derived from the observations of astronomers. The mechanism of the universe was known before Harvey discovered the circulation of the blood, or Watt constructed a steam engine. The astronomers seem to have been the pioneers of every branch of human knowledge. The Old and the New Testaments open astronomically. "In the beginning God created the heaven and the earth." (Gen. i. 1.) "The wise men from the east came to Jerusalem, saying, where is He that is born King of the Jews? for we have seen His star in the east." (Matt. ii. 2.)

It must be remembered that the science of astronomy in one important respect differs from all other sciences. Astronomers are observers only—they ascertain causes by watching effects. They cannot interfere with or alter the causes in operation. They cannot make experiments. That man presumed too much upon the powers of his astronomical friend, who having invited him to bring some of his acquaintance to see an eclipse of the moon by the aid of a telescope, and arriving too late, assured those who accompanied him that the astronomer was not only a personal friend, but also a very kind-hearted man, and he did not doubt that the eclipse would be done again in order that they might see it. Yet upon these observers all experimenters erect their fabrics. The gigantic and uncontrollable phenomena, and all the laws of the universe of planets—of the ebb and flow of the tides, of meteorology, of terrestrial magnetism and its connection with the sun, are the results of observation. They could never have been known by experiment; indeed, we could not so interfere with them as to make an experiment. Remember, experiment is an interference on our parts, and a redirecting of energy into a new channel, in order that that may be observed which cannot otherwise be observed. Hence, if we wish to utilise observation it must be by the adaptation of an experiment in the presence of an observation—to contrive, in fact, a system of apparatus which may enable us to take observations and at the same time to so control the elements of an experiment as to bring them within the range of our means of observation.

Such combination of experiment and observation is to occupy much of our attention this evening, as on the records of these men—Cavendish, Atwood, Kater, Sabine, and Baily, especially Captain Henry Kater, are built our system of measures and weights; for to them we are indebted for what must constitute a court of final appeal, should the time ever come when our present standards being totally lost, it is essential to re-establish them.

The energy of gravity is peculiar, and differs from those other energies with which we are to be concerned, in that it seems inexhaustible—its power is not proportioned to the work it does. All other energies are in process of exhaustion by work when that work is measured by motion; not so gravity. Imagine a large ball, and a second small one, which gravitates towards it—the number of these small balls may be increased, and still the influence of gravity on each ball is as intense as though there was only one small ball; no exhaustion from work done affects the energy of gravity, and yet it seems not to have any power of recouping its expended energies. There is no elasticity about it—at least, none in the hands of men.

For example, we can, in food, avail ourselves of affinity, and so, through the agency of assimilation, revive the energies of an exhausting vitality. Electricity can, upon a system of relays, or upon its extraordinary property of induction, renew at a distance, not only its pristine vigour, but an energy many-fold greater than its original one. Light can have its intensity and purity restored by heat. Gravity remains in its solitariness. True, we believe that vitality, affinity, electricity, light, and heat are independent of, and beyond the influence of, gravity; yet, we know them not—we cannot bring them within the ken of our senses, except when they are associated with what owns the dull, dead, inert, and yet powerful influence of the energy of gravity. For all means yet employed have failed to develope or detect the presence of these imponderables in a *perfect vacuum.*

This fact seems to give support to the suggestion that the "potential energy of gravitation may be, in reality, the ultimate created antecedent of all motion, heat, and light at present existing in the universe."

The mode in which we estimate or measure gravity is peculiar. It is the only one of those energies with which this course of Cantor lectures has to deal that tells its story upon a scale beam or spring balance. No concentrated rays of a tropical sun have ever caused an appreciable deviation of the most delicate balance; neither light nor heat imparted to a body in *vacuo* has ever required the fraction of a gramme to be added to the other scale-pan. But when gravity is concerned we cannot add the most minute microscopical molecule without having the equilibrium disturbed.

Gravity alone, of all the imponderables, rises up equal to the burden laid upon it. Its power seems to increase with the amount of matter involved or work to be done. The more required from it, the more it does. You cannot overburden it. An avalanche of rocks or a gossamer thread are equally the playthings of gravity.

For the purpose of these Cantor lectures, the law of gravitation which binds the planets in their courses is of little concern, unless we find that the same law binds the material elements with which we are concerned. The question whether the influence whose law Sir Isaac Newton so clearly propounded resulted from an unknown and ungovernable something, resident and centralised, as it were, within the planets, or whether it was a property of every molecule or group of molecules, was not set at rest until Nevil Maskelyne, the Astronomer-Royal at Greenwich, went to Mount Schiehallien, in Perthshire, in 1774, to calculate the density of the earth.

The mountain of Schiehallien has very steep sides. Mr. Maskelyne suspended plumb-lines from two opposite and nearly vertical sides. Now, if those plumb-lines deviated from what one may call verticality, they would have been caused to deviate by the attraction of the mass of the mountain. Thus Maskelyne examined this—he had an instrument by means of which he could, by observations upon the stars, determine the exact direction that the plumb-line should take, and he found that the strings did not take that direction. Having done that on one vertical side of the mountain, he repeated the experiment on the other side, and found that the deviation there was opposite to that which it was on the first side.* Having determined that these strings no longer followed the vertical, he formed an estimate of how much this mountain attracted the plumb-bob at the end of the string, and so arrived at a conclusion that each particle of matter does attract every other particle. This was the first approximation to an estimate of that which forms a very important element in connection with other experiments. We may here state that in certain regulator-clocks the makers put the single weight in the corner of the case, so that being removed to the greatest distance its influence upon the pendulum-bob, similar to that of Schiehallien upon the plumb-bob, may be the least possible.

This, then, established the fact that the power whose law Newton discovered was no gnome resident in some mysterious terrestrial centre, but was a property of every molecule of matter, and could not by any means or contrivance be separated from those molecules. Whether this property be within the molecule, or only in what may be called the atmosphere around the molecule, may be left to those who arrange theories.

Mr. Michael suggested to Cavendish an experiment which has ever since gone by the name of Cavendish's experiment, and from which was deduced the first pretty accurate calculation or actual measurement of the density of the earth. Cavendish, as you know, was a very wise man. It is said of him that "he was the richest wise man, and the wisest rich man, that the world ever saw." He left more than a million of money. He had also another quality which would be very desirable to cultivate in certain parts of this kingdom at the present time—he uttered fewer words than any other man who attained the same age is supposed to have done. He discovered many things, and, amongst others, he was the first to make an attempt at weighing the whole earth, and he weighed it with an accuracy which has only been confirmed in recent times.

The apparatus that Cavendish used was double the size of this which you see before you, but it was similar in construction. He had two balls of lead, similar to these large ones, suspended from a very light bar, that bar being trussed, as it is called, by a kind of triangle of wires, and the whole being attached to a hook in a pulley, round which he passed a cord, by means of which the balls of lead can be moved to any position you please. In order to exclude every external influence, the apparatus was inclosed in a room of its own, and to observe the phenomena that took place within that closed room lamps were applied at small orifices, and telescopes were placed at others. In addition to this apparatus with the two balls of lead, which weighed about 3 cwt. each (as far as my memory serves), he had another apparatus placed below the other, as you see here. From a centre immediately under the pulley to which a frame carrying the leaden balls is attached, was suspended by an exceedingly fine wire a light rod with two little balls, less than bullets, and these balls held a certain position, and could not move from it beyond certain limits. Being placed in the aforesaid enclosed room, where there were no draughts or variations of temperature, or anything external to affect them, and they had been left for some time—say, for 24 hours, they became stationary, and would not move unless some external force were applied to them. At the end of the light bar carrying these small balls was an ivory scale and a pointer, and upon this was directed the light of a lamp from outside the room, whilst a knob was also placed outside, by turning which the motion of the large leaden balls could be controlled. At another orifice was placed a telescope, by means of which the motion of the pointer could be observed. After the little balls had became quite stationary, by the cord he very gently swung the larger balls to a position close to the small ones, and after a certain lapse of time, varying from a quarter of an hour to an hour, he observed the space through which the small balls were moved from the position they had occupied. It may be well to state that a thorough examination had been previously made as to whether any influence could be due to magnetism.

This experiment had to be repeated very frequently, because of the minuteness of the range of these balls and the magnification of it. The application of the results was to be so important. He therefore made three experiments on each occasion, and observed the position that the balls took. He also observed another matter which is of great consequence, although this evening to be passed over very lightly, namely, the number of oscillations made by the small balls before they came to rest. These balls oscillate like a pendulum, and by the number of times they swing before coming to rest certain calculations of great importance to the inquiry may be made. These calculations being completed, the conclusion he arrived at was that the earth was 5·4 (say $5\frac{1}{2}$ times) heavier than water.

Now it is only right that you should be told how from these balls the density of the earth can be deduced. The mass or quantity of matter in these balls is known; their attraction upon the little balls is known from observation. The mass therefore of any other ball being known, we can tell the attraction that it would have upon these balls. It is quite clear that if this large ball had double the mass it would have double the attraction at the same distance; if treble the mass, treble the attraction, and so on. Again, if the mass of the little ball was known and the attraction of the great one known, and the mass of the great one known, then if the mass of another ball is known, we shall get the attraction of that other ball. It should also be attempted to make clear how from these two balls we can weigh the earth, and probably it will keep your interest alive in the matter if informed that, in 1835 (Cavendish's experiments being made at the close of the last century, about 1798), Mr. Baily, the founder of the Astronomical Society, repeated them. Mr. Baily had been a stockbroker in London; he retired from business, and purchased a house in Tavistock-place, the one, I believe, in which Mr. Digby Wyatt now lives. He there made many experiments, and some most extraordinary calculations, and did a large amount of astronomical work. Amongst other things he undertook to weigh the earth, and he weighed it as Cavendish did, namely, by an apparatus constructed on the same principle as the one before you. He swathed the box or chamber, in which the balls were, with flannel, and put a gilded cover over all. He also lined the inside with tin-foil and connected it by a copper wire with the earth. These precautions were intended to neutralise, as far as practicable, changes in atmospheric temperature and terrestrial electricity. How important he considered it, you may judge from this that he made more than 2,500 experiments with balls of this character; he sat watching them for 1,200 hours, and that number of experiments extended over some years. The repetition was planned in 1835, commenced in 1837, and concluded in 1842. The result of these 1,200 hours of watching, exclusive of the calculations which followed, led to the conclusion that Cavendish was right within a fraction of 2-10ths., that is to say, Cavendish concluded that the density of the earth was 5·4 times that of water; Baily concluded that it might be 5·6 times that of water.

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* The deviation was noted by a zenith-sector, and after making the requisite corrections there was left an attraction which caused the two lines to be drawn together, so including an angle of 12 seconds due to the mountain.

It may be permitted to repeat the reasoning in order if possible to make clearer the principle on which it proceeds. From the weights we know the masses of the large ball and of the small one. We know that the small balls in relation to the large ones were free from the influence of gravity; we also know by observation how much the one attracts the other. Double the ball, and you get double the attraction, and so on. Now, we know the size of the earth, and by placing this little ball on a spring balance, we know how much the earth will attract it. Therefore, the weight of the little ball being known, and the size of the earth being known, there is nothing left except the attraction to find, and, as we have the attraction from these two balls, we can, by a simple arithmetical operation, determine that the earth is 5·6 heavier than water.

This seems the best opportunity to name that the present Astronomer Royal (Prof. Airy), investigated by very different means and on very different principles, this question of how much heavier than a globe of water the earth is. Qualifying the conclusions from his experiments as himself suggests, consequent upon certain geological considerations, it may be asserted that Cavendish's result is very nearly correct.

Time passed by; Cavendish's experiment was made, as I told you, about 1798, and Baily repeated it about 1835. We must now go back, as a matter of history, to Cavendish's time, and the next step we arrive at in determining the energy of gravity was the experiment that was made by Atwood, who was born in 1746. He was a fellow of Trinity College, Cambridge, and was the first to entertain the idea of devising some plan of measuring the force of gravity. Let me endeavour to make this matter clear. Cavendish determined the density of the earth, but he did nothing whatever as to determining the force of gravity. Force, as stated in the first lecture, can only be measured by motion. We can easily obtain motion from the action of gravity, but we must observe that motion in order to measure force. If a weight be let fall it falls far too quickly to permit of an estimate of the rate at which it falls. That rate is due to gravity. Atwood thought, as Galileo had previously done, that by causing the fall to be delayed, he might be able to draw a conclusion as to the exact force of gravity, and the plan he adopted was this. You are aware that the intervals between the ticks of a pendulum vary according to its length. Here is a pendulum, and you see the rate at which it is going; if, now, the pendulum weight be lowered, so as to lengthen the rod, you may observe that the pendulum ticks more slowly—in fact, it is now beating seconds. You were told, in the first lecture, that we must have a certain unit of measurement, and the *second* is the unit of measurement usually taken for time. If we want smaller measurements, for it it is easy to divide the second into a hundred parts, they are taken by another contrivance. A very simple and sufficient one is a clepsydra, or water clock, arranged specially for this purpose.

What Atwood thought of doing in order to measure the force of gravity, having, you remember, no previous measurements to guide him (for Galileo did not touch the problem that Atwood proposed to solve), was to take two weights evenly balanced over pulleys such as these, the apparatus being most delicately made You see that these two small weights are exactly balanced, one being at each end of a cord which passes over pulleys at the top of the apparatus, so that the weight in descending passes down in front of a graduated scale. These weights, then, are exactly balanced. Here are three very small weights, fractional parts of the ones which are suspended. If one of these small weights falls by itself, it would fall so rapidly that its rate of falling could not be observed; but if, whilst it is falling, it is caused to bring this mass of matter with it, the rate of falling will be retarded, whilst the law of the rate remains the same, *i.e.*, the law which governs the rate of falling will be similar, although the mass moved is increased. If now there be placed upon one of these balanced weights two of these little fractional weights, there is a something that will cause the connected mass to move, and this platform at the bottom will be struck about four seconds after the motion commences. The usual plan is to let the motion be commenced by electricity, which at the same time sets the pendulum in motion. You can count the strokes of the pendulum from the commencement to the end of the motion. You can see this mass of matter has been moved through eighteen spaces in four seconds. If the measure be altered, you will readily understand that these fractional weights would carry it through a different space in the same time; if other weights be put on, they would carry it through other spaces. The experiment as made before the apparatus was brought here shows that the force of gravity is such as to cause a body to fall through about 32 feet in one second, the meaning being that if this small weight had not been required to bring the other weights along with it, then it would have fallen from rest through 32 feet in the first second. That was the first attempt of estimating by measurement the force of gravity.

But Atwood's apparatus, though exceedingly good as matter of illustration, falls very far short indeed of that which Captain Kater adopted; and all that we have, and all that we know, of the form of the earth, and the true kinetic measure of gravity, spring from Kater's experiments, and not from either Cavendish's, Baily's, or Atwood's. Kater felt that if instead of weights falling as they have fallen in the experiments of Atwood, he could observe the effect of gravity upon the weight falling without associating it with other weights, if it could be kept quite distinct, and if in any way he could cause gravity to repeat the operation slowly and deliberately without any interference whatever, we might get at the conclusion much more rapidly than Atwood could by his arrangement, because the friction of the wheels, the weight of the cord, and other incidental matters affect the problem. What Kater did was to design a pendulum, of which this is a copy. It was from a pendulum like this that not only was the force of gravity determined in all parts of England, but also the form of the earth itself has been decided and estimated. Our standards of weights and measures all come from a pendulum like this. If, in fact, the standards were all lost, it would be from such a pendulum they must be restored. Let me anticipate the conclusion by stating that when the standards were lost in the burning of the houses of Parliament they were restored by seeking for copies, because the great number of corrections and the great difficulty of counting this pendulum and freeing it from interfering causes, are very serious obstacles. Few are aware of the enormous difficulty there is in placing a pendulum so as to be free from external influences, and counting the oscillations of it.

Whilst upon weights and measures, your attention may be directed to a small piece of wood here, which is a model of the standard one pound weight of Great Britain. It is one which a committee of learned men obtained, and this in my hand is a copy. The real standard is made of platinum. It is a cylinder 1·35 inches high and 1·15 inches in diameter. Observe there is a groove turned in it, and there is an ivory fork by which it is to be lifted—these standards are not to be touched. There are only five of them made, and if ever the one pound weight is lost in England it is to be recovered, not by repeating Kater's experiments, but by copying one or other of these five standards. The five are kept—one at the Exchequer Chambers, at Westminster, one at the Royal Mint, one with the Royal Society, one at the Royal Observatory, Greenwich, and one is immersed in the sill of the recess on the east side of the lower waiting-hall of the New Palace at Westminster.

To return, then, to Kater's experiments. He had first to determine a pendulum which should vibrate seconds in the latitude of London. He did it in the house of Mr. Brown, in Portland-place, which house has an astronomical bearing from Portland Chapel of 74 deg. 38 min. 50 sec. west from north, the distance being 283 feet, and therefore the house is about half-way up Portland-place on the left-hand side. In that house the pendulum was first adjusted. Nothing seems easier than to deal with a simple vibrating ball on a string. It is not, however, so easy as it seems. It cannot be made to swing in the same plane as this one now appears to do. If left free to choose its plane of vibration it is seldom contented. It will not have a dozen swings in the same plane, it must therefore, somehow or other, be made rigid, and so prevented from such vagaries. Here is a small vessel of lead, hanging by a bundle of untwisted fibres from a hook, and you might think nothing could be easier than to let it swing backwards and forwards on the same path, but it will not swing for two minutes in the same path; hence, pendulums are all compelled to act in restrained paths, and generally supported on knife edges. French clocks have two strings of silk to the pendulum. These are fastened to two hooks at the top, and the pendulum rod being hung from the junction of the two silken cords, it is constrained to describe a path in a plane at right angles to that in which are the silk threads.

To return to the leaden vessel. It is now filled with fine white sand, and at the bottom there is an opening out of which the sand can trickle whilst the vessel swings freely. The figure caused by the sand falling on a board beneath will show the path that the vibrating body describes. It shall now be let go in what appears to be a straight line. If you watch that path you will see it is a very curious one. The sand at once indicates that the ends of the line are travelling round, also that the line itself is becoming wide in the middle. In fact a straight line is seldom formed by the falling sand from such pendulums. Even if a circular path be commenced, you will find it cannot be retained. It reminds one very much of one of the secular astronomical changes, that is, our year of 365 days and a fraction results from this gradual advance of the perihelion path of the orbit of the earth; observe it tends first to a straight line, then through an ellipse to a circle, and then a return action commences, and it will repeat this process from the straight line opening out again, and so pass on through various phases, until it comes to rest. Hence a pendulum constructed of a simple form is of no value, and yet it is in its simple form we require it. It was needful to assume for the purpose of the calculation that we can make a pendulum do that which this swinging vessel of sand is not doing.

Captain Kater was the first to deal with the case of converting the compound pendulum into a simple one. A pendulum is said to be a simple one when it consists of a heavy particle at the end of a very light thread. Such is almost an imaginary pendulum. All pendulums that we see are compound ones. Now, by pursuing the plan adopted by Captain Kater, he was able to obtain from the compound pendulum what would be the length of an equivalent simple pendulum. His pendulum has two pairs of knife-edges, a pair at the upper end, on which it swings, and a pair at the lower end. He placed one pair of these knife-edges on a smooth, hard surface, so that the pendulum might vibrate without anything causing it to continue its vibrations except the force of gravity. Now, if you look to this diagram you will see the motions of a compound pendulum. If it were short it would move thus, and if it were longer it would move more slowly. The black dots in the diagram represent the lower ends of pendulums of different lengths. Assume that the black dots are the ends of separate pendulums, one behind the other, from the same support, they will then occupy those places after the same interval of time from rest; if, however, these pendulums are united, then the one is kept back by the action of the other; now they are really united in a compound pendulum. There is, however, some point or other at which, if all these masses were concentrated, the velocity at that point would be the velocity of the mass, therefore such a pendulum would vibrate in the same time, and it would be called a simple pendulum. Kater found that this collected point, which is called the centre of oscillation, and this at which the pendulum is suspended, are interchangeable; in fact, he found that if the pendulum was accurately adjusted by means of these moveable weights, he could suspend it upon a pair of the knife-edges, and he could get a certain number of vibrations in a minute or a second. Then, if he turned it upside down, assuming the pendulum to be right, and caused it to swing as before, upon the other pair of knife edges, it would make the same number of vibrations. Those two points he marked, and the distance between them is the length of an equivalent simple pendulum. With such a compound pendulum as now described, and of which the one before you is a copy, counting the number of vibrations it makes, you can always deduce the length of a simple pendulum that would make the same number of vibrations.

What Kater did, then, was this—he had a clock kept going, strictly to truth, that is, to true astronomical time. The clock was furnished with a gridiron pendulum of the construction shown in the diagram, and so carefully arranged as not to be altered in length in consequence of change of temperature. On the bob of the pendulum, in front, was a white speck, as on the pendulum bob of this clock. He placed the compound gravity pendulum, which has been described, in front of the clock, the clock pendulum beating 86,400 strokes per mean solar day. The rate of the clock was determined by astronomical observations, and therefore, on any part of the earth's surface, it would be possible to so arrange the solar pendulum that the clock should always record 86.400 beats in a mean solar day.

Now let us turn to this two-ended pendulum of Capt. Kater. It is of an invariable length, and acted upon directly by the force of gravity; there are no weights or clockwork in connection with it. When it is up on one side, it is the power of gravity that causes it to fall, and it is gravity which keeps it going. If, for example, a powerful magnet be placed under that pendulum, then it will come to rest sooner than it would otherwise do, because it is pulled down with greater force. If, therefore, gravity changes in its pull on this pendulum, it will tell on the rate of its vibrations. The rate of vibration of the equivalent simple pendulum is known, because it has been calculated from this compound one; hence, if this compound pendulum be placed in front of the clock keeping astronomical time, and if the vibrations of the pendulum be counted whilst the vibrations of the clock pendulum are being recorded, it might be ascertained whether the force of gravity varied in different places.

The means by which Kater compared these vibrations are very simple. You see the white speck, previously referred, to on the bob of this gridiron pendulum. He took a telescope and placed it at some distance on a level with that white speck. Between the white speck and the telescope, and near to the gridiron pendulum, swung the gravity pendulum, which moved slower than the other, being made a little longer. Keeping his eye upon the telescope, and directed upon a narrow piece at the end of the gravity pendulum, which was the same width as the white circular speck upon the bob of the clock pendulum, he could tell when the two coincided. As one pendulum swung slower than the other, it was quite clear that a coincidence must take place, and he noted the time of the coincidence. That was the beginning of counting vibrations, and he then waited until they separated and until the coincidence again took place a second time, which gave the number of the vibrations in a given time as recorded by the clock. Experiments like these were repeated very frequently and carefully, until at length the average was obtained as to the number of vibrations that this gravity pendulum made, compared with the vibration that the one on this mean solar clock made. Within the tube of this telescope there are crossings of very fine wires—so fine as to be hardly visible to unaided vision; the threads of a spider's web were formerly used for this purpose. A spider is taken in the fingers, then, if shaken he would run his web out to save himself, and this web was placed in the focus of the eye-piece, and the threads were so that the crossing of them was in the axial line of the telescope. It was by looking along that axial line that the time was observed when the coincidence of these two pendulum marks took place. The accuracy with which that was done is more easily to be imagined than realised.

Assuming that this has been accomplished, let us look for a moment to other elements which would disturb the result. In the first place, the pendulum vibrated in air; and you were told, in the first lecture, that a body weighed in air and weighed in any other medium is not balanced by the same weight. Hence the effect of the air upon the pendulum has to be considered. Then the pendulum is vibrating in a changing atmosphere, sometimes warm, sometimes cold, and a change of the temperature causes an expansion or contraction, hence the effect of that expansion was to be considered. And, simple as it seems, to estimate whether a pendulum is longer or shorter is really very difficult. Indeed, great was Captain Kater's perplexity about it.

He measured the length of his pendulum thus: he formed a box similar to the one on the table, and laid his pendulum in it, and applied a microscope over one of each pair of opposite knife edges, placing behind them a piece of white paper, so that the edge might be seen. He then applied the microscope. Again he put beneath them a piece of black paper, and he found that the measurement with the white paper was never the same as the measurement with the black paper. After describing how with microscopes he attempted to measure between knife-edge and knife-edge, by placing them when white on a black ground, and when black on a white ground, he adds:—"In one case, the knife-edges seemed to start forward to each other." This difficulty is summed up thus:—"On the cause of this extraordinary fact I can hazard no conjecture, and it remains an interesting subject for future investigation."

We now know that this resulted from a phenomenon called "irradiation." Hence he was bound, even in looking through those microscopes to strike an average of the apparent errors.

Another error that occurred, which he also found great difficulty in remedying, and indeed never did remedy, so that in fact the experiments he made are liable to some infinitesmal corrections still, was this:—If a pendulum vibrates, as this one was doing just now, the air clings to it, and is carried along with it, from what is called the "viscosity" of the air. That viscosity is such, that if you were to put a short piece of gold leaf projecting edgeways upon the face of the pendulum bob, you would find that the gold leaf moved with the action of the pendulum, and was carried along with it, so that it turned neither to one side nor the other. If, however, the gold leaf projected beyond a certain distance, then you would find it bend with the air. Therefore the atmosphere in immediate contact with the bob was dragged along with the pendulum, and that particular element Captain Kater was not aware of. Government, some years ago, in order to set this question at rest, had large vacuum chambers erected, and pendulums set vibrating in them, to ascertain how great an error was caused by the viscosity of the air.

Captain Kater having determined the length of this pendulum in the latitude of London in 1818, it was thought of great consequence to ascertain how far the force of gravity varied in different latitudes.

A memorial was presented to the government in 1818, in order to ascertain by means of a pendulum how gravity varied throughout the British Isles, and Kater was commissioned to take steps for the purpose. Government placed at his disposal certain members of the Royal Corps of Engineers, with whom he set out to the north of Scotland, and made experiments at various places. He went up to Unst, in the Shetland Isles, then he came down to Portsoy, then to Leith, then down to Clifton in Yorkshire, then to Ashbury, then to London, and then to the Isle of Wight, and in each of those places he made certain experiments based upon the principles now too briefly described. This lecture would extend far beyond the allotted time if it entered into details with reference to local arrangements and special calculations. It may suffice to refer to the table on the wall for particulars of the results. The following is a copy of the table;—

Name of place.	Latitude of place.			Vibrations in a mean solar day.	Length of a pendulum to vibrate seconds.
	deg.	min.	sec.		
Unst	60	45	28·2	86,096·90	39·17146
Portsoy	57	40	58·65	86,086·05	39·16159
Leith Fort	55	58	40·8	86,079·40	39·15554
Clifton	53	27	43·12	86,068·90	39·14600
Ashbury hill...	52	12	55·32	86,065·05	39·14250
London	51	31	8·4	86,061·52	39·13829
Shanklin, or rather Dunmore	50	37	23·94	86,058·07	39·13614

From this table it will be seen that the length of a pendulum vibrating seconds in the places respectively entered is that given in the last column.

These lengths are sufficient to enable a mathematician to calculate the force by which the pendulum is caused to swing. Now, as the only force causing this swing is that of gravity, such a calculation determines the force of gravity at that place in relation to its power to produce motion. Hence is deduced those 39 inches, which, in ordinary expression is thus broadly stated to be the length for pendulums vibrating seconds in the latitude of London. Captain Kater deduced that 39·13829 inches was the length of a pendulum vibrating seconds in Mr. Brown's house in London. This length requires to be reduced to sea-level. Now, the rooms of the Royal Society, at Somerset-house, are 81 feet above low-water, and by the aid of a mountain barometer, made by Ramsden, Kater found the room in Portland-place to be two feet below those of the Royal Society, and as the length of pendulum above the floor was four feet, the elevation of pendulum above sea-level is 83 feet.* Now gravity varies inversely as the square of the distance of the place from the centre of the earth, therefore the length of pendulum must be increased in this proportion; and taking the radius of the earth for the latitude of Portland-place to be 3954·583 miles, we have 39·1386 inches for pendulum vibrating seconds at the level of the sea in the latitude of London.

The greatest difference between the mean and that of any of the sets of experiments is only ·00028 of an inch, or $\frac{1}{134959}$ of length of pendulum. The length 39·1386, as thus determined, is that required to perform one vibration, in $\frac{1}{86400}$ of a mean *solar* day, under the circumstances described, and at the level of the sea.

Finding how much could be obtained from this, with regard to the British Isles, Government commissioned Captain Sabine to go to different places on the east coast of Africa, the Island of Ascension, Bahia, Trinidad, Jamaica, New York, Greenland, and Hammersfest in Norway, and repeat Captain Kater's experiments. These experiments are repeated, and then, by an arithmetical process, which need not be referred to in detail, it was very easy, having given the number of vibrations of this invariable pendulum (for the distance between these knife edges did not vary), performed in a solar day, to calculate the power that was pulling it; and from that calculated power could be obtained the mass of the earth beneath the place where it was being pulled, making, of course, all the allowances for corrections and other circumstances. That calculated power gives the thirty-two feet which we are all acquainted with as the measurement of gravity. The meaning of which is, that gravity will generate in a 1 lb. weight, in one second, a velocity 32 times greater than that which it is agreed shall be called the unit or absolute measure of force. Put conversely—the absolute unit of force is equal to the weight of $\frac{16 \text{ oz.}}{32{\cdot}2} = \frac{1}{2}$ oz. nearly.

Captain Foster afterwards repeated these experiments, and made others, and from them has been obtained the figure of the earth, and calculations of all kinds used in scientific investigations throughout the globe depend upon them. Captain Foster was unfortunately drowned in the river whilst observing some of his experiments, but Mr. Baily undertook to tabulate his results, and completed the calculations on the data which had been obtained by Captain Foster's observations. The calculations Mr. Baily made for this purpose occupy many closely-printed quarto pages of figures. The result was solely to ascertain the length of the pendulum, and so deduce the figure of the earth. Great beyond all ordinary estimate is the amount of care, patience, perseverance, and anxiety that attends experiments of this kind.

ANNUAL INTERNATIONAL EXHIBITIONS.

The number of visitors admitted to the Exhibition on Thursday, 19th inst., was as follows:—Season tickets, 195; on payment of 1s., 3,100; total, 3,295. On Friday, season tickets, 170; on payment of 1s., 3,182; total, 3,352. On Saturday, season tickets, 2,040; on payment of 2s. 6d., 1,866; total, 3,906.

The number of visitors admitted to the Exhibition during the week ending Saturday, June 21st, was as follows:—Season tickets, 4,398; on payment of 2s. 6d., 3,285; on payment of 1s., 11,558; total, 19,241.

The number admitted on Monday was, season tickets, 283; on payment of 1s., 2,320; total, 2,603. On Tuesday, season tickets, 137; on payment of 1s., 3,101; total, 3,238. On Wednesday, season tickets, 182; on payment of 2s. 6d., 1,201; total, 1,383.

In accordance with arrangements previously made, and published in last week's *Journal*, the Shah visited the International Exhibition and the Albert Hall on Monday last. At half-past ten the Royal carriages containing His Majesty and his suite drew up at the north-west entrance, in Prince Albert-road, to the Exhibition building, where the Shah was received by their Royal Highnesses the Prince of Wales, the Duke of Edinburgh, Prince Arthur, and other members of the Special Committee, including Lord Carnarvon, Lord Granville, K.G., Lord Ripon, Lord Lansdowne, and many others. His Majesty passed through the Machinery Department and the Picture Gallery to the Albert Hall, where he listened to the second part of a concert, the first part having been concluded previous to his arrival.

The Judges appointed to award the prizes by the Society of Arts for the improvement of London cabs met on Thursday last, at the International Exhibition. There were present the Duke of Beaufort, Lord Arthur Somerset, Lord Alfred Churchill, General Eardley-Wilmot, R.A., F.R.S., Col. Henderson, Mr. Cole, C.B., Mr. Cassels, and Mr. Le Neve Foster. The Judges inspected the various cabs exhibited, and agreed to the following course of proceeding:—That the cabs should be tried in competition in their various features and in motion, in the West Annexe of the Exhibition, on this day (Friday), 27th June; on a future day, after this trial, the cabs will go in procession to the City and back. They will then be exhibited in Palace-yard, and evidence of their merits and defects will be taken publicly at the House of the Society of Arts.

Mr. Wormersley, of the Carrow Works, of Messrs. Colman's mustard and starch business, has invented and patented a piece of mechanism for improving and facilitating the manufacture of small wooden boxes, varying from nine inches to twenty-four inches in length, with a proportionate depth. By the new machine, it is said, there is not only a great saving in time and labour, but the box is much more finished and easily rendered airtight. The machine cuts transversely into a wooden board, of a width and length that vary for different-sized boxes, three rather deep V grooves, and at the same time bevels the rough ends of the board. This done, the board can be folded or bent together until the groove is close, with or without glue added, when there are produced the four sides of a box, only a bottom and a lid being wanted to complete it. Nails are knocked in crosswise at each of the mitred corners, a bottom and a lid are quickly nailed on, and then there is completed a box without any gaping cracks at the corners. The machine was made at Carrow, by Mr. Keymer, under Mr. Wormersley's direction, and will shortly be exhibited in the International Exhibition.

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* There is reason to conclude that these measurements require to be corrected.—A. R.

EXHIBITIONS.

Vienna Exhibition.—Belgium is well represented at the Vienna Exhibition in the industrial section, by nearly 500 exhibitors. It is stated that one firm alone has spent no less than 200,000 francs for the carriage and fixing the machinery that they have sent. The well-known engineering establishment of Seraing, John Cockerill & Co., exhibit a powerful blowing engine in this department. The number of Spanish exhibitors is between 3,500 and 4,000; and special mention must be made of the interesting exhibit of school books and educational appliances sent by the Minister of Public Instruction. A model of the triumphal car of Maximilian I. is sent here from the National Museum of Madrid. The Spanish colonies contribute a complete assortment of cigars and tobacco. In the Italian Section an interesting collection of models of ancient ships is sent from the arsenal at Venice, showing the progress of naval architecture from the earliest times down to the present day. Models of the piles on which the city of Venice is built are shown, no less than 1,200,000 piles having been used for the foundation of the church of Sainta Maria della Salute.

Sanitary and Educational Exhibition.—In connection with the Social Science Congress, to be held at Norwich, from the 1st to the 8th of October next, there will be an exhibition of educational, sanitary, and domestic appliances, based on the experiment which proved so successful at Leeds, in 1871. The large and spacious drill hall has been placed at the service of the Social Science Association (with the sanction of the Government) by the commanding officer. The object of the exhibition is to bring under the notice of the public generally, and particularly those who are interested in social, sanitary, and educational questions, the latest scientific appliances for improving the public health and promoting education. Among these may be mentioned:—All matters relating to house construction, connected with which are building materials, light, warming, ventilation, and interior ornamentation; flues, fire-places, stoves, boilers, furnaces, gas apparatus; cisterns, baths, piping, filters, fountains, lavatories, and all things connected with the supply and use of water; drain-pipes, tubes, sinks, traps, troughs, closets, urinals, filters, and all plans, diagrams, sections, models, and specimens of sewage and drainage contrivances; cooking apparatus and food-manufacturing machines, culinary utensils, specimens of food, adulterations, condensed fluids, preserved meats, light and cooling beverages; disinfectants, deodorants, antiseptics, and other things relating to the prevantion of disease and preservation of health; hygiene in clothing and dress; plans and models of school-buildings, forms, desks, books, maps, and other articles used in teaching; and all sorts of appliances appertaining to the advancement of sanitary science, the promotion of education, and the improvement of the health and domestic comfort of the community at large. The exhibition will be open to exhibitors from all parts, and the management will be under the superintendence of a committee. A mere nominal charge will be made for space and admission—just sufficient to cover the costs of preparation and defraying the working expenses.

A Virginia railroad conductor has invented a revolving signal light to be attached to the rear of trains, by which the engineers behind them can tell by the speed of their rotations, as shown by the succession of different coloured lights, at what rate the trains are moving, and when they are at rest.

The quantity of wood of all kinds annually imported into Great Britain is not much less now than 16,000,000 cubic feet.

PREVENTION OF FIRES.

The following has been addressed to the Editor of the *Times*:—

Sir,—I read with deep interest your excellent article on the subject of fires and the best means for their prevention or limitation in your paper, and the valuable information it conveys of the inquiries instituted by the Society of Arts concerning the means of protecting this vast metropolis against the dangers of conflagrations.

The plan submitted by Mr. Sharp to the committee appointed for the purpose, however perfect it may be, implies necessarily a great expense, and a considerable lapse of time for its practical execution, even if it were so extensively adopted as to afford the required general security. But, while the ashes of the fires at Chicago and Boston are still warm in the recollection of the public of both hemispheres, and fearful reports are daily read of destructive fires in public and private costly establishments, which, if detected in time might have been readily got under, the command of some contrivance that should give timely notice of the beginning of a fire is, and must be, one of the greatest *desiderata*, especially in rich, densely-populated cities. The studies of men of science and practical engineers have been, therefore, eagerly directed to the attainment of that object, and many very valuable and ingenious contrivances have been produced. But of all those that have come under my notice none possesses, as that invented by Professor Grechi, of Lima, all the required qualities of simplicity, efficiency, relative inexpensiveness, and adaptability to all kind of substances, either solid, liquid, granular, or of any other form that might be feared to be in danger from excess of heat or fire, and equally efficient by day or night. Experiments were given by him before a number of persons at the International Exhibition on the 4th of June. A number of small tin boxes, connected with a central battery, and bells, or lamps, were distributed in various parts of the building, some suspended in the air, some submerged in liquids, and some in grains or other substances. As soon as an elevated degree of temperature was produced, either in the room or the receptacles containing the substances above-mentioned, the loud sound of a bell was heard, a number indicating the portion of the building where the excess of heat was produced was shown on a dial frame, and a lamp was lit by means of a chemico-mechanical contrivance.

Considering the advantages of such a contrivance, and the little expense at which such great benefits can be secured, it seems to me that every room in every house should be provided with one of those fire-detectors, that might be instrumental to the saving of so many lives and rich property that are now daily lost for want of timely warning of danger.

By bringing this invention to the knowledge of your readers, who are millions, you will confer a benefit to humanity, and acquire a right to their gratitude. Further particulars, and an inspection of the instruments, can be had at Messrs. Negretti and Zambra's, Holborn-circus.

F. S.

A new gas burner, known as Wallace's burner, has been found, by Mr. G. J. Warner, to be peculiarly adapted for producing sensitive flames. The gas flame issuing from such a burner is singularly sensitive to sound, especially to high notes.

The discovery of a valuable mine of mica in Warren County, U.S., is reported, from which plates of the mineral over a foot in diameter can be readily obtained.

The specific gravity of the South Staffordshire coal is stated to be about 1·3, so that a cubic yard should weigh 2,190·24 lb., or nearly the statute ton of 2,240 lb.

CORRESPONDENCE.

PRODUCTION OF SILKWORM GRAIN.

Sir,—In consequence of my time having been fully occupied, I have deferred until now my intention of making a few observations on the "Production of Silkworm grain;" and although two months have elapsed since M. Roland's valuable paper on this subject was read before the Society, I trust that I shall not be considered trespassing on your valuable space in making them now.

Having lived for some years in silk-producing countries, and having paid some attention to the cultivation of the silkworm, I am naturally interested in any effort that is being made to insure the production of sound grain.

It is admitted by all authorities that the silkworm disease is both hereditary and contagious, and I quite agree with M. Roland, that in so short-lived an animal as the silkworm, it is useless to attempt to cure any disease, but rather to prevent it by rational education.

There is no doubt that M. Roland's plan affords a natural system of restoring the silkworm to health, and preventing the hereditary taint from reappearing, but I would go still further, and endeavour more effectually to stamp out the disease by a microscopic selection of moths for breeding, and by adopting the cellular system, which has given such excellent results in Italy, in the production of healthy grain.

The food of the silkworm should not be neglected, for by proper nourishment the worms will be preserved in more perfect health, and therefore will be enabled to a great extent, to resist the effects of contagion.

In my opinion, far too little attention has hitherto been paid to the cultivation of the mulberry tree, and without going to the extent of asserting, as many people do, that the silkworm disease is caused by some malady in the mulberry tree, I have no hesitation in advocating the re-acclimatisation of the mulberry as one of the principal means by which the silkworm may be regenerated.

It cannot be denied that the leaves of the mulberry tree, in its native climate, contain more resin and saccharine matter than those grown in Europe; and there seems to be no doubt that this tree, during its long exile from the country to which it is indigenous, has degenerated to a certain extent. Liebig confirms his supposition in the following passage in one of his writings:—"Le maladiè des vers à soie provient essentiellement du fait que la feuille du mûrier ne contient plus en quantité suffisante, on en proportion convenable, les elements de la nutrition de l'animal." Bonafous, in his "L'art d'élèver les vers à soie," says, "Une longue servitude ou une domésticité héréditaire agit sur les animaux de la même façon q'une longue culture finit par éloigner les végetaux de leur premier type."

To Signor Gottardo Cattaneo, of Milan, is due the credit of having re-acclimatised the mulberry in Italy, and the splendid results obtained from silkworms reared on the "original mulberrry trees" (*Gelsi primitivi*) grown from seed obtained in the north of China by this gentleman, tend to support this theory.

If England is ever to become a silkworm-grain producing country, I cannot too strongly recommend that no care or expense should be spared in the re-acclimatisation of the mulberry tree.

I am convinced that much good might be done were the subject taken up by the Society of Arts, and I venture to suggest that the "Sericulture" would be a fit title for a course of Cantor lectures; and were competent persons sent to Italy and other silk producing countries, to make themselves acquainted with silkworm rearing, the various systems of producing grain, and the use of the microscope in detecting traces of the disease in the moth and eggs, there is very little doubt that in a few years their knowledge would be turned to account, and England might compete with Japan for the production of grain.

A large field for enterprise is, I am convinced, open in this branch of industry, the importance of which will be seen from the fact that Italy imports annually not less than 92,000 kils. of silkworm grain, representing a money value of upwards of two millions sterling.—I am, &c.,

Bombyx Mori.

Italy, 10th June, 1873.

THE SCIENCE OF ENERGY.

Sir,—In the very able and interesting Cantor lecture by Mr. Rigg, I am sorry to see that he begins with the great fallacy which for the last twenty years has vitiated the whole science of energy. He says, "Wherever, energy is lost by resistance heat is produced." This, of course, is a simple matter of fact and observation; but if such a matter be mis-stated, or imperfectly stated, at the threshold of a science, all its conclusions become erroneous, or, to say the least, only partially true. Now what are the real facts as proved by experiments? The destruction of energy may produce heat, or cold, or neither; that is, it may produce an equal quantity of both, so that in the result there is no variation of temperature. Thus a weight falling on a mass of metal produces heat; if its fall be checked by elastic wires it produces cold; if the two be combined, equal quantities of heat and cold may be produced. Conversely, a weight falling on a lump of india-rubber produces cold; if its fall be checked by an elastic string of india-rubber it produces heat. If its fall condenses air it produces heat; if it be so contrived that it expands air it produces cold; if it compresses water above 42° F. it produces heat; if below 42° F. it produces cold; if at 42° F., it produces neither heat nor cold, or perhaps equal quantities of each. An electric current passing through wires usually produces heat, but the wires through which it passes may be so arranged that it shall produce cold.

It is quite plain that if a true science of energy is to be built up, the whole of the facts must be taken into consideration. Partial facts can be the foundation of only a false science. The experiments on which only a true theory can be built have hitherto been comparatively few and one-sided. If the theories of Joule, Sir W. Thomson, and other great men, as they undoubtedly are, have been too hastily accepted in their completeness, and too wide generalisations drawn from partial facts, it is the part of true scientific greatness to pull down a too hastily constructed building, and to lay fresh foundations in more numerous experiments. The scientific world ought to be looking forward with interest to the time when the Committee of the British Association appointed to report on this subject will at length break their long silence of three years and a-half, and either give us a theory which will bear full investigation, or at least confess the imperfection of the present theories.—I am, &c.,

H. Highton.

Putney, June, 1873.

ECONOMY OF COAL.

Sir,—The *Edinburgh Review* for April last contains an article upon the cost and consumption of coal, No. 280, pp. 456-91, wherein it is stated (p. 467), "That so long ago as the year 1635, coals cost in London 10s. per London chaldron, the lowest price to which we can trace them, as well as the earliest date; that in 1793 the price was 42s. 6d. per chaldron; and (p. 467) persons —not paupers, but economical lodgers—have this last winter (1872-3) been paying as much as 5s. for a single sack of coals of inferior quality." In a note (p. 470) it is stated—"The anonymous author of the well-known work, entitled 'Our Coal and Our Coal-pits, the People in them, &c.,' has afforded appropriate information about strikes in pp. 203 *et seq.* of his work (1853)." In this review also (vol. 91, pp. 88-89, and vol. 125,

p. 549) the opinion of Professor Rogers as to the areas of coal-fields and the reason of fatal accidents in coal-mines, are stated respectively. The writer, in No. 280, observes that "every five years an increased supply of a million tons of coal is required in Great Britain, and as in every six minutes a child is born in London and its boundaries, in every six minutes an additional ton of coal is required." The article concludes with the allegation that "prodigality, wastefulness, lack of prudent calculation, social selfishness, class interests, and national neglect of social, moral, and physical laws in relation to this gift will bring retributive justice upon us or upon our property.

In a country like Britain it is not possible to regulate the periods for using fires, but the knowledge of the thermometer is practically as useful in regulating the temperature of a room as that of the barometer is in preparing for storms at sea, might avoid the household waste which now prevails.

During a recent visit to the Shetland and Orkney Isles, I observed turf fires to be much used by the people, and I believe that chalk mixed with coal (30 parts of chalk to 100 of coal) may be used with advantage and economy.—I am, &c.,

Chr. Cooke.

Swalcliffe, Oxon, June, 1873.

NOTES ON BOOKS.

The Soldier's Manual of Sanitation. By Deputy Surgeon-General C. A. Gordon, M.D., C.B. (London: Balliere, Tindall and Cox. 1873.)—Brief directions, arranged in alphabetical order, are given for the treatment of accidents, wounds, sickness, and various casualties to which the soldier is subject. Such knowledge is very much required in our army, and it might often serve to prevent serious mischief, by enabling a simple remedy to obviate the necessity for the more elaborate treatment required when a disease has gained ground.

Turning for Amateurs. ("Bazaar" Office.)—This little work gives a complete account of the ordinary lathe, and the chucks and tools used therewith. There are also full instructions for the use of the tools most commonly employed in simple turning, so that the book is likely to be very useful to the class for whom it is specially intended.

GENERAL NOTES.

Food Preservation.—The Geelong Meat-Preserving Company are now preserving something over 20,000 tins a week of beef and mutton. What promises to be a very important trade has been opened up with India. Some time ago the company sent a small consignment there of preserved meats and soups; these were so highly approved of, that by the last mail the company has received an order for between fourteen and fifteen hundred dozen of tins.—*Melbourne Argus.*

An Old Invention.—From a paper on "The Locomotive Engine," by Joseph Harrison, jun., read before the members of the Franklin Institute of Pennsylvania, February 21, 1872, is taken the following paragraph:—"The engineer, noting the curious things in bronze and in copper exhumed at Pompeii, and gathered together in the Museo Borbonico, at Naples, will linger near a small vessel for heating water, little more than a foot high, in which are combined nearly all the principles involved in the modern vertical steam-boiler; fire-box, smoke-flue through the top, and fire-door at the side, all complete; and, strange to say, this little thing has a water-grate made of small tubes crossing the fire-box at the bottom, an idea that has been patented twenty times over, in one shape or another, within the period of the history of the steam-engine."

Asphalte Roofing.—Warwick Castle is now being roofed with asphalte in the parts being restored, after severe tests have shown asphalte not only to be non-inflammable, but calculated to stop the progress of fire, however great the heat may be. With so many alarming fires around, says the *Engineer*, it is worth consideration whether this material cannot be brought into wider use as a contribution to general safety.

England and Central Asia.—The *Eastern Budget* says that the Russian Government is not at present disposed to assist M. de Lesseps in his plan for a railway communication between Russia and India. It is now busily engaged in preparing for the construction of a railway from Petrovsk, on the Caspian, to Resht and Teheran, and it considers that this line and that from Baku to Teheran, *via* Tiflis, which is already in course of construction, should be completed before any others are taken in hand.

Photographic Printing.—M. Marion, of Paris, has been making some stir about a photographic process, which he claims, for printing. A sensitive paper is prepared with the ferro-prussiate of potash; the drawing or diagram to be copied is placed on this, and the whole exposed to the solar rays. A copy is formed of white lines on a blue ground. This is nothing more than the cyanotype process of Sir John Herschel, which he published more than twenty years since, and which has for many years been employed in this country by Mr. Willis for copying mechanical drawings.—*Athenæum.*

The St. Gothard Railway.—According to the latest official returns it appears that the progress made, up to the 30th of April, at the St. Gothard tunnel, was as follows:—At north end, Goscheman, 117 metres; south, Aisolo, 177 metres. Total length of gallery driven up to the 30th of April, 294 metres; to the 31st of March, 252 metres. Length driven during the month of April, 42 metres. The line from Lugano to the Italian frontier at Chiasso, will probably be commenced without delay; and tenders for the construction of about twenty-five kilos. of railway are advertised to be sent in during the present month.

New Engraving Process.—A very novel and curious process of wood-engraving is called the Planotype. The design to be engraved is transferred to a block of lime-tree wood. The block is then placed in a machine resembling an engraving machine, the graver being heated red hot by a gas jet. The design is gradually burned into the wood. Figures or letters of reference are impressed by means of punches. When the red hot engraver has done its work a cast in type metal is taken from the block, which is then used for printing like the ordinary stereotype plate. It is said that the finest details are faithfully produced, and that the practice carried out on a large scale is found to give satisfactory results.

New Fuel.—Mr. L. Banks, of Hull, proposes a new manufacture of fuel. The invention relates to the combination of the following matters:—1. The refuse which accumulates round the mouths of coal-pits. 2. Small coal. 3. Turf, peat, or such like matter. 4. Mineral pitch. 5. Coal-tar. 6. The scum or refuse from cotton seed after obtaining oil-cake therefrom. The coal-tar and the mineral pitch are prepared by being mixed whilst hot, and after being boiled in the ordinary manner in equal proportions. The two are then run together; before use they are re-boiled and mixed with the other ingredients before named. The whole are then compressed together by steam-power or otherwise, and the composition is then ready for use.

Sugar a Test for Potable Water.—From an article on "The discrimination of Good Water and Wholesome Food," in the *Pharmaceutical Journal and Transactions*, we find the following simple directions given for testing water, whether it is good and drinkable:—"Good water should be free from colour, unpleasant odour and taste, and should quickly afford a good lather with a small proportion of soap. If a half a pint of the water be placed in a perfectly clean, colourless, glass-stoppered bottle, a few grains of the best white lump sugar added, and the bottle freely exposed to the daylight in the window of a warm room, the liquid should not become turbid, even after exposure for a week or ten days. If the water become turbid it is open to grave suspicion of sewage contamination; but if it remain clear, it is almost certainly safe. We owe to Heisch this simple, valuable, but hitherto strangely neglected test."

Solar Heat as a Tool.—During the recent building of a bridge in Holland one of the traverses, 465 feet long, was misplaced on the supports. It was an inch out of line, and the problem was how to move it. Experiment proved that the ironwork expanded a small fraction of an inch for every degree of heat it received. It was noticed that the day and night temperature differed by about 25 degrees, and it was thought this might be made to move the bridge. In the morning the end out of place was bolted down securely, and the other end left free. In the heat of the sun the iron expanded, and towards night the free end was bolted down, and the opposite end was loosened. The contraction then dragged the whole thing the other way. For two days this experiment was repeated, till the desired place was reached. We find that no record that the heat of the sun has ever been employed in this way before.—*Iron.*

NOTICES.

SUBSCRIPTIONS.

The Midsummer subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

THE LIBRARY.

The following works have been presented to the Library:—

Exposition Triennale des Beaux-Arts de Bruxelles. Compte Rendu du Salon par Hyacinthe de Bruyn.

The Darwinian Theory and the Law of the Migration of Organisms, translated from the German of Moritz Wagner, by James L. Laird. Presented by the publisher, Mr. Edward Stanford.

Record of Draught of Water of Sea-going ships leaving Ports in the United Kingdom. Reports from 8th May, 1872, to 26th February, 1873.

The Soldiers' Manual of Sanitation, by Deputy Surgeon-General C. A. Gordon, M.D., C.B.

The Railway Gauge Question in Victoria, Australia. Papers laid before Parliament. Presented by the Agent-General for Victoria.

Manuel du Microscope dans ses applications au Diagnostic et à la Clinique, par Les Docteurs M. Duval et L. Lereboullet. Presented by G. W. Yapp.

Algemeene beschrijvende Catalogus der Houtsoorten van Nederlandsch Oost—indië, door F. W. Van Eeden. Presented by the Author.

Journal of the Society of Telegraph Engineers, Vol. 1, No. 3.

Proceedings of the Zoological Society of London. Part 3, June—December, 1872.

Transactions of the Zoological Society. Vol. 8, part 5.

Direzione Generale delle Strade Ferrate. Relazioni sulle costruzioni e sull'esercizio delle Ferrorie Italiane pare L'anno, 1872.

An Inquiry into the Necrology, History, &c., of some Parishes in the County of Glamorgan, by J. H. James. Presented by the Author.

Some Account of the Parish Churches of Abbey-Dore, Kilpeck, Allensmore, and Holmer, by J. H. James. Presented by the Author.

A Practical Treatise on Life and Fire Assurance, Annuities, and Reversionary Sums and Leases, for Terms and for Lives, by J. H. James. Presented by the author.

Sociedad Economica Matritense. Resumen de sus Actas y de sus Tareas en el año, 1872. Presented by the Society.

Phonic Shorthand for Schools, Business Writing, and Reporting, by Eliza B. Burns. Presented by the Author.

The following have been presented by the Author, Alexander George Findlay, F.R.G.S.

A Directory for the Indian Ocean, with Descriptions of its Coasts, Islands, &c., from the Cape of Good Hope to the Strait of Sunda and Western Australia; including the Red Sea and Persian Gulf.

A Directory for the Indian Archipelago, China, and Japan, from the Straits of Malacca and Sunda, and the Passages East of Java, to Canton, Shanghai, the Yellow Sea, Japan.

A Directory for the North Pacific Ocean, with descriptions of the Coasts between Panama and the Sea of Japan, and of the Islands north of the Equator, including the Japanese Archipelago.

A Directory for the South Pacific Ocean, with a description of its Coasts and Islands between Cape Horn and Panama, New Zealand and Australia.

A Directory for the Ethiopic or South Atlantic Ocean, including the Coasts of South America and Africa; with the Islands, &c.

Memoir, descriptive and explanatory, of the Northern Atlantic Ocean, and comprising instructions, general and particular, for the Navigation of that Sea.

A description and list of the Lighthouses of the world, 1872-73.

Chart of the Lighthouses of Great Britain, &c.

Chart, and notes explanatory of, of the North Atlantic Ocean.

And the following Sailing directories, with charts:—

The English Channel and Southern Coast of Ireland.
Western Europe.
The Mediterranean Sea (Western part).
The Mediterranean Sea (Eastern part).
The Strait of Gibraltar and the Mediterranean Sea.
The Mediterranean Sea, including the Adriatic Sea, the Black Sea, the Archipelago and the Coast of Africa.

The following have been presented by the Smithsonian Institution, Washington, U.S.:—

Proceedings of the American Philosophical Society, No. 89.

Third and fourth annual reports of the Geological Survey of Indiana, by E. T. Cox.

Monthly reports of the Commerce and Navigation of the United States, for the fiscal year ended June 30th, 1872.

Thirty-first and second Annual Reports of the American Institute for 1870-72.

Special Report on Immigration, by Edward Young, Ph.D.

Complete Works of Count Rumford, Vol. I.

Memoir of Sir Benjamin Thompson, Count Rumford, by G. E. Ellis.

Department of Agriculture Reports for 1868—71.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Aeronautical Society, 8. (At the House of the Society of Arts.)
Royal United Service Institution, 8½. Lieutenant W. M. F. Castle, R.N., "Game of Naval Tactics."
Asiatic, 3.
Statistical, 3. Annual Meeting.

Tues. ...Biblical Archæology, 8½. Mr. J. W. Bosanquet, "The Fall of Nineveh, and the First Year of Nebuchadnezzar, King of Babylon."

Wed. ...Obstetrical, 8.

Thurs...Bishop Otter's Memorial College, 3. (At the House of the Society of Arts.)

Fri ......Geologists' Association, 8.
Archæological Institute, 4.

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Is prepared to supply the above Disinfector to Public Companies, Hotels, Hospitals, on Ship Board, or to Private Families. Can be fixed to any existing closet in ten minutes, and hold sufficient Disinfecting Fluid for 950 uses of the Closet.

Complete destruction of sewer gas, and removal of all odours guaranteed, thus rendering the atmosphere of the Closet as pure as the outer air, and so purifying the drains that smells in the basement of houses (where it is used) from kitchen or scullery sinks are unknown.

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DEATH OF BARON LIEBIG.—RESPECTFUL NOTICE is given by LIEBIG'S EXTRACT OF MEAT COMPANY (Limited), that the Guarantee Certificate of Genuineness of Quality, signed hitherto by Baron Liebig and Professor Max von Pettenkofer, will in future, in accordance with Baron Liebig's own directions made many years ago, be signed by his Colleague Professor Max von Pettenkofer, the eminent Chymist, and by Hermann von Liebig, son of Baron Liebig, who has been acting as his special assistant in the Analysis of the Company's Extract. Thus the excellence of the well known standard quality of Liebig Company's Extract of Meat will continue absolutely unaltered.

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SPECIAL PRIZES

OF

THE SOCIETY OF ARTS.

THE ALBERT GOLD MEDAL,

Established in memory of His Royal Highness the Prince Consort, for eighteen years the President of the Society, and awarded annually "for distinguished merit in promoting Arts, Manufactures, and Commerce."

£500

Has been placed at the disposal of the Council to promote, by means of prizes or otherwise, ECONOMY IN THE USE OF COAL FOR DOMESTIC PURPOSES. With this view the following prizes are offered:—

1. For a new and improved system of grate, suitable to existing chimneys as generally constructed, which shall, with the least amount of coal, best answer for warming and ventilating a room.—THE SOCIETY'S GOLD MEDAL AND FIFTY POUNDS.

2. For a new and improved system of grate, suitable to existing chimneys as generally constructed which shall, with the least amount of coal, best answer for cooking food, combined with warming and ventilating the room.—THE SOCIETY'S GOLD MEDAL AND FIFTY POUNDS.

3. For the best new and improved system of apparatus which shall, by means of gas, most efficiently and economically warm and ventilate a room.—THE SOCIETY'S GOLD MEDAL AND FIFTY POUNDS.

4. For the best new and improved system of apparatus which shall, by means of gas, be best adapted for cooking, combined with warming and ventilating the room.—THE SOCIETY'S GOLD MEDAL AND FIFTY POUNDS.

5. For any new and improved system or arrangement not included in the foregoing, which shall efficiently and economically meet domestic requirements.—THE SOCIETY'S GOLD MEDAL AND FIFTY POUNDS.

The Council reserve to themselves the right of withholding all or any of the above prizes, as the judges appointed by them may determine.

The competing articles must be delivered not later than the 1st of December, 1873, with a view to their being tested, and subsequently shown in the London International Exhibition of 1874. Competitors must state for which premium their communication is sent in competition.

£200.—SWINEY PRIZE.

JURISPRUDENCE.—Under the will of Dr. Swiney, a silver goblet of the value of £100 sterling, containing gold coin to the same amount, is presented, on every fifth anniversary of Dr. Swiney's death, to "the author of the best published treatise on jurisprudence."

The next award of this prize will be made on the 20th of January, 1874. Competitors should send in copies of their published works not later than December, 1873.

£100.—TREVELYAN PRIZE.

PRESERVED FRESH MEAT.—The sum of £100, placed at the disposal of the Council by Sir W. C. Trevelyan, Bart., with the Society's medal, is offered for the discovery of a process for preserving fresh meat in an uncooked or raw state better than by any method hitherto employed, applicable to the preservation of meat in countries where it is now almost valueless, so as to render it an article of commerce.

FOTHERGILL PRIZE.

Under the will of Dr. Fothergill, funds are bequeathed for the offer of a medal, and the following subjects are proposed to the Society for their consideration:—

"1. The best method of preventing destructive fires, and of detecting incendiaries.

"2. Of speedily extinguishing fires when water is scarce.

"3. Of speedily securing valuable property from the flames, and also from thieves.

"4. Of preventing or diminishing the numerous fatal disasters from fashionable muslin dresses catching fire, whether by rendering such dresses less combustible, or having constantly in readiness a cloak of incombustible fabric, composed of asbestos or amianthus, with which instantly to enwrap the whole body.

"5. Paper of this kind (incombustible) might preserve from fire valuable deeds and other manuscripts. A premium for the encouragement of such a manufacture is also earnestly recommended.

"The above to be varied at the Society's discretion."

On the present occasion the Society's medal is offered as follows:—

GOLD MEDAL.

UNINFLAMMABLE WOOD.—For the economic production of uninflammable wood, so as to render buildings in which it is employed less destructible by fire

HOWARD'S PRIZE.—GOLD MEDAL OR £25.

For the production of a traction engine of moderate power, capable of being employed as a substitute for horse power on tramways and in the streets of cities and towns. The engine to form one structure in combination with the tramway carriage. The power may be generated by any means, provided that noise, noxious fumes, or the discharge of refuse into the air or on to the road-surfaces are avoided.

GOLD MEDAL.

For the discovery or manufacture of a means for safely and economically generating power suitable for use in place of steam. It should be free from refuse, noxious fumes, and injurious effects on the metals with which it may be brought into contact, or on to the workmen employed.

SILVER MEDAL OR STOCK PRIZE.

Under the will of John Stock, funds are bequeathed for the offer of a medal for the encouragement of drawing, sculpture, and architecture.

SHELL CAMEOS.—On the present occasion the Society's medal is offered to female artists, for the best cameo designed and executed on any of the shells ordinarily used for that purpose.

The Conditions of the above, and a List of the General Prizes may be obtained on application to the Secretary.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,076. Vol. XXI.

FRIDAY, JULY 4, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

ANNUAL CONFERENCE.

The Twenty-second Annual Conference between the Council of the Society and the representatives of Institutions in Union, took place at the Society's House, on Friday, the 27th June. Edward Carleton Tufnell, Esq., Vice-President of the Society, presided.

The following is a list of the Institutions and Local Educational Boards represented at the Conference, with the names of the representatives nominated by them:—

Birmingham and Midland Institute	Mr. W. C. Aitken. Mr. Alfred Cresswell.
Bromley (Kent) Literary Institute	Mr. W. W. Baxter. Mr. G. H. Payne.
Bromsgrove Literary and Mechanics' Institute	Mr. R. P. Amphlett, Q.C., M.P. Mr. H. F. Vernon.
Carlisle Mechanics' Institute	Mr. C. P. Hardy. Mr. Edmund Potter, M.P.
Crewe Mechanics' Institute	Mr. G. Pottie. Mr. J. Robertson.
Faversham Institute	The Mayor of Faversham (Mr. R. Watson Smith).
Huddersfield Mechanics' Institute	Mr. John Sugden.
Hull Young People's Christian and Literary Institute	Mr. E. Allison. Mr. H. J. Atkinson.
Lancashire and Cheshire Union of Institutes	Dr. R. M. Pankhurst. Mr. T. Ashton, J.P. Mr. T. Lawton.
Leeds Young Men's Christian Association	Mr. London.
London, Birkbeck Literary and Scientific Institution	Mr. J. H. Levy. Mr. T. Lyle. Mr. G. M. Norris. Mr. T. J. Pearsall.
„ City of London College	Rev. R. Whittington. Mr. W. J. Bishop. Mr. J. Husband. Mr. J. H. Levy.
„ St. Stephen's Evening School (Westminster)	Mr. W. H. Baker. Mr. W. Davis. Mr. W. J. Hill.
„ Tonic Sol-fa Teachers' Association	Mr. W. R. Bourke. Mr. E. J. Hammond.
„ Walworth Literary and Scientific Institution	Mr. J. S. Noldwritt. Mr. R. Strong, J.P. Mr. F. Wood.
„ Young Men's Chr. Association	Mr. W. Priestland.
Watford Public Library	Rev. Newton Price.
Wellingborough Literary Institute	Dr. Charles Adams. Mr. Cuthbert Curtis. Mr. T. S. Curtis.

The Educational Officer (Mr. C. Critchett) read his Report to the Council, as follows:—

To the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce.

Gentlemen,—It again becomes my duty, as the officer of the Society entrusted with the Educational Department, to submit to the Council, for the information of the Conference, an account of its proceedings in connection with education during the past year.

You will, no doubt, remember that when I had the pleasure of appearing before you last year, it was my duty to speak of a very important, but rather discouraging announcement, to the effect that the Council had then decided to discontinue the annual examinations, which have been carried for no less than eighteen years. In the *Journal* for the 29th December, 1871, this paragraph appeared:—

> "The Council have passed the following resolution:—'That the time has now arrived when the present system of examinations is no longer necessary, and that the encouragement of particular subjects, bearing especially on Arts, Manufactures, and Commerce, should be promoted by special means.' It will therefore be seen that, after the next examinations, to be held in April, 1872, the present system will cease."

The announcement of the discontinuance of the examinations produced, as was not unnatural, considerable discouragement amongst the teachers and students, who, for years past, had looked to the certificates and prizes of the Society of Arts as their most powerful stimulus to exertion, and from various large and influential institutions, especially in the manufacturing districts and in London, the Council received memorials expressive of the very strong desire of the managers that the old examinations, to which they had been so long accustomed, should be continued.

The Council, therefore, instructed me to inquire how far the ground occupied by our examinations might be truly said to be covered by those of other public bodies, and I found, upon closely investigating the conditions upon which the Universities and the Science and Art Department, as well as other bodies, carried out their respective systems, that, after all, their examinations did not, to any great extent, reach the class of students for whom ours were established. The Council, therefore, in deference to the strongly expressed wish above referred to, determined to rescind the resolution for the discontinuance of the examinations, but this decision was not arrived at till late in the year, and it was not till the 18th of October last that the following notice appeared in the *Journal*:—

> "In accordance with the report of a Committee appointed to consider the propriety of rescinding the resolution for discontinuing the examinations, the Council have decided to continue them in the following subjects, for the year 1873:—
>
> Arithmetic.
> Book-keeping.
> Floriculture.
> Fruit and Vegetable Culture.
> Logic.
> Political Economy.
> English History.
> English Language.
> French, including Commercial French.
> German, including Commercial German.
> Italian.
> Spanish.
> Theory of Music.
>
> "It will be seen that several of the subjects in which examinations were held this year have been omitted, and

French and Commercial French have been combined, as well as German and Commercial German."

The fact of this announcement appearing so late as in October last naturally had a tendency to diminish the number of candidates. Many of the Institution classes must have been for a time carried on under the impression that the acquirements of the students would not be tested this year in the usual manner; moreover, six subjects —The Metrical System, Mensuration, Domestic Economy, Geography, Latin, and Elementary Musical Composition, were removed from the list. Taking all this into consideration, it may be said that the diminution in the numbers this year, as compared with last, is but insignificant. The tables show that, in 1872 there were 1,198 examined, of whom 972 passed, while in 1873 there were 1,052 examined, of whom 880 obtained certificates, and thus the proportion of those who have succeeded in obtaining certificates is greater this year than last, when only 81 per cent. were successful, while on the present occasion rather more than 83 per cent. have been so. 43 prizes have been given this year out of 51 offered, while last year there were 55 awarded out of 79 offered, the proportion being higher this year, compared with last year.

The number of papers worked this year was only 1,359, as against 1,689 last year, the number of those for which certificates were given being respectively 1,087 and 1,327. In estimating the significance of these figures we ought, of course, to allow for the necessary diminution caused by the omission of the six subjects just referred to. The number of papers worked last year in these subjects was 302, and if this be added to 1,359 the sum is 1,661, or only 28 less than last year, a conclusive proof, as it appears to me, that there is no falling-off in the interest with which these examinations are regarded by the class of students for whom they were established. Indeed, considering the discouragement and doubt that the announcement of their intended cessation would be apt to produce, it is wonderful that so large a number of candidates have appeared this year.

The Prince Consort's prize of twenty-five guineas has been awarded to Thomas Richard Clarke, now of the Birkbeck Institution, and formerly of the Salford Working Men's College, who has gained eight first-class certificates, and six prizes, in the last four years. It is remarkable that last year this prize was gained by a candidate from the Salford Working Men's College.

I have again to express regret that neither this year nor in the three preceding ones have the Council been able to award the prize of ten guineas offered to females, no qualified candidate having fulfilled the conditions, but out of the nine other prizes offered specially to females three have been taken. I may mention that the first prize in Political Economy is this year taken by a female, an upholstress. There were fifty-two females who gained certificates.

I may here draw attention to an announcement which appeared in the *Journal* for the 4th April last, that the National Union for Improving the Education of Women of all Classes,* a society of which her Royal Highness the Princess Louise (Marchioness of Lorne) is president, has offered a scholarship of £25, tenable for one year, to the best female candidate in the Society's General Examinations, it being a condition that she shall be in training as a teacher, and that she consent to pursue her studies for six months at some place of superior instruction in the United Kingdom or abroad approved by the National Union. I am in communication with the National Union in reference to the award of this scholarship.

It is to be regretted that the *viva voce* examinations in modern languages, suggested by a member of the Council, Mr. Hyde Clarke, have never been taken up to any considerable extent by the Institutions, for with the present greatly increased facilities of intercommunication with foreign countries, and the value attached in many parts of the world to English workmen, the advantages of such a system seem unquestionable. This year, however, these examinations have been held at two Institutions, and five candidates have obtained certificates, a larger number than on any former occasion.

The prizes for writing from dictation, for writing and manuscript printing, and for the best specimens of handwriting, as shown in the papers generally, have all been awarded, and the report of the examiner this year is the most favourable that has yet been given.

It appears from the table, p. 637, which shows the result of the Elementary Examinations held by the local boards, the papers being furnished by the Society, that there has been a large increase in the number of candidates. In the higher grade there were 605 this year against 460 last year, and in the lower grade 1,640 against 1,605, the total increase being 180.

Having now reported upon what it will in future be necessary to call, for the sake of distinction, the Society's General Examinations, I pass to the new system carried out this year for the first time—the Technological Examinations.

Many of those present will remember that the conference last year was specially organised for discussing this subject, and that H.R.H. Prince Arthur honoured the Society by presiding. On this occasion the Council put forward the outline of a scheme for these examinations, proposed by one of their members, Major Donnelly, R.E., and this was afterwards elaborated and published as a programme, which is probably familiar to most of those present.

The object of this system is, as stated in the Council's report read at the last conference, "to supplement the existing examinations of the Science and Art Department, by organising examinations in the science and technology of the various arts and manufactures of this country, to be conducted by examiners capable of testing the practical knowledge and skill required in the application of the scientific principles involved in each art or manufacture."

In order that a skilled artisan may really work intelligently at his craft, it is absolutely necessary that he should be acquainted with at least the outlines of the sciences bearing upon it. With this view, it will be seen that the main feature of these examinations is their three-fold character. In the first place, the candidate must prove that he possesses "such an elementary knowledge, at least, of abstract science as will enable him thoroughly

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* Offices 61, Sloane-street, London, S.W.

ELEMENTARY EXAMINATIONS, 1873.

NAME OF BOARD.	Number of Centres.	HIGHER GRADE.				LOWER GRADE.			
		Males.		Females.		Males.		Females.	
		Examined	Passed.	Examined.	Passed.	Examined.	Passed.	Examined	Passed.
Aldershot and Farnham District	1	58	56	3	3	88	87	29	29
Hertford	1	18	11	12	9	106	74	28	19
Lancashire and Cheshire Union of Institutions	46	231	127	5	3	912	399	304	174
Leeds Young Men's Christian Association	1	8	4	..	..	24	11	..	..
Lichfield	1	..	..	4	2	5	2	7	3
New Swindon	1	38	19	..	..	23	10	12	10
Rugby	1	..	..	3	..	..	..	5	4
Weston-super-Mare	1	9	4	..	..	18	1	..	..
Yorkshire Union of Institutes	14	216	102	..	..	73	27	6	1
Totals	67	578	323	27	17	1249	611	391	240

to understand the scientific principles of which his art or manufacture is an application; and, in the second place, he must show such a knowledge of the application of those principles in his trade as will show that he is practically conversant with the various processes and manipulations of the factory or workshop." In the third place, in order to obtain a certificate he must send in a form, certified by his employer, showing that he is, and has been for some time, employed in his trade; that is, he must be a real workman, not an amateur.

The scheme having received the cordial approval of last year's conference, the Council decided to hold the Technological Examinations this year for the first time, and the following five subjects were chosen for the inauguration of the system:—Cotton, Paper, Silk, Steel, and Carriage-building.

In the year 1856, when the Society's General Examinations were held for the first time, six candidates appeared, while in the year 1869, the last occasion on which all the subjects were retained, the number was 2,160. It is remarkable that this year, the first in which the Technological Examinations have been held, exactly the same number, viz., six candidates, have appeared. The number is, no doubt, small, and may not at first sight appear encouraging, but when we remember what a complete novelty Examinations in Technology are; how little those intending to become candidates could judge of the nature of the questions that might be put to them, and moreover when we consider how extremely difficult it is to make such a system public amongst the men likely to avail themselves of it, I think the Council may rest satisfied with this small beginning, in the hope that in a few years the numbers may increase many hundredfold, as was the case with the General Examinations.

In only three out of the five subjects I have mentioned did candidates appear, and, as the results of the science examinations of the Science and Art Department are not yet known, I am unable to say at present whether these candidates have entitled themselves to certificates. I do not, therefore, in this report give their names, but I think it will interest the conference to quote the substance of the examiners' reports on the technological papers.

Mr. John Cheetham, examiner in the cotton manufacture, says of the one paper submitted to him:—

> "Only one candidate has come forward in Cotton Manufacture. His paper, however, is a very satisfactory one. He has passed an excellent examination in the subject, evidencing, in some of his replies, an amount of practical knowledge and a familiarity with mechanical details which, with his skill as a draughtsman, would have justified him in competing for the 'Advanced,' instead of the 'Elementary' grade."

Neither in paper manufacture nor in silk did any candidates appear. I may, however, mention that the gentlemen who undertook to set papers in these subjects were, for paper, Mr. Richard Herring, and for silk, Mr. Francis Cobb. In steel manufacture, including cutting and edge tools, two candidates came forward, and the report of the examiner, Mr. John Anderson, of the Royal Arsenal, Woolwich, is as follows:—

> "I have gone carefully over the papers on 'Steel Manufacture,' and my only regret is that there are so few of them, for those submitted are very superior, and are probably as good as may be expected from students of this class, the papers being written in the short space of three hours.
>
> "Both papers are written by practical engineers, and in addition to their engineering knowledge of the steel subject, they have evidently been reading up the more recent books on steel and materials, and one of them more especially seems to be fairly acquainted with the opinions expressed at the recent meeting of the Iron and Steel Institute.
>
> "It is scarcely possible to draw a distinct line between that which is the real self-acquired knowledge of a student upon any subject, and that ephemeral sort of knowledge which is the result of mere cram for the occasion; it is therefore necessary, in the absence of any other test, simply to take the papers as they are here submitted, and be guided by the written answers.
>
> "As both of these papers are for 'Honours,' there is no difficulty in drawing a comparison between them; for, although both are good, still one of them is considerably more perfect than the other."

In the subject of carriage building, there were three candidates, of whom Mr. George N. Hooper, the examiner, says:—

> "The papers sent in are all highly creditable to the writers, and very encouraging to those who have proposed, and have, thus far, worked out the subject of technology in connection with British manufactures.
>
> "The candidates have on this occasion only answered the elementary questions. However, I must candidly say that I am convinced there are large numbers of young men engaged in the carriage manufacture who could have answered the questions quite as well if they would have

taken the trouble to try, or, I may even say, had they known anything about such examinations being held.

"Many capitalists and manufacturers are not only willing but eager to find intelligent managers, foremen, assistants, who, if they possessed industry, perseverance, and a desire to please would be well paid, and have means of material as well as social advancement.

"If the most intelligent of the rising generation of artizans will but apply their best faculties to their daily occupation, they will find openings not only ready but waiting for them to occupy.

"On one aspect of these examinations I must, however, issue a warning. It has been found that some winners of prizes at workmen's exhibitions have had their heads so turned by a first success that this has injured their future prospects. If, however, a first success is followed up with patient industry and moderation, the examinations can have but beneficial effects."

These reports cannot but be encouraging to the candidates and to the Council. It is satisfactory to find that on this first occasion no candidate has failed, and that the examiners are able to speak in high terms of the technological papers. It is earnestly to be hoped that none of these candidates will have failed in the science subjects, as, should they have done so, they will not, according to the regulations of the examination, be entitled to certificates.

One of the principal objects of the conference held last year was to endeavour to enlist the aid of other public bodies, notably of the ancient and powerful City companies, or Trade Guilds, of London in this undertaking. It was known that many —though not all—of these companies possessed large revenues, and it had been observed, especially of late years, that most laudable anxiety had been shown by those to whom the responsibility of administering these revenues had been committed, that they should be made use of, to a considerable extent, for the public advantage, and particularly for encouraging, in some mode, the trade or craft which was now, or had been at some recent period, the occupation of most of the members.* Under these circumstances, and knowing the earnest desire felt by the courts of some of these companies to use the wealth committed to them for really laudable objects, and not to squander it, as had been too often done in former and unenlightened times, in useless if not injurious charities, the Council made an appeal to these guilds to aid them in this undertaking. I cannot but feel that, considering that the whole system is new, and that notwithstanding every effort to make it public, it is as yet but little known; that, moreover, it is, or was till recently, perfectly untried, and that consequently its success had not been assured—I say, considering all these circumstances, I think the City Companies have, on the whole, very fairly responded to the appeal made to them. The Fishmongers' Company, always amongst the first in every truly liberal undertaking, has given us a donation of fifty guineas, and the Mercers, Drapers, Vintners, Salters, Coach Makers, Spectacle-Makers, and Cloth-Workers have all given contributions. The last named company, the Clothworkers, have it in contemplation to take a much more important step and to establish scholarships in their own branch of manufacture, but as the details have not yet been settled I am unable to say exactly what will be done; but I believe it has been determined that the Society's Technological Examinations shall be made use of as the means of deciding upon the merits of the respective candidates for these scholarships.

Her Majesty's Commisioners for the Exhibition of 1851, in a letter to Major Donnelly, say that, "with the view of encouraging persons to present themselves for the examinations in technology, which have recently been established by the Society of Arts, they have resolved to offer to grant three studentships, of fifty pounds each, to be awarded to the persons who shall distinguish themselves the most in the subjects of steel, silk, and carriages respectively at the examinations in the present year. These scholarships are to be awarded on condition that the recipients go for a year to some place of scientific instruction, such as the Royal School of Mines, the Royal College of Science in Dublin, Owens College, Manchester, or the English, Scotch, or Irish Universities, or other school approved by her Majesty's Commissioners, or travel abroad for the purpose of improving themselves in their trades."

Such rewards as these will be a real encouragement to students, and it is hoped that when the other great trade guilds, who have already shown their willingness to aid the Society in this movement, really understand its character and appreciate the very great advantages it is likely to confer upon the arts and manufactures of this country, they also will follow the example of her Majesty's Commissioners and of the Clothworkers' Company, and aid the Society in establishing scholarships. Indeed, I have no doubt that should any public body or individual decide to give prizes or scholarships in any particular branch of manufacture, the Council of the Society would at once add that subject to its programme.

I must not omit to mention the liberal manner in which several individual members of the Society, whose names have been announced in the *Journal*, have come forward in aid of this scheme, and with such a splendid example before them as that of Sir Joseph Whitworth, who by the establishment of the scholarships called after his name has done so much to encourage technical education, I cannot but hope that other wealthy and liberal men may be led to encourage these Technological Examinations by endowments of a similar kind.

In conclusion, I may announce that it is the intention of the Society to continue the same five subjects next year, with the addition of some others which have not yet been decided upon.

I have the honour to be, Gentlemen,
Your obedient servant,
Charles Critchett,
Educational Officer.

Appendix.

EXAMINERS' REMARKS.

The Examiner in *Arithmetic* says:—"As a whole the papers very much resemble those of previous years. Some of them are exceedingly well done; most of them exhibit a fair acquaintance with the subject; while a few are quite below par both in theory and practice."

The Examiner in *Book-keeping* says:—"The papers are of more than average merit."

The Examiner in *Floriculture* says:—"There is nothing

---

* As an instance of this may be mentioned the course of lectures recently delivered under the auspices of the Stationers' Company, by Mr. Ellis A. Davidson and the Rev. Arthur Rigg, on the arts of printing, type-founding, paper-making, engraving, and wood-cutting. The demand for tickets was so great that the lectures were repeated.

TABLE I.

RESULTS OF THE GENERAL EXAMINATIONS OF 1873.

NAME OF LOCAL BOARD.	No. of Candidates Examined at Previous Examination by Local Board.	No. of Candidates who Passed Previous Examination by Local Board.	No. of Candidates Examined at Final Examination.	No. of Candidates who Passed at Final Examination.	No of Papers Worked at Final Examination.	No. of First-class Certificates awarded.	No. of Second-class Certificates awarded.	No. of Third-class Certificates awarded.	No. of Prizes awarded to Candidates.	No. of Unsuccessful Candidates.
Aberdeen	56	38	39	30	39	3	10	17	...	9
Accrington	...	...	3	2	3	1	1	...	...	1
Aldershot and Farnham	25	25	15	13	28	5	8	8	1	2
Arbroath	7	7	7	7	7	1	3	3	...	...
Ashby-de-la-Zouch	14	14	13	8	13	...	3	5	...	5
Ashford	11	11	11	11	17	8	6	3	...	...
Bacup	40	35	17	14	20	1	2	13	...	
Birmingham	34	26	27	24	35	10	9	12	1	3
Blackburn	4	4	2	2	2	1	1	...	...	...
Blandford	...	...	1	...	1	...	...	...	...	1
Bolton Church Institute	...	...	5	4	7	...	4	2	...	1
,, Mechanics' Institution	13	13	14	7	28	1	2	8	...	7
Bow and Bromley	5	4	4	3	4	...	...	3	...	1
Bradford	7	6	6	6	9	2	4	2	1	...
Bromley (Kent)	...	...	1	1	1	1	...	..	...	...
Bromsgrove	...	...	2	1	2	...	...	1	...	1
Burnley Mechanics' Institution	...	...	1	1	2	...	1	...	...	...
Carlisle	25	21	25	25	32	6	14	11	...	...
Chorley	3	3	1	1	1	...	1	...	...	...
Crewe	20	12	2	1	3	...	...	1	...	1
Derby	4	4	3	3	4	...	2	2	...	...
Devonport	9	9	6	6	7	4	2	1	2	...
Dudley	2	2	2	2	4	...	1	1	...	...
Dundee	...	...	30	21	35	5	8	11	...	
Edinburgh	...	...	4	4	6	2	1	3	2	...
Freetown	...	...	2	1	2	...	...	1	...	1
Glasgow Andersonian University	30	26	36	33	38	5	22	8	...	3
,, Athenæum	50	49	45	38	54	5	16	26	1	
,, Mechanics' Institution	51	49	40	30	42	4	13	15	...	10
Halifax Mechanics' Institution	8	8	7	5	10	1	3	3	...	2
,, Working Men's College	25	21	22	20	34	...	10	16	...	2
Hertford	7	6	6	5	11	...	2	6	...	1
Hitchin	1	1	1	1	1	1	...	...	...	...
Huddersfield	12	7	8	3	12	1	2	2	...	5
Hull Church Institute	30	24	18	17	18	14	1	2	...	
,, Young People's Institute	50	47	39	33	42	9	16	9	3	6
Hyde	5	5	5	4	7	1	3	2	...	1
Ipswich	8	7	12	12	12	2	8	2	...	...
Kendal	...	...	5	5	5	1	2	2	...	...
King's Lynn	...	...	4	4	4	1	2	1	...	...
Leeds Church Institute	...	...	7	7	7	4	2	1	...	...
,, Young Men's Christian Association	32	20	23	16	38	5	5	9	1	7
Leicester	...	...	10	3	13	1	...	4	...	7
Lichfield	2	2	1	1	2	...	2	...	...	...
Liverpool	25	25	21	20	31	4	14	9	...	1
Lockwood	1	1	4	2	8	...	1	1	...	2
London, Birkbeck Literary and Scientific Institution	99	88	76	68	100	26	34	28	13	8
,, City of London College	68	64	90	81	124	37	43	32	8	9
,, Royal Polytechnic Institution	16	16	31	30	41	6	12	20	2	1
,, St. Stephen's (Westminster) Evening Schools	18	17	23	19	36	2	9	15	2	4
,, Tonic Sol-fa Teachers' Association	20	20	8	8	8	...	3	5	...	...
,, Walworth Literary and Scientific Institution	...	...	1	1	1	...	...	1	...	...
Manchester	100	90	94	80	136	44	28	35	3	14
Mossley	19	18	9	9	12	3	3	5	...	...
Newcastle-on-Tyne Church Institute	3	3	10	9	14	3	7	3	...	1
Oldham	7	7	7	7	10	...	3	6	...	...
Paisley	5	5	8	8	9	3	4	2	...	...
Parsonstown	3	3	4	4	4	1	1	2	...	...
Pembroke Dock	12	12	6	6	6	2	4	...	1	...
Penzance	6	6	6	5	14	4	1	7	...	1
Preston	...	...	1	...	1	...	...	...	...	1
Richmond	...	...	4	4	8	1	4	3	...	...
Rotherham	1	1	2	2	2	1	1	...	1	...

TABLE I.—(Continued).

NAME OF LOCAL BOARD.	No. of Candidates Examined at Previous Examination by Local Board	No. of Candidates who Passed Previous Examination by Local Board.	No. of Candidates Examined at Final Examination.	No. of Candidates who Passed at Final Examination	No. of Papers Worked at Final Examination.	No. of First-class Certificates awarded.	No. of Second-class Certificates awarded.	No. of Third-class Certificates awarded.	No. of Prizes awarded to Candidates.	No. of Unsuccessful Candidates.
Salford	59	46	30	27	30	7	5	15	...	3
Stockport Mechanics' Institution	...		9	7	12	...	...	9	...	2
Stockport Sunday School Improvement Society	38	30	15	10	21	...	...	10	...	5
Stourbridge	..	...	[illegible]	2	3	...	1	1	...	1
Swindon	...	...	1[illegible]	9	12	3	3	4	1	2
Thirsk	...	...	1	1	1	1	...	...	...	...
Wakefield	...	...	15	[illegible]	18	3	1	7	...	7
Walsall	2	2	3		5	1	1	3	...	...
Watford	22	21	13	2	14	...	...	2	...	11
York	30	22	15	13	16	4	3	7		2
Totals ...	1144*	1003*	1052	880	1359	261	378	448	43	172

* These returns were incomplete.

Number of Local Boards, 73.

N.B.—Seventy-nine Candidates came forward in Writing from Dictation, and Thirteen in Writing and Manuscript Printing, but, as Certificates are not given for those subjects, they are not included in the above Table, but the prizes awarded in both these subjects, and also the prizes awarded by the Council for Handwriting generally, are included in the list.

TABLE II.—Number of Papers Worked in each Subject in the Four Last Years, with the Result for the Year 1873.

SUBJECTS.	1870.	1871.	1872.	1873.				
				No. of Papers Worked.	No. of First-class Certificates.	No. of Second-class Certificates.	No. of Third-class Certificates.	No. of Papers in respect of which no Certificate was awarded.
Arithmetic	501	546	431	430	66	114	165	85
Metrical System	52	30	56	..	..	..	..	..
Book-keeping	290	295	254	265	119	80	56	10
Mensuration	63	74	48	..	..	..	..	..
Floriculture	9	5	6	9	3	4	1	1
Fruit and Vegetable Culture ..	8	6	7	10	2	4	3	1
Domestic Economy	13	29	13	..	..	..	..	..
* Political Economy	25	31	23	28	7	12	6	3
Civil Government		..	..	..	..	..	..	..
Geography	103	103	91	..	..	..	..	..
English History	120	105	103	93	6	23	26	38
English Literature	82	..	..	..	..	..	..	..
English Language	..	170	174	183	14	51	67	51
Logic	16	23	30	21	4	7	6	4
Latin	20	21	16	..	..	..	..	..
† French	145	158	193	177	9	24	82	62
Commercial French	..	17	20					
† German	26	26	48	41	5	17	12	7
Commercial German	..	4	12					
Italian	3	3	3	2	1	1	..	..
Spanish	10	19	6	9	3	..	4	2
Theory of Music..	72	87	109	93	23	42	20	8
Elementary Musical Composition	51	59	46	..	..	..	..	..
Totals	1.609	1.811	1 689	1.359	261	378	448	272

* These two subjects were united in 1870.
† These two subjects were united this year.

special in the papers this year. The greatest deficiency is in the spelling of the names of plants, and this I have noticed ever since these examinations have been going on, and I have referred to it on previous occasions. Occasionally the candidates fail to catch the purport of the question set, and in such cases, of course, the replies are wide of the mark."

The Examiner in *Fruit and Vegetable Culture* says:—"The papers for this year are of a much higher standard than usual. The two sets which have obtained first class certificates indicate much experience on the part of the candidates."

The Examiner in *Political Economy* says, "that he is desirous of expressing his opinion of the high merit of the answering of the candidates obtaining first-class certificates, and of the creditable character of the answering of the candidates obtaining second-class certificates. Much of the answering of the candidates obtaining third-class certificates is not without merit."

The Examiner in *English History* says:—"There is more than usual inequality in the merits of the papers. Those which have obtained the distinction of a first class were good in all respects, and leave nothing to be desired in respect to accuracy, careful study, grammar, and, in many instances, excellent hand-writing. I am, however, sorry to say that a large number of candidates have failed even to pass in consequence of their very inaccurate spelling. I had hopes, after the experience of the last two years, that this defect would not have reappeared as it has done on the present occasion. I think the attention of teachers should be called to this point."

The Examiner in the *English Language* says:—"I believe that the papers are more numerous than they have been in any former year; but a rather smaller proportion of them than usual reach a high standard of excellence, and the number of failures is considerable. I may, however, observe that in the important matter of parsing there is a general improvement."

The Examiner in *Logic* says:—"Having regard to the length of time allowed for answering, I am very well satisfied with a large proportion of the papers. Indeed, in some cases I am surprised at the considerable knowledge shown, and cannot but think that the examinations must be useful in stimulating study. If I have any general observation to make, it is that students should give more attention to the practice of logical exercises, as recommended last year."

The Examiner in *French*, including *Commercial Correspondence*, says:—"The papers this year are on the whole very satisfactory. There are but few first-class certificates; indeed, there is no candidate showing exceptional powers; but the total number of certificates awarded this year will, I think, be found to be above the average of previous years. One feature which I have noticed on former occasions, but which has struck me more forcibly this time, is that the best and the worst papers are found mostly in groups; showing that the individual aptitude of each candidate is very materially affected by 'local' circumstances—in other words, that the results of the examination are almost absolutely determined by the quality of the teaching."

The Examiner in *German*, including *Commercial Correspondence*, says:—"I consider the result of the last examination very satisfactory. Six candidates have done so well in the subject of German commercial correspondence, as to be entitled to a first-class certificate, and the papers for second and third-class certificates have mostly been far better worked out than those of former years. This result is the more satisfactory, since the subjects set for the last examination were published much later than usual. The candidates for second-class certificates, in particular, seem this time to have paid more attention to the special subjects than was the case on former occasions, and the result is that the translations from English into German are far more correctly done than at the former examinations. Those candidates who were successful enough to obtain first class certificates have evidently had much practice in German commercial correspondence, whilst those who have failed showed chiefly a want of knowledge in German commercial phraseology. I must, therefore, particularly recommend to future candidates for first class certificates to apply themselves diligently to the study of German commercial correspondence, both theoretically and practically. Perhaps nothing requires so much continual practice as German commercial correspondence; so that successful candidates should bear in mind that their present proficiency will be of little value for practical purposes, unless they keep up by constant practice the routine of writing commercial letters in German."

The Examiner in *Spanish* says:—"Considering the results of this examination, I apprehend that the knowledge of the candidates is not, with few exceptions, so thorough and comprehensive as it should be to warrant their competing for the certificates of the Society of Arts, which are undoubtedly one of the best encouragements to learning. I venture to make these observations, thinking that some disappointment may be spared to future candidates if they are timely warned that the certificates they seek are to reward real and not superficial knowledge."

The Examiner in *Handwriting* says:—"This year there is very considerable improvement. Specimens of the bold, well formed characters, to which prizes have hitherto been systematically awarded, are more numerous than on any previous occasion. Much of the writing is, indeed, extremely creditable, and would doubtless obtain very high marks at the Civil Service examinations. It is gratifying to see that the candidates have generally had in their minds the advantages of extreme and uncompromising legibility, without which the most elegant or characteristic writing cannot be considered satisfactory."

The Chairman said the first subject which had been suggested for discussion, was—

"THE IMPORTANCE OF HAVING CLASSES IN SUCH SUBJECTS AS LITERATURE AND POLITICAL ECONOMY IN THE INSTITUTIONS, INSTEAD OF, AS NOW, CONFINING ATTENTION ALMOST EXCLUSIVELY TO SCIENCE SUBJECTS."

Mr. Lawton (Lancashire and Cheshire Union) said that throughout the district which he represented, evening classes were becoming more and more important; but, unfortunately, there were very few classes in literature and political economy, owing to the great difficulty of getting teachers, and providing sufficient fees to pay them. Practically, there were only four or five classes in English literature. Now, in a great many cases, the elementary stages of scientific subjects, especially bearing upon the manufactures of the districts, were now taught in the day schools, so that the boys who were now leaving these schools, did not require to attend evening classes in those subjects. It was very desirable, therefore, that some further teaching should be provided for them, in order to broaden their knowledge and enlist their interest in the institutions. The Science and Art Department paid science teachers, but it did not give any payment to teachers in such subjects as those he had referred to; and therefore the fees required from the pupils were so high as to make it almost impossible for students from the working classes to pay them. It seemed to him necessary that something should be done to extend the operation to evening classes, because, in the course of four or five years, a large body of educated youths would be leaving school, especially in the large towns, who, he was happy to say, were now receiving scientific instruction in connection with the ordinary day schools. He might mention that, from Manchester alone, about two thousand students were sent up to the Department last year, the great majority from day schools. He thought it desirable to widen the area embraced by these classes, and with regard to such important subjects as literature and political economy some strong inducement was needed, if they were to be properly and thoroughly studied. He therefore begged leave to propose:—

"That this Conference recommends the Science and Art Department to take into consideration the question of adding Political Economy to the list of subjects, and paying teachers on results, on the same system as that applied to other scientific subjects."

Mr. Pottie (Crewe) seconded the motion, which was carried unanimously.

"The Desirability of Restoring the Subject of Latin to the General Programme"

was the next subject for discussion.

Mr. Cresswell (of the Midland Institute, Birmingham,) said the experience of their institution in Birmingham showed how advantageous it would be to restore this to the programme. He therefore begged leave to move:—

"That the Council be requested to reintroduce the subject of Latin into their list."

The Rev. W. Price (Watford) seconded the motion.

Mr J. S. Noldwritt (Walworth Institution) remarked that wherever classes were held for teaching languages it was always desirable that Latin should form a portion of the course, because it was evident that any student who had previously acquired a knowledge of the Latin lauguage, however slight, was so far better able to proceed with any modern language than one who had not had that advantage.

Mr Seymour Teulon begged leave to make a remark which had been suggested by Mr. Critchett's report on the technological examinations. It was fair to mention that the Stationers' Company, although they had not been subscribers to the Society's fund for technological subjects, had taken up the matter themselves, and during the present year had arranged for a series of technical lectures, which were given in their own hall, and presided over by the Lord Mayor, who happened to be the master of the company. He (Mr. Teulon) could not but think it would be an exceedingly good application of part the funds at their command, and would help those wealthy and influential bodies to retain their vitality, if they were to contribute liberally towards the advancement of technical education in the way referred to in the report.

Major Donnelly, R.E., doubted whether it was necessary to re-introduce the subject of Latin into the programme, as he thought the local examinations of Oxford and Cambridge sufficiently provided for that subject.

Mr. W. H. Baker (of St. Stephen's, Westminster,) thought the Society should hold examinations in all subjects not included in the programme of the Science and Art Department, South Kensington. He therefore begged to support the resolution.

Mr. Critchett said that the University examinations were confined to persons under eighteen, whereas there were often adults in the evening classes who could not avail themselves of the Oxford and Cambridge examinations.

The **Chairman** said it was extremely useful to learn Latin, if only for the sake of obtaining a better knowledge of English. He could not help connecting a knowledge of Latin in some degree with the remark made in the report of the examiner in writing about the importance of "uncompromising legibility," because without a clear knowledge of a language it was impossible to write it correctly. He had often been puzzled on receiving letters and papers which he could not read, especially from the female part of the population, and he might particularly refer to telegrams, which were now mostly written by young women. He not unfrequently received a telegram which he was utterly unable to decipher, mainly because these persons thought more of what they considered beauty than legibility. They often wrote in that angular style which was formerly considered the correct thing for ladies, but which he had always been strenuously opposed to. He believed a knowledge of Latin, by giving an insight into the derivation of words would prevent many of those blunders in spelling which were now unfortunately so frequent.

The resolution was then put and carried.

The Chairman asked if any gentleman was prepared to open the next subject which had been sent in.

"Would it be desirable to make Commercial Correspondence compulsory for a First-Class Certificate in Modern Languages?"

Mr. Noldwritt said he hardly understood the proposition.

Mr. Critchett said it evidently meant that no first-class certificate should be given in a modern languag unless the candidate showed a certain knowledge of come mercial correspondence.

Mr. Noldwritt said in that case he would open the discussion, merely for the sake of opposing the proposal. A person might be disposed to study a modern language for various reasons quite unconnected with commerce, and he should think it was very undesirable that any attempt of this kind should be made to force upon all students a knowledge of commercial correspondence. For instance, this would certainly dispose of all the female candidates.

Mr. E. Allison (Hull) also spoke against the proposal, saying he had himself, with his own imperfect knowledge of German, been able to understand a German letter, but a German lady to whom he had shown it was quite unable to understand it, simply because she did not know the technical business terms employed. It would evidently be quite absurd to say that no one should obtain a prize in a modern language without being able to write a commercial letter in it.

Mr. Lawton said he desired to move a resolution, bearing on one of the rules of the Society's examinations. Last year the Lancashire and Cheshire Union offered an exhibition of £10 to the candidate who should obtain the greatest number of marks in English literature and history, but it turned out that the regulations of the Society would not allow a candidate who had once obtained a first-class certificate in a subject to be again examined in it, so that a candidate who had taken first-class certificates last year in English history and the English language, with no prize, had had his papers cancelled. He was not aware of any other examining board who shut out candidates in this way before they had obtained a prize, and he thought it a very undesirable regulation. In the Science and Art Department those who obtained a first-class certificate could go in again for a medal, and it seemed a great pity that a candidate should just have got into the first-class and then be thrown aside altogether, and not allowed a second opportunity of competing for a prize. He begged to move, therefore—

"That the Council of the Society of Arts be respectfully requested to cancel the regulation whereby a candidate who has obtained a first-class certificate in any year, in any subject, cannot again be examined in the same subject."

Mr. Strong (Walworth) had much pleasure in seconding the resolution, feeling sure that it had only to be brought under the notice of the Council to be acted upon. It seemed to him that the present regulation placed one who had worked hard, and had gained a certain amount of success, in a worse position than one who had made but little effort.

The resolution was put and carried.

The Chairman said the next subject for discussion was:—

"What Subjects should be added to the Technological Programme next year?"

Jewellery and electro-plating were suggested.

Major Donnelly said he thought this was a question which should rather be left to the representatives of different institutions to state their views upon; but, speaking as a member of the Council, he thought they would be prepared to add any subjects for which prizes were offered, either by individuals or by subscription. If any locality, for instance, would come forward and offer prizes in some particular branch of manufacture, the Council would be prepared to undertake the expenses of holding an examination in that subject. Cloth manufacture would probably be added next year; and the Glass-workers Company were also purposing to offer prizes in that branch, so that that subject also would be added. He did not quite see how the subject of jewellery could be treated in their examination.

Mr. Critchett said that Mr. Aitken, of Birmingham, who had forwarded the suggestion, but who was not present, had mentioned in his letter that hitherto the technological examinations had not embraced any subject in which candidates from Birmingham had been able to compete.

Mr. Teulon said he could quite imagine that, in electroplating there might be a most interesting examination paper prepared, for he believed the subject was a large one, and that several different processes were in use, some producing by far the best and hardest electroplate, whilst the others were quicker in their operation, though not so perfect in quality. He could quite understand that it was a matter in which Birmingham workmen were greatly interested.

Mr. Noldwritt suggested that cabinet-making should be added to the list of subjects.

Mr Cresswell (Birmingham) said he had expected to see Mr. Aitken present. He was quite sure electroplating would make a good subject, being one of the principal trades of Birmingham. Many of the students in their institutions were electro-platers, who, from the knowledge they had obtained in the evening classes, had been enabled materially to improve their position, some even going into business for themselves. He should strongly advocate that subject being added to the programme. In reply to a question from Major Donnelly, he said he had very little doubt that Messrs. Elkington, and other large manufacturers, would come forward and offer prizes.

Mr. Lawton said he hoped at the next conference to be able to report a great increase in the number of candidates for these examinations.

Mr. Noldwritt suggested that ornamental plasterers' work, pargetting, which had formerly been followed to a considerable extent, but had lately fallen much into disuse, might be encouraged.

The Chairman said that the subjects which had been suggested would be brought to the attention of the Council.

"The Effect of Political Clubs upon the Institutions."

Mr. Lawton said this matter was affecting their position in Lancashire and Cheshire to a considerable extent. Only last week the secretary of an institution waited upon him with £1, as their portion of the assets of an institution which had been forced to close, because on one side of the street there was a Conservative working men's club, and on the other a Liberal one, and all the adult members, or the principal portion of them, had left the poor educational institution in order to join these clubs. This was not merely the case in that district, for these clubs were starting up everywhere, especially in the villages, and were telling most seriously on the attendance at the evening classes. He did not himself see how they could get out of the difficulty; but, perhaps, it was desirable that this statement should be made in order to show why it was that the number of adult members attending the institutions in the North was now much smaller than it had been some years ago. Perhaps if the subject of political economy, which had been already suggested, were added to the list of subjects taught in classes, it would have the effect of giving more interest to their proceedings.

Mr. Teulon said it would be very desirable to know if the same difficulty had been noticed in other districts. It certainly seemed desirable that such instruction should be given to the members of the classes, that whatever political clubs they afterwards joined, they might have sound principles upon which to work.

Mr. Strong also said that, in his opinion, the various institutions should, as far as possible, provide instruction for their members in history and political economy, so that they might be able, by comparing what had taken place in the past, to look forward and act wisely in the future.

Mr J. H. Levy (Birkbeck Institution) said a debating society was generally a very good element in an institution; but it would not do for all the Liberals to go to one society, and all the Conservatives to another, or else the objects of such societies would be defeated. If, therefore, the literary institutions could establish debating societies at which both sides would be represented, he thought it might prove an attraction. There was one other matter which he wished to mention, namely, the examination in modern languages. Formerly there was a special examination in Commercial Correspondence, but this had been given up as a separate subject, and amalgamated with the ordinary examination in modern languages. He had no fault to find with the examination in commercial correspondence being combined with modern languages, but it would be a great mistake to make it a compulsory portion of that subject. There were a large number of persons who studied modern languages who had no need for commercial correspondence, and did not want to give time to it. He therefore suggested that a certain part of the paper should be taken up by all candidates, and, in addition, that there should be two other portions, one containing commercial correspondence, thus giving an alternative, so that each candidate might take up either the commercial or the literary part as he preferred. In this way both classes of candidates would be treated fairly.

Mr. Teulon said it was not proposed to make commercial correspondence compulsory. This subject had been introduced some years ago, because many of the leading houses, both in London and the provincial towns in England, had found it extremely difficult to find clerks who could write a good foreign letter. It was, therefore, thought desirable to give young men an opportunity of obtaining a certificate of competency in this subject, but it was perfectly voluntary, and had nothing whatever to do with a thorough knowledge of a foreign language.

The Chairman said he should be glad to hear what any gentleman had to say on the next subject.

"The Act of Parliament of 1843 was passed for the purpose of securing to Literary and Scientific

and Mechanics' Institutions exemption from local rates, provided the Institution does not make any dividend, bonus, or profit. On the faith of this Act of Parliament the Walworth and other Institutions were established. What can be done to arrest the impending danger with which such Institutions are menaced by the Bill now before the House of Commons proposing to abolish the Exemption?"

Mr. Noldwritt said the Act of 1843 was not passed in the form originally intended, for an Act had been drafted by Lord Brougham for the purpose of securing the exemption of literary institutions from every kind of taxation. That, however, was dropped, and eventually the Act of 1843 was passed, securing freedom from local taxation, provided there was no proprietary interest. This led to the formation of several young institutions, amongst others the one which he represented. Six or seven years afterwards, in 1849 or 1850, an attempt was made in Parliament to deprive them of those privileges, but it did not succeed. A meeting was convened in London, on behalf of the Birmingham and Midland Institute, by Mr. Ryland, at which Mr. Bright attended and spoke strongly on the subject. A powerful opposition was organised, and the Bill was not carried. That meeting led to the formation of the Union of Institutions with the Society of Arts, and it appeared to him that the institutions forming that union had reason to complain that when this recent attempt was made to deprive them of their exemption, something worse than indifference had been exhibited by the Council of the Society of Arts on the subject. In his opinion, they ought to have taken up the matter, and invited the co-operation of institutions throughout the country to resist the measure. He should like to know how many institutions now in union with the Society expected to be in existence in another year? Many of them would be entirely wiped out by this Act, and, for his part, he thought the Society had not acted properly in not taking this matter up. He begged to ask if something could not be done before it was too late?

Mr. Teulon thought it was hardly within the province of the Council to enter into such a question. There was at the present moment a Bill before Parliament which dealt with this question, and the better way clearly would be for those institutions which objected to the proposed provisions in that Bill, to petition, through their members, for the exemption which they required. He could only say that the Society of Arts had recently been compelled to pay rates upon their own building although they resisted it for some years. The Council, however, after maturely considering the matter, thought it would be better to pay the rates than to limit the usefulness of the Society, as they would have had to do in order to claim exemption.

Mr. Noldwritt thought the Society should have sent out circulars, and convened a meeting on the subject. Had the Act of 1843 not been passed, some of the institutions would never have been started; and he considered it a breach of faith on the part of the legislature to attempt to alter their position. He wanted to know what the Society of Arts was prepared to do in the matter, and whether they thought the institutions could pay their way and go on if the Bill passed.

Major Donnelly thought it was rather for the institutes interested to have made a representation to the Council to convene a meeting to consider the subject, and for the members of those institutes to have sent representatives to the conference to consider the question. As far as he knew, there had been no representation at all to the Council to take up the matter, and, therefore, he thought it was not right to accuse the Council of neglecting it, when the institutions themselves had taken it so little to heart, and made no movement in the matter.

Mr. Lawton had attended that conference a great many years, and had always found the Council ready to receive and consider any communication from the Institutions in Union. He agreed with Major Donnelly that it was a matter which concerned the Institutions themselves, and that it was their duty either to petition through the Society of Arts, or on their own account get up a memorial and lay the whole case before the members who had charge of the Bill. The Council had had no representation from the institutions feeling aggrieved, and therefore had taken no action in the matter.

Mr. Strong thought the question would have an important bearing on the well-being of institutions. As most of those present were aware, the objectionable clause had passed the House of Commons in committee, therefore he feared any action in that direction would now be too late. If they intended to offer any opposition to the Bill he thought it should be in the House of Lords. He was rather of Mr. Noldwritt's opinion, that the Council should have seen the importance of the measure, and have taken some action upon it, because the institutions looked to them, as the centre, to assist the scattered institutions by bringing them together. Provincial institutions might not have seen the force of the clause taking away the exemption, but to those institutions which were now only just able to keep their heads above water it would be a death-blow if it were passed. He hoped that the Council would, as early as possible, consider the matter, and see if there was any way of offering opposition to the Bill.

Mr Pottie (Crewe) thought it would be very desirable if something could be done by the Society of Arts or by the united efforts of the institutions on the question. He represented the Crewe Institution, which was composed entirely of working men, and last year the Poor-law Guardians came upon them for a rate of £15. They thought the Act of Parliament was specific that scientific or literary institutes were exempt, and therefore they went before a magistrate. The London and North Western Railway Company, with which they were connected, kindly sent their lawyer to assist them in disputing the claim. However, they did not succeed, and had to pay the rate. Then the Local Board came upon them for some £17 or £18, which they had had also to pay. Their subscription was 8s. a year, and it was thought at one time they would have had to raise it to 10s. to keep the institution alive, but he was happy to say that had not been found necessary.

Mr J. H. Levy considered the question a very important one, and if the Society could do anything it was very desirable it should be done. He was very much in doubt, however, whether the same effect which had been produced in the North by the political clubs might not happen with the Society of Arts if it were to interfere with questions of this kind. It was distinctly a political question, and although he was thoroughly of opinion himself that a great wrong was being done, and that the landed interests were interfering in their own interest with prescriptive rights that had existed for some time, in order to ease the local rates, the ultimate effect being to relieve themselves (and he was inclined to think they were doing an unwise thing in the matter), still that was not the right place to discuss such questions. He could quite understand Mr. Noldwritt feeling strongly about it—everyone must do so. It was especially unfortunate that this measure had been introduced at the present time, because the institutions had been hitherto in a great degree deprived of the persons who ought to go to them, elementary education not being sufficiently advanced to provide them with sufficient supporters. Now, when an Elementary Education Act had been passed, one of the effects of which would be to prepare young persons to go to these institutions, in order to ease the rates for this education they were doing something to kill the institutions which they would go to afterwards. He could not help thinking a great deal of mischief was being done, and he thought it very hard that these institutions should be treated in the way proposed, when the ragged schools, Sunday-schools, and places of worship throughout the country were exempted.

Mr. Robertson (Crewe) thought the importance of the subject could not be over-estimated, but did not think the Society of Arts could be in any way blamed for not taking action in the matter. The institutes were not subject to the Society, and therefore to blame the Council for not guiding, advising, or taking action was entirely wrong. No one would have blamed the Council if they had petitioned the legislature to exempt literary institutions throughout the country; no one would blame them if they did so now, and no one would blame the institutions themselves if they did the same. A line must be drawn somewhere, and somebody must pay the rates. Every one could present a good case for being exempted; but if all were exempt who was to pay? There were many institutions, no doubt, which could not afford to pay rates. Mention had been made of one at Crewe, which had had to pay; but the facts of that case were, that they let out their large room for entertainments, from which they drew a revenue; and since the rates had been imposed upon them, they had managed to improve their income from this source, so as to avoid the necessity of raising their subscriptions. He thought that other institutions should do the same, so as to be able to pay the rates from that source.

The Chairman said the matter would be considered by the Council.

Mr. Levy said although he thoroughly agreed that it was a very serious matter to the institutions, he could not ask the Society to take action, because it was a political question.

Mr. G. C. T. Bartley said it was quite possible that the Council might be unfavourable to the principle of exemption.

Mr. Norris suggested that the Council be asked to consider the matter. He would second a resolution to that effect.

Mr. Noldwritt then moved:—

"That the Council be requested to consider the desirability of taking action in the interest of the institutions, in reference to the Bill now before Parliament for abolishing their exemption from local rates."

Mr. Norris seconded the resolution.

The Chairman thought the gentlemen present would, each in his own locality, have much more influence with Parliament than the Society. London was a very large place, and they had no member specially representing them, but most of the members of local institutions had considerable influence with their members.

Mr. Levy said if the Council thought it desirable to act at all, it might do so by making itself the nucleus of an organisation to oppose the passing of the Act.

Mr. Allison did not think any blame attached to the Society for not taking the matter in hand, but rather the other way. One member had said it would be better to pay the rate than take any action; but they not did derive any revenue from their institution at Hull. They had 1,800 members, and their subscription was 4s. per annum, which was as low as possible, and they paid their rates and taxes when due. They had a cricket club, and so on, in connection with the institute, but derived no revenue from that source. He thought the resolution as moved was a very innocent one, but if it was to go further, he should certainly oppose it, considering that the Society was not called upon to go into political questions.

The resolution was then put and carried.

Mr. Lawton thought it would be desirable to alter the words "Political Economy," in the first resolution which had been passed, to "Social Economy."

Major Donnelly thought the alteration desirable, as he imagined some persons would imagine that political economy was connected with politics.

Mr. Levy objected to the alteration, believing it would produce confusion in people's minds on the matter. All the great books upon the subject called the science "Political Economy," not "Social." The fact was that social economy really did include politics, so that instead of avoiding the bugbear they were actually introducing it.

Mr. Noldwritt considered the term "political economy" was widely understood, and would not be confounded with politics.

Mr. Lawton moved:—"That the best thanks of this Conference be given to the Chairman for his kindness and ability in conducting the business on this occasion."

Mr. Robertson had great pleasure in seconding the resolution, which was put and carried unanimously,

The Chairman acknowledged the compliment.

PURCHASE OF RAILWAYS BY THE STATE.

The discussion on this subject was resumed on Thursday evening, June 26th, the Marquis of CLANRICARDE in the chair.

The Chairman, in commencing the proceedings, said he had had the greatest satisfaction in listening to the able speeches which had been made during the discussion, and, notwithstanding what had been said in opposition to Mr. Galt's paper, on the whole he was bound to say they had not the least shaken his conviction that the acquisition of the railways by the State would be a most excellent and desirable course to adopt. All who had had the advantage of hearing or reading Lord Derby's speech would bear him out in saying that the objections to Mr. Galt's plan could not have been more forcibly stated than they were by that noble lord, and, naturally, everything which fell from him fell with great weight. Notwithstanding, however, his powerful exposition of the arguments he submitted to the meeting, he had not succeeded in convincing him. The same with regard to Mr. Vignoles. Whatever fell from so experienced an engineer of course deserved attention, but he was sorry to hear him say that the plan of transferring the Irish railways to the State was brought forward only by persons who had injudiciously invested their money in the railways. Mr. Vignoles' age and experience were such that he must in former days have been acquainted with the real facts of the case, though it was evident he had forgotten them. He (the Chairman) recollected the circumstances attending the formation of the Irish railways, and so far from the railway proprietors coming to the State to ask for assistance, the proposal emanated from the Irish Government of the day, in 1835 and 1836, under that very able official and man of sense, Lieut. Drummond. He it was who brought forward a proposal for Government making the railways, and a plan was submitted to Parliament, with the approval of the late Lord Carlisle, and actually adopted by the House of Commons. It was therefore quite incorrect to say that stock-holders in Irish railways suggested the transfer of their property to the State. It was with great reluctance that he differed from Lord Derby on this question, as he had the highest possible respect for his opinion, but it must be recollected that not only was the opposition raised to this measure generally raised by persons professionally connected with the railways, of whom he wished, however, to speak with the highest possible respect, but, at the same time, if they were to be guided by authority on this question, however high some of these individuals might stand, on the other hand there was the authority of Government in every other civilised country to the contrary. It might be right or wrong, but it was the fact that no other country had adopted the system which prevailed in the United Kingdom; even in our colonies and dependencies, wherever the railway system had been brought to any perfection, the Government had control of the matter as one not to be thrown open to what was called, erroneously, in his opinion, competition. Even in this country was it the fact that there was free competition? Not only would such a thing be really impossible under the existing system, but the State interfered at every turn with every attempted amalgamation, and every plan for extending the railway system. This Parliamentary system was very imperfect —for no one of competent authority examined into these competing schemes. When a committee was selected, care was taken that the gentlemen who constituted it should know nothing whatever of the circumstances of the country with which they were about to deal. As an instance coming under his own observation, he might mention that the last railway committee on which he was asked to sit had to deal with competing schemes in the north-east part of Yorkshire. Twenty-seven days had already been spent upon the matter by a committee of the House of Commons, who had selected one out of three competing schemes. When the Bill came up to the House of Lords, he believed that the members of the committee agreed with him in rejoicing that they had such an easy task before them, supposing the whole matter to have been well discussed before the committee of the House of Commons. But after two days had been taken up in opening the case, they found it necessary to go very thoroughly into it, and after the three Bills had been laid before them, they came unanimously to the resolution that the one selected by the committee of the House of Commons was the worst. In the end, no bill at all was passed that year, and ultimately the contending companies agreed among themselves, and a Bill was passed different from any of the three which had been originally introduced. Now, was there any sense in such a system as that, necessitating, as it did, an enormous waste of money, when the whole matter might have been decided by a competent tribunal at a very moderate expense? Lord Derby and others had admitted that the financial difficulties could be easily removed, and he was somewhat astonished to hear that noble lord express himself to the effect that the possession of these railways would be a burden upon the State in a moment of difficulty. He should have thought that, at such a time, it would be of the greatest benefit that the railways should be controlled and sustained, if necessary, by the State. It never was proposed to give the railways to the public for nothing, but they would be most valuable property. Supposing even that, in a time of distress, not only the shares were depreciated in value, as they naturally would be, but that there was also a diminution of traffic, so that the returns might to some extent suffer, would it not be much fairer that such financial difficulties, arising as they generally did from some public action of the Empire, such as going to war, or otherwise, should be borne by the whole country, than that the loss occasioned in such a way should fall upon individual shareholders who were in no way responsible for the causes of the depreciation. He believed that it would be much less loss to the community as a whole, that the State should, with its powerful credit, bear any temporary difficulty of this sort, than that permanent loss, and perhaps ruin, should be entailed on individuals. He believed the experience of foreign countries had shown that railways did benefit the State, and that a vast sum of money had been wasted in this country upon their construction. Some two or three years ago, at a meeting of the Cobden Club, Mr. Gladstone stated that between one and two hundred millions had been lost in this way, but he should put it much higher. He believed this country had thrown away at least 250 millions by the system pursued, and if railways could be constructed which would afford the same accommodation, and more than that given by the present companies, for a sum of money smaller by the amount he had mentioned, than what they had already cost, to say nothing of the question of ruin to individuals and families from disastrous speculations, it would certainly be a great advantage to the country. For all these reasons he thought that railways would be much better in the hands of Government; and although there might be difficulties, as there always were difficulties connected with any important change, he would ask why were the most eminent men selected to conduct the affairs of the State unless they were prepared to meet and overcome difficulties as they arose. He had no doubt these difficulties might be surmounted, and he hoped the present discussion would be useful, by calling the attention of those competent to judge to the subject.

Mr. Caulfield felt sure that the opponents of the transfer of the railways to the State could not find a more able advocate of their views than Earl Derby; but, nevertheless, he thought the public papers had already shown that his objections were not tenable; in fact, they fell to the ground by their own weight. In his opinion, it was simply a question of the time when it was desirable such a transfer should take place. He would not pretend to adduce all the arguments necessary to make it clear that the time had now arrived, but he might refer to a very exhaustive treatise on the subject by Mr. Galt, which he believed contained everything which could be said upon it. That treatise was brought down to the year 1855, and contained the essence of nearly all the Blue Books which had been issued on the subject, and a great deal more, which nothing but great research could produce, and the only question was whether events which had since taken place had in any way altered the conditions of the question. It appeared to him, however, that the reasons then alleged against private management of railways had since increased in force. The amount contributed to the railways yearly approached very nearly to the interest on the National Debt, and for that sum it was quite certain that four times as much accommodation as was at present afforded could be obtained.

Mr. Saywell said he cordially agreed with the observations of Lord Derby at the previous meeting. This question was of great importance, but he was not one of those who were disposed to imagine that the transfer of the railways from private enterprise to the service of the State would result in an amount of infallibility not possessed under commercial direction. In talking about the State it was necessary to ask what the term really meant. It meant no more than the particular political party which at any given time was able to command a majority in the House of Parliament, and he did not believe that such a body of men would be, as a matter of course, able to manage railways better than those who now conducted them. He opposed the project because they were met there in the rooms of a Society instituted for the encouragement of arts, manufactures, and commerce, and he had always entertained a belief that arts, manufactures, and commerce were best promoted by private enterprise. He did not see, therefore, how he could consistently support a project which, to his mind, would have the effect of very much discouraging all private enterprise. It was evident that private enterprise could not enter into competition with the State, and though one gentleman had proposed that the railways should be put up to public auction and let by contract, that did not seem to be the view of the reader of the paper, who rather advocated that the State should take the complete management and control. If, however, the railways were let by contract, the objection felt by many to placing any additional power in the hands of Government would be removed. In his view, if the Government attended properly to their Imperial duties, they would have quite enough to do; and he quite agreed with the objection urged by Lord Derby, that the measure proposed would lead to the placing of an immense amount of political power in the hands of the Government, which was a thing which ought to be guarded against. They must not forget the long and bitter struggles which our forefathers had had to go through in securing the liberties which we now enjoyed. Those struggles were caused by the overwhelming power of Government, and any increase in that power in the present day would be sure to act prejudicially to the rights and liberties now enjoyed. It would not stop at the railways, as had been already said; the canals and steam boats would follow, and if the State once interfered with trading matters, who was to draw the line? It was not a question of raising the money; no doubt if the step were decided upon, the money could be obtained, but it was a serious question whether they were prepared to place such a large amount of power and patronage in the hands of any Government. He felt very jealous of any and every Government, believing that the Government of this country had quite as much power as was consistent with the preservation of free institutions. He was not one of those who objected to any power being placed in the hands of Government, for it was necessary that they should possess a certain amount of power, but it did not follow that they should become traders or interfere with commercial matters. Such things, he contended, were quite outside their proper functions. Postal and telegraphic communication stood on a different footing, because if at any time a state of war should arise, it was very desirable that such matters should be under the control of the State. With regard to economy, Mr. Frederick Hill had given a very striking instance of the advantage of the contract system over one of State management. It did not at all follow, however, that improvements were not to be looked for in railways, for having travelled a great deal, not only in England and Ireland, but also on the Continent, he was quite ready to admit that there was great need of large reforms, not only in railways managed by private companies, but also in those under State control. For instance, he should advocate the universal adoption of the block system, which, he believed, would secure entire immunity from accidents, at any rate from collisions, and a different construction of carriages, with communication from one end of the train to the other, would, he thought, be very desirable. But these matters could be done quite as well by private enterprise as by the State; and it must be remembered that the State itself was answerable for the greatest part of the waste of money which had been alluded to, as was abundantly shown in the case of the South-Eastern and London, Chatham, and Dover Railways.

Mr. Hyde Clarke said it was a great advantage in all such discussions to elicit individual opinions, but at the same time it was totally impossible that a great and important question should be decided by the views or opinions of any one person. The question before them was of the most momentous kind, affecting as it did the welfare of the whole community. It was a very common thing to say that the welfare of a country depended on its powers of production, but it must be also borne in mind that a very large proportion of the energies of the population were devoted to transport. This consideration entered largely into all questions of prices, whether of food or other commodities, and therefore in dealing with a question of this kind in such a country as Great Britain, which competed with all the nations of the world, it would not do to be led away by considerations whether they would prefer one party or another in power; but all the circumstances must be looked at in order to consider what would be best for the welfare of the country at large. At the previous meeting Mr. Bass had stated that he was a contributor to the extent of £140,000 per annum to the traffic of the country. Now this was very important, in comparison with other outlay in the employment of the labouring classes. The manufacture of Mr. Bass was one not confined to this country; it largely contributed to the export trade, and it was within the cognisance of many gentlemen present that English manufacturers were now subjected to a keen competition on the part of those on the Continent, particularly on the point of cheapness of transit; in fact, the recent extension of the Austrian railways had enabled the brewers of Vienna, who, within a very recent period, had no share in the foreign trade, to compete with English brewers, not only in our colonies abroad, but also within our own empire. A matter of this kind, therefore, affecting the employment of a large number of the working classes, must be looked at from a higher stand point than the question whether a majority constituting the Government was to be invested with any amount of prerogative or not. After all, Government was limited by public opinion, and public opinion in the interest of the country would govern this matter, whatever might be the individual views entertained. Of course, all were in favour of private enterprise—both theoretically and practically they must be so—but, at the same time, it must be borne in mind that those other powers of co-operation and aggregation which they possessed must not be limited. They had all been advocates of private enterprise, with regard to railways; and for himself he must say that many years ago, when Mr. Galt brought this matter forward, he was one who strongly advocated private enterprise, and thought the period had not come when any other course could be adopted. All experience on this subject had shown that whatever errors had been committed in the past, with regard to laying out particular lines, they had given an example to the world with regard to railway construction. At the same time, it must be owned, on the other hand, they had, to a great extent, failed in administration. He would not enter into detail upon that point, because it was hardly right to take up the time of the meeting with the consideration of questions which had been so long and so fully discussed. They ought rather to endeavour, after bringing together a variety of opinions, to produce, if possible, a united sentiment and action on the part of the community, in order that the best possible result might be obtained. If, however, it was desired to ascertain the real value of railway management in this country, there was, perhaps, no fact more striking than that which came under their own notice a year ago with regard to the Midland Railway. It would be remembered that the metropolis was placarded with announcements to the effect that third-class passengers would be carried by every train on that line, and, of course, the same thing rapidly spread amongst the other railway companies. Now, 20 years ago Mr. Galt had proved statistically and practically that third-class passengers could be carried profitably by every train, and, in fact, the same thing had been proved even earlier, yet it took twenty-five years, at least, for the railway managers of England to arrive at a conviction upon that point, and they were now forced to confess that the operation was not only beneficial to the public, but profitable to the companies. But what led them to this? Simply the fact that they were coming before Parliament for further privileges with regard to Amalgamation Bills, and it was necessary to give a sop to the public. Now what was wanted was some system of managing the railways which would bring public opinion to bear upon them, and which should insure their administration in conformity with the requirements of the country. That was not the case at the present moment. It was only casually, and under circumstances of emergency of the kind to which he had referred, that any concessions, even for their own advantage, could be obtained from the managers of railway companies. It therefore became absolutely necessary that some other machinery should be provided—no one pretended it would be perfect—the machinery which was called that of Government, and which at all events was under the influence of public opinion. With regard to the Post Office, step by step they had been able to obtain from the Government department reforms suited to the exigencies of the times, the benefits of which were enjoyed by all. He would not go into the question of the relative merits of a Government system; but what did that phrase mean? There were many kinds of Government; there was the old Government system of this country, and there was another system which raised up an Empire in India—the Government of the East India Company. That was no more a Government of private enterprise than the Government of this country, and even in this country there were various kinds of Government management, some as bad as railway management itself, and some better. In dealing with the question practically, of course they would choose the best, and apply to a new state of affairs the experience of the past, so that a practical and useful result might be obtained. To those who looked beyond mere political questions, and who looked to the influence on the commerce of the world of what was taking place during this era of competition, it must be apparent that they could no longer delay such a change as this whether they liked it or not. If, from their interests as railway shareholders, or directors, they were inclined to hesitate, the time, he believed, would come when, step by step, whole branches of manufacture would be injured, and the very men who were turned out of employment would force this matter forward as a Parliamentary question. It was a great and important question to be considered on public grounds, and whatever had been the divergence of opinion expressed in the discussion, sufficient facts had been brought forward to show that it was fairly within compass that the transfer of the railway system to Government could be carried out. As to the financial part of the question, it was certainly surprising to find a man of standing and ability stating that the operation was an impossibility. It was known to be one of the simplest things possible. It had been treated as if it were a question of raising an enormous loan, like the French indemnity, whereas it was as simple as the common operation of a conversion, such as had just been carried out by the great financiers of this country for the United States' Government on a large scale, and this, in the case of railways, the stock of which was held in the country itself, could be dealt with with still greater facility. He was greatly surprised to hear the statement that the transfer of railways would nearly double the National Debt, and with all due respect, he could not understand what that statement meant. So far as he could see, the country was already in debt for this amount to the owners of the railways quite as much as to the owners of consols. Nay, perhaps more so, because of the system of monopoly which existed. Having, in former times, opposed Mr. Galt's proposals, he felt compelled to come forward now and say that whatever difficulties he had felt in the matter had been since removed by the course of events and the conduct of railway managers, and he was now thoroughly convinced that such a measure could not be much longer delayed. The only question, in his opinion, was whether any further delay at all should take place.

Mr. George Jones had been rather disappointed at the small amount of new ground opened by Mr. Galt in his paper. With regard to fares, for instance, the cheapest scale recommended by Mr. Galt was one farthing a mile, but this, he believed, was far too high. It was well known to engineers and machinists that a little grit, if allowed to accumulate, would prevent the smooth working of the grandest machine ever invented, and eventually, perhaps, stop it altogether. He contended that the practice of charging per mile was the grit in the machine which prevented the successful working of cheap passenger fares, and suggested that a system of charging per stage instead of per mile should be introduced, the stage being determined by the position of a town of a certain magnitude or of an important junction, so that there would be seven stages on the Great Western between London and Bristol, and eleven on the Great Northern between London and Leeds. Mr. Jones was proceeding to elaborate this scheme, when a gentleman rose to order, remarking that these were matters of detail, not in any way affecting the main question before the meeting.

Mr. J. A. Franklin said he had had special experience in connection with Indian railways, and wished to offer a suggestion or two, but, as he was suffering from an affection which prevented his speaking, he had asked Mr. Kisch to present his views to the meeting.

Mr. B. Kisch commenced his remarks by observing that many speakers had assumed that the time must come, even if it had not already arrived, when the management of the railways must in some form or other be brought within State control; whilst, on the other hand, it had been argued that it would be highly undesirable that the State should in any way come into competition with private enterprise. The suggestion made by Mr. Franklin would, he thought, combine the advantages of the present system and of Government control, and it had this important feature, that it could be applied gradually. It was well-known that railway stocks and shares might be divided broadly into two classes—ordinary shares, and the various kinds of preferences and debentures. The latter class, although stated on good authority to amount to about sixty per cent. of the whole capital invested in railways, had no voice whatever in the management. Now, considering that the holders of this description of securities were, if possible, more interested than ordinary shareholders in the permanent prosperity of the lines with which they were connected, it seemed only just that they should have some control over the business, and Mr. Franklin suggested that these should be taken up by the Government, and that the influence thus given to it should be exercised in the interest of the public. The conversion could be easily effected, and a reduction of interest could be made by giving the present holders Government security.

Mr. Hale rose to order, suggesting that there was no necessity to occupy time by discussing these matters of detail.

Mr. Franklin said this was one mode by which Government control could be exercised over the railways. The smallest amount at which they could be completely taken over by the State would be 700 or 1,000 millions sterling, whereas the plan he proposed could be tried at an expense of some 230 millions only. The private proprietors would also retain an interest to the extent of the ordinary stock, though virtually, as in India, where this system had answered very well, the whole control was in the hands of Government.

Mr. Galt said the question was not whether somebody could suggest some plan for the better management of railways, or for introducing more of the State element, but whether they should be transferred to the State.

Mr. Brooke also thought they were rather going beyond the subject which he, as a London tradesman, had come to speak upon.

The Chairman remarked that the subject was a very large one, and it was somewhat difficult to say exactly what belonged to it, and what, strictly speaking, did not.

Mr. Kisch said he could not confine himself exactly to the question whether the railways should be purchased or not, unless the system on which they should be purchased had been agreed upon. What was proposed was that Government should become the purchasers of three-fifths of the capital, and that by virtue of their position they should then step in and assist in the management of companies, which they would naturally do in the interest of the public. At the same time the interest of ordinary shareholders would be watched over by boards of directors, similar to those at present existing. The difficulties of Government interference might be avoided by a permanent commission being appointed.

Mr. John Jones said the commercial interests of the country seemed to be the chief motive power which had brought the meeting together, but those interests were not to be measured only by magnitude of figures. There were other principles involved. Supposing the country were to increase its exports and imports by 100 per cent., and if at the same time the wages of the people were not improved, or their condition in life at all advanced, would that be any benefit to them? There was nothing which pressed more hardly on the trade of this country than the Government—it was one of the greatest obstructives to improvement from the burden of taxation which was imposed, taking, as it did, out of every man's pocket that whereby he would fertilise his own neighbourhood, and make his business more prosperous, and his life more comfortable. And yet this Government, which was the preponderating burden on every man's life, did not seem to have attracted the attention of the speculative men who had brought forward this proposal. They spoke of the advantage of unity. On the same principle, no doubt, it would be an enormous benefit, and would tend to the diminution of the cost of Government, if France and England were to be amalgamated. That was Mr. Chadwick's great principle, the value of unity. See what could be saved in that way. The army and navy might be done away with, the Courts of the two nations might be done away with, the separate systems of administration, all would be done away with, and what an enormous benefit would arise from the two nations combining together; but if such a thing were suggested, who would be the loudest to cry out "Home Rule?" No doubt his Lordship in the chair would be one, and this pleasing view of unity, with all its advantages and pecuniary benefits, would be abandoned in favour of some other principles which were considered equally valuable to human life. How, if the railway system were placed in the hands of Government, it would result in putting the working men connected with the railway, who were an enormous number, in a very disagreeable position. Supposing a porter or a guard insulted his inspector at a station, he would be dismissed, but there was no moral disgrace attaching to him, and he could go to another railway and get employment. If, however, the Postmaster-General dismissed any particular officer, he could not be taken on again at another place, but he was deprived of his livelihood altogether, possibly on account of such a trifling matter as offending some particular individual. This was a very serious matter when people talked about the interests of the working classes. Another consideration was this—Government had never initiated anything good since it first existed. One would have thought that all the best artillery would have come from the brains of men who were daily using it, and whose lives were passed in connection with it, but such was not the fact. Governments had always shown themselves incapable of any progress. They had never initiated new weapons for their own service; and private persons outside had introduced the very things which they ought to see provided with by the men whom they employed. The result would be, if the Government were to take possession of the great system of railways, which was still open to immense improvement from the genius of mechanicians, that a stop would be put to that progress. Men of talent had enormous difficulties to meet in pressing their ideas upon large bodies, such as railway companies, and this would be increased tenfold if the matter fell into the hands of Government. There was a great deal in the localisation of power and convenience, and he believed if the Government were in possession, in full power, there would not be that aptitude now shown by localities in providing themselves with new conveniences, according to the particular wants of the neighbourhood. No doubt an immense waste of money had taken place through the action of the Legislature in promoting litigation and contending schemes; but where perfect liberty existed separate from the competition of Government—supposing a development of traffic between two towns—it was open to anyone to set the machine in motion for introducing the needful communication. A great deal was talked about the Post Office; but that great system never itself originated the idea of the penny postage. It was Mr. Rowland Hill, whose great talent and energy was far beyond that of the generality of Government officials, who had developed that system.

The Chairman, interposing, said that the merits of Sir Rowland Hill were world-wide, and it was quite needless to occupy time by descanting upon them.

Mr. Jones said the East India Company had been mentioned as an instance of good management of a country by Government, but he objected entirely to such a view. He contended that the East India Company was not a Government establishment, and was no illustration at all of the principle contended for. Another consideration was this, that if Government possessed itself of the railway system, the whole of the work would be given out in large contracts, and the result would be that the trade—which was now distributed among many different manufacturers who were each able, possessing a moderate capital, to supply the wants of a particular district or railway—would be thrown into the hands of a few great establishments. Government must deal on a large scale, and it would be found that it would give all its machinery to one or two firms, all the iron rails to another, and many of the present manufacturers would have to go to the wall; in fact, the result would be that the vast majority of individuals would find it hopeless even to rise above the condition of servants.

Mr. Brooke begged to say that he entirely endorsed the statement of the noble Chairman with reference to the importance of this question, and the desirability of Government taking charge of the railways. He might speak on behalf of a large number of the tradesmen of London, who were in the habit of paying large sums to railway companies for carriage, and also of farmers and producers in the country, and he was quite sure they would all agree in supporting Mr. Galt's proposition. It was quite true, as had been said by the Chairman, that many individuals and families had been ruined by railway speculation, and even those who were not directly affected had lost large sums, as he had himself, through the failure of those who had engaged in these enterprises, led into them by the brilliant prospects held out by the marvellous, able, and clever men whom Lord Derby had spoken of as the projectors of railways. These men had to consult the interest of their employers, and it was as true now as ever, that no man could serve two masters; therefore, they could not serve the public whilst they had to consider the interest of the railway companies. On this account it was that an increase constantly took place in their charges, and this led to the prices of all kinds of meat, poultry, fish, and vegetables in London being much higher than they need be. Government were now managing the telegraphs with very great advantage, for his experience showed that greater facilities were now given than by the private companies, and he had no doubt that as soon as they saw their way the charge would be reduced. The same with regard to the Post-office Savings Bank and Life Assurance. He was quite satisfied that it would be a wise step for the State to take the control of the railways, and hoped it would be done as speedily as possible.

Captain Tyler then moved the adjournment of the discussion.

Mr. Greer, in seconding the motion, said he thought that most of the speakers had hardly perceived the exact subject before them, which was not whether the railways had been managed well or ill, as between themselves and the public, or as between themselves and their constituents, but whether the system of having railways managed for private interests was good for the State at large. His feeling was extremely strong that, viewed in the interest of the State, railways should be managed for the general good of the community, and not for the good of the shareholders. If the State would manage the railways, taking into account how much could be made of them, in the way of doing good to the country, he had no doubt that ten times the amount of work now done, in the shape of carrying passengers, and two or three times as much in the carrying of goods, might be accomplished with very little expense. Railway managers at present simply considered what was best for the proprietors. Now he might illustrate this by a thing which not unfrequently happened at a time when the Dutch had the monopoly of the Spice Islands. When there happened to be a very prosperous year, it was well known that, rather than that the price of the article should be lowered, they destroyed a large quantity of the spice, and that was unfortunately the principle on which railways were now managed. No one wished to impute wilful mismanagement to these gentlemen—it was simply that they had to consult private interests instead of the common good. If a uniform Government system were introduced, a great deal of mismanagement would be got rid of, and he must take exception to a great part of the speech of Mr. Jones, who found fault with Government, for he did not believe Government wanted to have anything to do with railways if they could avoid it, because it would give them a great deal of trouble. There was an impression amongst the public that anything in the hands of Government would necessarily be mismanaged or jobbed. But in the case of railways he believed such a thing was thoroughly impossible, for this reason—the railway system would bring the Government, or whoever arranged it in communication with the people, and they could not perpetrate a job without somebody being damaged by it. Now-a-days everyone knew how to bring his grievance before the public, and even if newspapers were not read, or listened to, somebody in Parliament would get up and ask a question which the minister would be bound to consider and give a specific answer to. There was no class now not represented in the House of Commons, and therefore every one who had a grievance could easily find somebody to take it up and speak for him. Why was it that the carriage of letters and the management of the telegraphs was so well conducted? Simply because the Government had greater means and facilities for conducting such matters, and, as a rule, the greater the system was, the more complete it would become, and the more the officials concerned in carrying it out would become adapted to the positions they had to occupy. All Government departments were extensive systems, similar to those which managed the railways. The East Indies had been referred to, and there, from the natural unwillingness of Government to interfere with private interests and to increase political power, they had not taken possession of that Empire until it was absolutely forced upon them. Still he believed it had been a great blessing to the natives of that country, and that a much better system of Government existed now than when it was under private management. He recollected when Mr. James Silk Buckingham, at a public meeting, stated that he had been turned out of the country because he presumed to establish a newspaper in India, and at the same period missionaries were sent home lest they should run the risk of endangering the goodwill of the people by interfering with their religious opinions. Now it was governed more like England, and it was much for the good both of the native population and of the public at home. He was quite convinced that it would be a good thing for Government to take the control of the railways, having for their primary object not the obtaining a revenue, but the fostering and encouraging of commerce, and the advantage of the community at large.

The discussion was then adjourned till Thursday, July 3rd, at eight o'clock.

The following statement has been sent by Mr. B. Kisch. It contains a summary of views held by that gentleman and Mr. J. A. Franklin on the subject:—

The evils of the present system, both present and prospective, are admitted on all hands, but the difficulties in the way of State purchase are also recognised to be enormous, and, even if such purchase were carried out, it is impossible to say what fresh difficulties might not present themselves. Lord Derby has pointed out many that would probably arise, and who shall say that even he has foreseen all? Captain Tyler, than whom no more practical authority exists, says,* "I would fain contrive, or see contrived, some method of averting or controlling the joint-stock monopoly which looms before us in the future. But I despair."

Those who have hitherto treated of this question appear to have seen no alternative other than a continuance of the present system, ultimately leading, as Capt. Tyler shrewdly foresees, to a gigantic monopoly on the one hand, or an out-and-out purchase by the State on the other. No other or middle course appears to have been contemplated. Yet it would appear that a middle course, suggested by the system now in vogue on the Indian lines, presents a practicable solution of the problem, a solution which may be shown to possess, moreover, many incidental advantages over and above those which could result from a complete purchase by the State.

It appears from Captain Tyler's report that the proportions of loans, debentures, guaranteed and preference stock, and ordinary stock of railways in the United Kingdom in 1871 were as follows:—Loan and debenture (renewable), 15; debenture stock, 12; guaranteed and preference, 31; ordinary stock, 42; total, 100, the ordinary stock forming only 42 per cent. of the total.

In some companies the proportions are different, notably so in the Midland, which has lately been seeking amalgamation. Here the figures are as follows:—Renewable debentures, 10·19; debenture stocks, 13·03; preference stock, 41·69; ordinary stock, 35·09; total, 100·00.

Now, it is obvious that, as between the holders of the ordinary stock and the other sections of the proprietary, the former represent a fluctuating and temporary, the latter a stable and more permanent interest: for while it is the chief aim of the ordinary stock-holder that dividends should be increased to the highest possible degree, with a view to thereby raising, for the time, the market value of the stock, even though to the ultimate detriment of the property, the holders of other property in the concern have a greater interest in permanently maintaining the property. And yet it is the comparatively temporary interest in which the management of the line is in practice almost entirely vested. Debenture holders are not represented at any railway board, and the holders of guaranteed and preference stocks are frequently not represented. Now, mere justice should require that the proprietors of so considerable a stake in the company should have some substantial and organised control over the administration. But it would clearly be far more to the advantage of the companies that any such controlling voice should be given rather to a stable than to a fluctuating body; and of all bodies to hold such an interest, the most permanent would be the State. The plan suggested is, that so far as debenture and preference stock may be acquired by the State, the Government, by virtue of the proprietary rights so acquired, should, in the interest of the public, have a controlling voice in the management of the line, such as it always has had in the case of the Indian railways.

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* "Journal of the Statistical Society," June, 1873, p. 221.

Many of the advantages of such a plan are obvious. The chief of all, however, probably is that it admits of being tried at once, and as an experiment, on any scale that may be desired, and, if found successful, of being gradually introduced. There would not necessarily be any compulsion on the debenture and preference proprietors of any particular line to part with their property to Government, nor, on the other hand, on Government to buy such interests indiscriminately. No comprehensive measure would be required such as might evoke serious opposition from any side.

In respect of various economies to be effected, the advantages that would follow are equally clear. Take, for instance, interest on loans, debenture stocks, &c. The credit and security of the State must always rank higher than those of the most powerful and best-managed company; and assuming, for illustration, that the ordinary capital were as much as fifty per cent of the whole, a saving of one-half per cent. in debenture and other fixed interests would be a gain of one per cent. to the ordinary stock.* The facilities and advantages that the proposed plan would offer for the amalgamation of companies are not less remarkable. Amalgamation is at present resisted by Parliament in the public interest, and two applications with that object have been refused within the last few days, viz., from the London and North-Western and the Lancashire and Yorkshire Companies' which are to some extent competing lines, and from the Midland and the Glasgow and South-Western Companies, which are rather in the nature of one continuous line. Now, with a government officer always at the Board in the interest of the public, with a power to veto, such as is possessed by the government representative on the Indian Railway Boards, there would no longer be reason to resist amalgamation on the ground of its tending towards monopoly; and the ordinary stockholders in the two amalgamating lines would reap the advantage of increased economy and improved administration.

The benefits arising to the public from the presence at the railway boards of an officer possessing power to suspend any action which may appear to be against the public interest, and to refer points of difference to a central, impartial, and independent body, such as the recently-constituted Railway Commission, are so obvious that they need not be further dwelt on.

No part of the existing patronage, nomination of officials, &c., need be taken out of the hands of the companies, the power of the government officer being restricted to a veto which would be used only in exceptional cases. This consideration also meets the most formidable objection raised by Lord Derby to State management, viz., that the State would become the largest employer of labour in the country, and would thereby become involved in all the questions between labour and capital which have lately come so prominently under discussion, and in which it has hitherto abstained from taking part.

Lastly.—Should it be considered that precedent is required to justify the recommendation of a scheme such as here advocated, such precedents are not wanting. Besides the experience furnished by the Indian railways, gas and water companies supply other instances of similar bodies being gradually brought under administrative control. Moreover, Boards of guardians, amalgamated into Unions, now act under Government supervision; and we now see guardians, appointed by a Minister of State, sit side-by-side with those elected by the ratepayers, a precedent going far beyond what is here proposed, inasmuch as the guardians administer what they believe to be entirely their own funds. In the face of this general tendency of the age towards bringing all departments of public service under State supervision, it is difficult to see what valid objection can be urged to applying the same policy to railway management, when it is shown that the difficulties with which the matter at first appears surrounded are capable of being cautiously and progressively overcome. The safety of this plan, due to its capability of being introduced tentatively, is apparent by contrast with the general result of rushing from one extreme to the opposite. The centralisation which ruined France under the Empire, has led to general measures of decentralisation.

CANTOR LECTURES.

The third lecture of the second course of Cantor Lectures for the Session, "On the Energies of the Imponderables, with especial reference to the Measurement and Utilisation of them," was delivered by the Rev. Arthur Rigg, M.A., on Monday evening, February 17th, 1873, as follows:—

Lecture III.

On the Energy of Vitality, with especial reference to the Measurement and Utilisation of it.

The "Energy of Vitality" is a manifestation by motion of the unknown and unseen power which is associated with life—indeed that which may (perhaps) be said to constitute life itself. This vital power (some may call it force) is presented to our notice in two forms, the animal and the vegetable; hence the two sciences of zoology and botany.

In the distinctions laid down in the classification diagram, it will be observed that the energies are divided into potential and kinetic.

In seeds, in eggs, in frozen toads, in suspended animation, in hybernating animals, are examples of the potential energy of vitality. The power is there, but it awaits those surroundings which may convert this potential or dormant energy into kinetic or active energy. So long as a living body lives, it possesses kinetic energy; it has power to move. Such a power is not possessed by any dead body, although from external sources it may be introduced into one.

The energy of vitality is converted into the energy of affinity in the assimilation of food, into that of electricity in muscles and muscular action, into that of light as in glow-worms and certain fishes, and into that of heat as in warmth of the body. One peculiarity of this vital power is the ability to seize on that which is material, and to adapt or select therefrom whatever may be suited for its special purpose. The earliest or most elementary of the animal forms in which this vital power of adaptation displays itself is called a protoplasmic germ. This germ, or, as it may be described, this microscopical cell, if placed in congenial surroundings, manifests an energy of growth or reproduction which adapts these surroundings in a way and under an influencing power quite unknown to us. The power of gravity enclasps all matter, the power of vitality exercises a selectiveness from matter; gravity influences all matter but changes the shape of none; vitality changes the form of all it influences. For example: the process of fermentation is one in which a minute molecule possessed of a vital power can communicate a similar power to another molecule, this again to another, in each case appropriating or attaching the molecule to itself for a while, and so producing a rapidity of what we call growth, which seems almost as a process of crystallization when the water of solution is being evaporated.

Between the development of a crystal, however, and of life, there is this marked difference. A crystal grows by appropriating *like* molecules, and deals with them according to laws unknown to us; a body having vitality not only appropriates various molecules, but re-combines, re-forms, and rejects. These the crystal cannot do. The growth of a crystal is a phenomenon in physics—the growth of an animal is a phenomenon in chemistry. In both cases the powers of reproduction or enlargement are mysterious. Although under the influence of vitality many forms of matter are produced, yet the crystalline one never appears; as soon, however, as the excretory process is completed, or the vital power is withdrawn, then commences work of a crystalline character.

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* In the case of the Midland Company, referred to in a former paragraph, the capital upon which economies may be effected is 65 per cent. of the whole.

How vitality is transferred, or what it is, or in what contained, how nourished, or how destroyed, we know not. With the energy of vitality, as manifested in the processes of reproduction and growth, we are not this evening required to deal. Within that frame thus mysteriously developed, there are combinations of mechanical and chemical apparatus fulfilling conditions with which we are deeply concerned. This apparatus, however, does not from year to year retain the same power. Owing to the vital action, the apparatus with which we are to deal, whilst in incessant fluctuating change, yet attains a climax, then slowly subsides, then follows that phenomenon, even more mysterious (if possible) than any other of the vital ones, viz., their sudden cessation, which we call death. Neither in its earliest development nor in its mysterious cessation are those phenomena presented which are consequent upon energies we can either measure or utilize. Whence that comes which imparts vital energy, and whither it goes, are problems rather for human faith than human understanding. When an engineer has to estimate the power of a steam-engine, he does not ask of its early formation and past biography, nor does he speculate upon its future uselessness; he regards it as he finds it. So with animal vitality. We have to regard the animal as an engine, and in lieu of steam we have vitality. The engine is constructed so as to be utilised by the power of vitality, as that other engine is by the power of heat. Animals are much more economical engines than any man has made. The Creator's work is still far in advance of the work of the creature. Count Rumford showed that the amount of work done by a horse is much greater than could be obtained by employing its food as fuel for a steam-engine.

Note, also, what an economical conserving of energy there is in hybernating animals, which store up in summer that which they expend in winter in maintaining animal heat. To those who intend to offer the results of their ingenuity in the economising of fuel for the Gold Medals and fifty pound prizes offered by this Society, in December next, may be commended for especial study this property of hybernating animals. Your lecturer has no authority to make the statement, but he can with some confidence assure them that, if successful in teaching us to economise fuel as they do, they will win not only the prizes of the Society, but also the thanks of the nation.

An animal body is, indeed, a wonderful self-acting and self-regulating machine. It is a structure composed of moveable parts, yet firm, and at the same time locomotive. Its hinges are well fitted with self-acting lubricators; its furnace supplies itself with fuel, and can regulate the supply to the demand; its telegraphic communications are extensive, rapid, and need no superintendence; in its laboratory are performed experiments in the very highest departments of organic chemistry.

There are two forms of vital energy which have so much of a kinetic character that we may utilise them. Indeed, one form is self-utilised; vitality seems to have engaged its exclusive services, and whether the animal be waking or sleeping, vitality claims *all those* services from the machinery of the body which are rendered in the circulation of the blood, the digestion of the food, the operation of breathing, the propelling action of the heart. These all are motions resulting from some impressed laws, which have hitherto been hidden from our powers of research. That they continue, and that we are unconscious of them; that we cannot stop them, and even if we could by any means measure them, that we could not transfer them to any other purpose is clear without demonstration.

Therefore, since for scientific physiology the study of this form of vital energy is of paramount importance, it very naturally and properly would rank as one of the chief subjects for medical students. Indeed, the minds of physicians are necessarily often guided by circumstances to meditate upon its operation, and they are called upon to accelerate its action here and to retard it elsewhere. Hence the observant anatomist becomes, if not a kinetic, at least a static mechanician; the thoughtful physician reflects and harmonises the external evidences of these internal energies, and combining the events which fall under his notice, he deduces conclusions which link the laws of vital energies in their operations with those of the other imponderable influences which pervade all the universe.

Under such circumstances as these Dr. Mayer of Heilbron, in Germany, was led to conclusions in respect to the relations between heat and work which the further investigations of others by very different processes—processes in which the energy of vitality does not enter—have established as correct.

There is another form of vital enery similar to this over which we have control, and which we employ as we please within the limits which the vital power and the construction of the apparatus through which it acts permit. This is that to which we usually give the name of "muscular energy."

The qualifying words, "within the limits," are essential, for the limit is in each case a hard and fast line, and we cannot overstep it. This limit is perhaps more admirably arranged in the animal frame than in any construction of man's devising. Although there are hundreds of muscles, yet their names, shapes, and businesses are very varied. Throughout all these changes one remarkable principle applies: every muscle is exactly adapted to the work it is likely to be called upon to perform.

There is a principle in mathematical science called the "Principle of least action." It may be explained thus—Given an object to be accomplished, then "the principle of least action" should teach how, with the smallest quantity of material and with the least expenditure of power, that object would be done. The more the muscular system is examined under this guidance, the more we are lost in wonder how exactly every portion of the body is suited for its specific work, and for the amount of work it is likely to be called upon to discharge, and more curious still, how (in special cases) the muscle may develope in order to meet certain requirements, as, for example, the muscles in the arms of a smith, as well as other muscles. And, further, how perfectly these muscles are varied in form and construction so as to meet the requirements of their respective occupations, and, if called upon by prospective emergencies, to be ready for more than ordinary exertion. Certain muscles are so prepared for extraordinary exertion, and then relapse into their normal state, thus strictly carrying out the "principle of least action."

As an illustration of this principle of least action, look at that most extraordinary muscle of all in the animal economy—the heart. Although certain features of its action should come under notice at a later portion of the evening, yet it bears upon the present subject, in that it is a bundle of small muscular fibres. There are probably more than a million of them, complex in their arrangements and perplexingly curious in their relative and combined actions, and yet this, regarded as one muscle, weighs on an average, in man, only 9·39 ozs. Its screw-like construction is such that at each action it propels forward the whole of its contents, leaving no filled-in corners. It has power to propel these contents to the vessels in the extremities of the body. Were not this muscle "up to the mark," these extremities would die for want of nourishment; if "beyond the mark," then some of the vessels along which the blood is driven might be burst in consequence of a liquid pressure greater than that they were calculated to sustain.

The balances required are perfect, and this little muscle of 9·39 ozs. sends life to all parts of the body—by day and by night—from birth to death. Now the work it is continually performing is as though it lifted its own weight through nearly twenty thousand feet in an hour. The height of St. Paul's Cathedral, from the ground to the top of the cross, is 404 feet, therefore the heart could place itself on the top of St. Paul's Cathedral nearly fifty times in one hour. Let a man consider how often in an hour he could ascend, even on the assumption that he was never tired, and then he may obtain an idea how much more work his heart is doing than he can do. Put otherwise, the heart, regarded as we regard a locomotive, can raise itself through a vertical height of nearly four miles in one hour. The most powerful locomotives, built specially for the ascent of gradients, can only raise their own weight through about half-a-mile, or one-eighth of that which the heart can do. The directors of an Alpine railway (that from Trieste to Vienna) offered a prize for the locomotive which could lift its own weight through the greatest height in one hour. It was allotted to the locomotive (Bavaria), which lifted its own weight in one hour through 2,700 feet, or about half-a-mile. The experiment was simply made by means of inclines on railway lines; the subject this evening does not warrant a larger reference to this matter.

By no contrivance can we make a machine which shall bear such proportions between size and work as the heart does. Here is a little machine, weighing say ten ounces, put in action and worked by vitality, as a steam-engine is worked by heat; and this little engine, which we could easily put in our pockets, can lift itself twenty thousand feet high in an hour. There must indeed have been a master-mind that designed and executed the manufacture of the animal machinery, and so perfectly carried out the "principle of least action."

By careful anatomical and mathematical investigations similar to those which are to be alluded to near the close of this lecture, the daily work of the heart can be shown to be one hundred and twenty-four foot tons. This is nearly one-third of the daily labouring force of the whole body.

This muscle of the heart is not only capable of exerting this wonderful power through the action of the vital force, but it seems not to need any rest, and yet it does not wear out, for the muscles in the heart of an old man are apparently as sound and healthy and fit for continuous work as those in the heart of a youth. How through life they have been so maintained, how as other muscles in the frame lose somewhat of energetic power, yet these fail not, is one of the many perplexities to science. That muscular power is, as we may say, restored by rest and food, any one who cares to think upon what he experiences and witnesses will readily admit; indeed, further, the nature of the work and the character of the food must be suited each to the other. Now the muscles of the heart never rest. The variation in their energy is within very narrow limits, so narrow that we may say that any series of observations, however long continued and whenever taken—as a series—would always average the same result. Hence the inference that in the animal economy these muscles possess the power (peculiar probably to themselves) of at one and the same time parting with energy and restoring it. This ever-balanced and ever-exerted energy, this actual external utilisation of energy, coupled with a perfectly self-recuperative operation, is what the searcher for perpetual motion, like the asymptote to the hyperbola, is ever approaching, but never attaining.

If men can find out how these particular muscles are exempted from the laws of muscle, with which laws these Cantor Lectures are mainly concerned, they will have advanced further in solving the problem of perpetual motion, which some enthusiast in every generation pursues with commendable but hitherto unsuccessful zeal.

The energy of vitality, as utilised and controllable by ourselves, is chiefly through the agency of muscles. The physiologist regards these muscles, with their attached tendons and nerves, as to the functions and offices they discharge in the economy of the individual, we are to regard them as to the external use to which they may be applied and the work to be obtained from them. How much we copy from nature may be concluded when we refer to the earliest attempt at locomotion from machinery. It was by basing the form and structure upon the muscles of animals. To thus imitate muscular action has hitherto baffled the ingenuity of man. If anyone has not satisfied himself of the nature of this action let him put the hand on the muscles of the arm when it is in repose; they are soft and yielding. Let him now make an exertion with the arm, such as raising a weight; the muscles become tense and hard. The weight raised is extraordinary compared with the weight of muscle employed, for it may be from sixteen to seventeen thousand times its own weight.

The physiologist considers the striated and unstriated variety of muscle, the nucleated cells, the vitality in each cell, the electrical relations of various tissues. With none of these need we be concerned.

Engineers regard muscles as machines for doing work, and as it is needful to know the structure of a machine before we can say how it can be made to work, so now the structure of muscle, as a machine, must be considered.

When a muscle is examined after vitality has ceased, it is found to consist of a great number of separate parts, or strings. If this piece of string were a muscle, there would be a bundle of strings, or fibres together, just the same as if I had doubled the string several times, and encasing them there is a covering or sheath, much the same as an India rubber tube, which covering encloses a number of muscular fibres or strings. That covering has none of the contractile elements of the muscle in it; it is merely an elastic covering enclosing that which has the contractile powers. Then, side by side with this bundle of fibres, or strings, in its case, is another one, also covered in the same way, and another, and another. These are kept in their place by the tubing, or covering spoken of, and a combination of these is called a muscle, which consists, then, of these fibres, which again are separated into fibrillæ. With such a peculiar arrangement of contractile strings it is clearly a problem for the mathematician and the mechanic to obtain a solution to the question of how much work can vital energy do when operating through the means of such apparatus as is thus supplied. The muscles are so varied in form, combination, and number, that but little progress has hitherto been made to deduce results and bring them into measurement.

Now, no substance is known that can act the part of a muscle. A muscle left free is in the state of an india-rubber band when slightly stretched. It is called into action by contracting, exactly the converse to that of india-rubber, which is brought into action by being stretched. A number of these fibres are put together, and form a group like a number of india-rubber bands. Sometimes the groups act in a straight direction, sometimes they take a sloping form. If they take a straight form, and if we know the number of fibres and the power of endurance of one, it is easy to calculate the power of the whole; but if the muscle acts diagonally, then it brings in the parallelogram of forces, and we need the mathematician to deduce the amount of energy which can can be utilised by this form. Sometimes the fibres are twisted like a screw, sometimes they spring from one point and spread out like a fan, and all these screws and fans the mathematician must get hold of and calculate; this is now being done.

Having endeavoured very briefly to explain the mode in which animal vitality can be utilised through the agency of muscle, it may perhaps be well to state that between that part of the system where the will is localised and the muscle, there are telegraphic ramifications of nerves. These nervous processes enter within the muscle, and, by some means unknown to us, influence the muscle to exert its mechanical powers—convey, in fact the will to that agent which is expected to do its bidding through the power introduced by vitality.

With this nerve power we are not concerned; the nerve as a material substance is intermediate between the will and the muscle; it has nothing to do with the amount of work done; its business is chiefly to connect the mental and the material processes of life. Of that which is the will, of that which travels along the nerve in consequence of the will, we know nothing. Call it electricity; that is not any advance, for we know nothing of what electricity is. The first region in which the vital power gives a measurable evidence is when the muscle begins to act. Prior to that all is speculation, and furnishes a very pleasant hunting-ground for physiological enthusiasts.

Whether muscle is a means or apparatus for the transformation of force, or whether it is the material out of whose chemical changes or electrical states force and consequent energy result, are beyond our present knowledge. A plant transforms light into energy, so may muscle transform what, for want of a better name, may be called vitality into energy, and yet not be itself consumed or destroyed. Although, for obvious reasons, that energy which is localised in animals is called the energy of vitality, yet it must not be inferred that such energy or source of energy is self-existent. The animal extracts it in those wonder-working laboratories—the stomach and the lungs. By some unknown process it is deposited in the muscle as potential energy, and awaits the decision of the will as to when and how it shall become kinetic. Although ignorant of the analytic chemistry of vitality, yet we are not ignorant of the materials with which it experimentalises. With this knowledge we must rest; we cannot repeat the experiments vitality makes. Given, every material and contrivance within reach, neither the physicist nor chemist, separately or jointly, can accomplish the phenomena with which the changes of these ingredients are concerned when they are associated with the vital principle.

To form an estimate of the number of the fibres in any muscle is an investigation requiring more of care and caution than of difficulty. Determining from a series of averages the magnitude of one—*i e.*, the area of cross section of one muscular fibre, and knowing the area of the section of muscle, the number is merely the quotient of the division.

The muscles are exceedingly small and delicate, and the way their size is calculated is by cutting a piece of cardboard exactly to the section of the muscle. Then another piece is cut out of the same cardboard to, say, a square form, and they are weighed against each other until the square card is exactly the weight of the irregular piece. Thus when the weights are equal the areas are equal, and by calculating the area of the square piece you are able to arrive at the area of the section of the irregular muscle. By the aid of a powerful microscope we can ascertain the size of a section of one of these fibrillæ—and it is found to be in men $\frac{1}{350}$ of an inch in diameter, so that in an inch there would be 350 of them, in women it is about $\frac{1}{450}$—*i.e.*, in one inch there would be 450 of them. It may here be mentioned that these elementary fibres are not circular, but polygonal, owing to their mutual pressure, and at the angles of the polygons are the vessels which supply blood. Hence it obviously follows that where these fibrillæ are very small, the supply of the blood, which is the food of the muscle, can get at them more readily than when they are very large. Where they are large they have greater strength, that is, can lift heavier weights, but where they are small they will have greater endurance, because more freely and and easily supplied with blood. Hence, as they are smaller in women than in men, the muscles of women have more power of endurance, but not the same strength as those of men. If a man wishes to test this, he has only to nurse a child, and then compare the length of time he could do so without fatigue with the length of time for which a mother can nurse it, and he will soon find the difference, and give a verdict adverse to himself.

There are two muscles in the arm with which we are especially concerned in estimating the measurement of such vital energies as we may utilise; indeed, it may suffice to consider that the muscles in the arms and legs are the only ones to which the subject of this evening's lecture directs attention, and we may illustrate the question of the great number of muscular fibres by calculating in the mode described their presence in the two most important muscles in the arm—viz., the one called "biceps," the other called "brachialis anticus." In the biceps there were found to be four hundred and forty nine thousand elementary fibres; in the brachialis there were found to be three hundred and forty-nine thousand; total, in these two muscles of the arm, seven hundred and ninety-eight thousand fibres.

Now, to examine these muscles—their fibres and their fibrillæ, to watch their action, and to speculate upon the causes of this action, is a department of science full of interest, and from which much that is valuable may be brought. The object of this lecture does not require that any such investigation should be made, and the competency of the lecturer is not equal to the task. Dr. Haughton, of Trinity College, Dublin, has for many years sought for means and opportunities, and availed himself of them, even at the risk of his own life, for determining accurate measurements of muscular force. This first mention of the name of one who for 12 or 14 years has given that attention to this subject which enthusiasm alone could induce, must not be passed without this addition. In reply to a letter towards the close of 1872 Dr. Haughton most kindly sent me 400 pages of the proof sheets of a work on "Animal Mechanics," which has not yet been published.* This work is my authority for the figures relating to experiments in respect to muscular strength and endurance. With the results his careful and numerous oportunities have afforded him we are clearly concerned. How carefully these have been collected may be judged from the following. He writes "This much I can guarantee, all the dissections, weighings, and observations have been made by my own hands, with every precaution of which I could think to ensure accuracy. My observations have also been made without preconceived hypotheses to guide them; and many of my most interesting results have been forced upon my notice by the facts placed before my eyes in the dissecting-room and laboratory"

First, as to the expression "co-efficient of muscular force." On the wall is a table of "co-efficients of muscular force."

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* Since the delivery of this lecture the work has been published, under the title of "The Principles of Animal Mechanics," by the Rev Samuel Haughton, F.R S., Fellow of Trinity College, Dublin. London: Longmans, Green and Co Dr. Haughton states in the preface that "the work is offered to the public with the view of showing the mutual advantage obtainable by anatomists and geometers from a combination of the sciences they cultivate. Anatomists will gain by the increased precision which numerical statements must give to their observations, and geometers will find in anatomy a new class of problems opened out to their investigations."

In the arm........	94·7 lbs.	per square	inch.
„ leg........	110·4 lbs.	„	„
„ abdomen ..	107·0 lbs.	„	„
Average ..	104·0		

The term "co-efficient" is a word of common occurrence in scientific investigation, and is plainly obtainable from "co-efficiency." When we speak of co-efficiency, we mean "that two or more things combine to produce an effect." It is the figure by which a unit measurement is multiplied in order to produce a result. To find the co-efficient of muscular force is to find some quantity which may be so combined with a measured area of muscle as that we can have a result on which to rely in reference to the question proposed. Adopting the view which the lectures on energy and gravity propounded, it may suffice for the present to say that the table on the wall tells us that, knowing the number of square inches contained in the cross section of any muscle, then multiplying these by the figures there stated, we obtain the weight which the particular muscle can, on sudden emergencies or for a very short space of time, sustain. It is the limit of endurance—it is the measure of load which is just sufficient to cause the muscle to break—if a small weight more be added then the muscular fibres will be broken. It is the very extreme tension to which muscular fibre may be subjected without actual rupture. It is obtained by treating muscle as engineers treat wrought-iron rods when they seek to ascertain what load they can carry by tension. This explains that the table does not give a co-efficient of work the muscle can do; such a co-efficient depends upon the energy that vitality (or vital force, if the term be preferred) can infuse into the muscle; but, however great that vital power may be, the work done by the muscle must be less than that obtained in the table to which these remarks apply. A few words in illustration may not be misplaced.

We find from experiments, which would occupy far more than an hour to narrate, that in order really to tear one square inch of muscle across, it would require 94·7lbs. in the arm, and in the leg 110·4 lbs. It is somewhat remarkable that in the arm, which does not carry the body, you have 94 as the strength of the muscle. When you come to those connected with the leg, which have to carry the body as well as do work, the fibres are very much stronger. Taking the average of the whole body, the co-efficient of one square inch of muscle in the human frame is 104. Therefore if we know the size of any particular muscle and multiply it by 104, we get in lbs. weight the limit of strain it will endure before fracture.

Now the next question is, how much it will raise. In this view of the case motion enters. Supposing a fibre was in the form of a string, a very long one, and by contracting it will raise 2lb. weight through 10ft. If, now, that fibre were doubled and only half the length, it would raise 4 lbs., but it would only lift it through half the space, because its power of contraction would be diminished by the doubling. Now, the products of the weight raised, and the distance through which it is raised, are the same in both cases. If it raises 2 lbs. through 20 feet, 40 would be the measure of that muscular exertion; and if it raised 20 lbs. through two feet, 40 would still be the measure; but the distances are different. After illustrating experimentally these statements, the lecturer remarked that if an ounce of muscle be distributed with large sectional area, then its contraction will be little, but the weight raised may be great.

Muscle has also another peculiarity different from anything with which we can deal. If a bundle of it be taken, as you are aware, it acts by contraction; but while it contracts it does not change its bulk. It does not swell out as we understand the word—it merely contracts. Thus if you had a long muscle acting in a vessel of water, and it contracted ever so powerfully, it would not in the slightest degree affect the level of the water in the vessel.

Now we come to the mode in which the mechanical action of these combined muscular fibres is to be brought to a question of simple calculation. As far back as 1798 Dr. Wollaston occasionally observed a peculiar sound in his ears, for which he could not account. He pondered over this sound until about 1808, when a faint dawn began to enlighten the gloom. In 1809 he made clear to his friends what he was about, and in 1810 the results were published in the Philosophical Transactions. What he then did is the basis of all our present knowledge of this subject of muscular power.

Dr. Wollaston began to surmise that the sound in his ears arose from muscular contractions. He stated that he was led to infer the existence of intermittent contractions, from a sensation perceptible upon inserting the extremity of a finger in the ear. A sound is then perceived which resembles most nearly that of carriages at a great distance passing rapidly over the pavement. The sound is not dependent upon the degree of pressure upon the tympanum, for when the ear is stopped with great force without the presence of muscular action no such sound is produced. For instance, if the head press with its whole weight upon the ball of the thumb no noise is perceived unless the extremity of the thumb be at the same time pressed against the head, or some other muscle of brought into play. To judge of the frequency be this contractile action, he contrived to imitate the sound and to render the sound itself and the imitation audible by the same ear. It was accomplished thus. While the ear rested on the ball of the thumb the elbow was supported by a board lying horizontally, in which were cut notches about ⅛ inch asunder similar to those in this board. By rubbing a pencil along these notches with a regular motion he imitated pretty correctly the tremor produced, and by counting the marks and noting the time, he found repeated observations agree with each other as nearly as could be expected. He also varied the experiment. One variety was this—the ear was stopped by a cushion pressed upon by the end of a notched stick that rested on his foot and conveyed the vibrations from the muscles of the leg to the ear along with the tremor produced by friction upon the notches; and still the results were nearly the same, viz., that the muscular vibrations resembled the sound of carriages at a distance. He induced many friends to repeat the experiments, and by going through the form of the experiment any one may, when convenient, satisfy himself. The humming sound will, of course, be perceptible only to the ears of the experimenter.

Put the first finger of each hand to the ears, not pressing them tightly, resting the elbows on a table thus, and then clench the fists firmly, you will immediately throw the muscles of the arm into action, and as soon as they are brought into action there is a peculiar humming sound perceptible. That is a sound caused much as the sound of flies, when buzzing about, is caused, or as humming birds cause their sound; it is caused by an intermittent action; in this case of the muscles, and upon that action the rest of this lecture will turn. There is, however, a better plan even than that for observing this phenomenon. When you go to bed, if you are particularly bent on scientific research, and will lay your head on the pillow so as to entirely exclude all external sounds from the ear, then clench the teeth firmly; those muscles which are concerned in masticating the food are brought into play, and you hear the sound most distinctly. Now, that sound gives a musical note, and from that musical note all our knowledge of muscular action springs. All musical notes are caused by the frequent repetition of a vibration at equal intervals. Here is a glass tube of some length, and a little jet of gas lighted. If the tube be placed over the gas light you hear a musical note. That is caused by the light being extinguished and relighted a certain number of times per minute, as you can see by watching the reflection in the mirror. If, now, the mirror being shaken behind the light, a number of separate flames appear, if these are counted, we can ascertain how often they occur in a minute or an hour. Therefore we know the number of beats which produce that musical note. Here is an instrument for causing a sound by the frequent interruption, at equal intervals of time, of a stream of air. The number of interruptions in a given time are recorded by the wheel-work and indicated on these dials. It is called a "Siren." Again, here is a gyroscope, which does the same thing. If some string be wound round, and it is set in rapid rotation, and then a piece of cane or quill be pressed against the little wheel at one end of the axle, the note produced will vary according to the speed of the rotation. Another illustration may be had from the heating of metals of certain peculiar shaped surfaces, and laying them on cold metal, sometimes a peculiar humming sound is heard.

When Dr. Haughton was suffering from a singing in the ears after an attack of fever, he produced a sound by exercising the muscles of the jaws; this sound was in unison with the singing in the ears, but separated from it by several octaves. Dr. Haughton was struck, like Dr. Wollaston, with the resemblance of the sound to distant cabs. He measured the intervals of the granite pavement, and found them about 4 inches apart. This gave three impulses in the foot. If the cabs were driven at eight miles per hour, we have 35·2 impulses per second. An organ pipe with a movable stop was tuned in unison, and thus 35 1-3 vibrations per second were deduced.

From this rate of muscular contraction Dr. Haughton deduces the amount of work stored up in human muscles. It may facilitate an explanation of the table and diagrams on the wall if, in as simple and clear a manner as in my power, the mode of conducting the experiments is described. Remember the object is to make clear to all not only the mode, but also the principles on which these experiments rest. Therefore every technical or professional term must as far as possible be avoided.

If the arms be held out horizontally, being raised direct from the sides, and not brought forward, they will be supported in that position by two muscles in each shoulder—or rather the portions of the two shoulder muscles which support them can be clearly defined and measured. The length of time for which this position can be maintained will of course vary considerably. The other evening I could hold mine in this position for only six minutes, that is to say, they became exhausted in this space of time. Therefore the sole power of the muscles employed was expended in maintaining the arm in that position for six minutes. Eight minutes will be found more near to the average.

Now let us consider what was happening whilst the arms were so held out. Clearly the muscles were giving off this note, that is to say, they are always giving it off when they are in action, and therefore the arm literally was swinging up and down, or vibrating, though to a very small and invisible extent. It would do so much more but for this peculiar arrangement; whilst the muscle contracts and produces the action that we usually call muscular action, that contraction does not take place through the entire mass of muscle at the same time. Each fibre contracts, but not in the same portion of the muscle and at the same time; there are waves succeeding waves, and the consequence is that there is, to all appearance, a steadiness in the arms through the continuity of these waves. But, as regards the action, it is the same as though that wave passed along at once. Now, if the wave passed along at once, then the arm would fall, because it would oscillate or move up and down as a wave does. Knowing how often that wave passes, you would know how often the arm fell. The arm falls 32 times per second. It falls as if it were perfectly free, and if perfectly free we can easily calculate the space through which it would have fallen in the 32nd part of a second, namely, the $\frac{1}{64}$th of a foot; in other words, we have reached this stage, that the action of a muscle is such that it allows the arm to fall through the 64th part of a foot in the 32nd part of a second. Now let us get to another stage. The cause of its falling is the action of gravity upon the whole mass of the arm. You may remember that last Monday, in dealing with the pendulum, it was explained that in a compound pendulum different portions fell through different spaces, but that there is one point which we called O, termed the centre of oscillation, which may be regarded as representing the whole mass. Now, assuming a shoulder to be the point of suspension of the pendulum, it is the point O in the arm which would fall through the 64th part of a foot in the 32nd part of a second, and that point O, by a mathematical calculation, can always be found. Regarding the arm as a perfect cylinder, this point is at two-thirds of the length of the arm from the shoulder.

Again, the work done depends on the mass moved, or supported, and the mass moved is that which is calculated as at the centre of gravity, which for this purpose is about the elbow—about eleven inches from the shoulder. Therefore, assuming the arm to be 24 inches, then the point O at 16 inches from the shoulder, falls through the 64th part of a foot, in the 32nd part of a second, and it is very easy from that to ascertain how far the point at eleven inches from the shoulder, representing the whole weight of the arm, would fall in the same interval of time. We have, therefore, got the centre of gravity, the weight of the arm, and the distance it falls.* We consequently have all the elements wanted. We have the mass, the weight of the arm, the space (the 1-64th of the foot), and the time (1-32nd of a second). Without going into the question of mathematics, the work done under these circumstances, as regards my own arm, was this, that I was able to do with both arms 1,980 lbs. in the six minutes that elapsed before fatigue came on; in other words, the work done was the same as though I had lifted 1,980 lbs. one foot high—1,980 lbs. is very nearly 18 cwt. That is to say, the work that these two arms did in falling through that space, and being lifted back again, was very little short of a ton. If any one wants to know how much work the human arm is capable of doing when working on its own account, he may raise weights amounting to 9 cwts. on to a stool a foot high, and he would then ascertain the exact work that each arm did when left to support itself. Such is an outline of the mode in which the calculation is made. If there are any persons interested in it, as a question of actual calculation, a table on the wall may be of interest.†

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* Dr. H. calls his and many other similar experiments "Statical," although reference is made to motion, because the muscles are kept in continued contraction until tired out, and undergo no translation in space, although a rapid and active molecular movement takes place within the muscles to which the work done is altogether due.

† To find the work done in holding arms horizontal, time before exhaustion being six minutes:—

From measurement, length of each arm is 24 inches.

From weighing, weight of each arm is 8 lbs.

From muscular note, vibration of each arm is 32 times per second.

From tables, centre of oscillation of each arm is $\frac{2}{3}$ of 24 inches, or 16 inches from shoulder.

From inspection, centre of gravity of each arm is 11 inches from shoulder.

Now from the usual expression—

$$S = \tfrac{1}{2}\,G\,T^2$$

$$\text{In this case } S = \tfrac{1}{2}\,32\left(\frac{1}{32}\right)^2$$

$$= \frac{1}{64} \text{ foot.}$$

Therefore centre of oscillation falls through $\frac{1}{64}$ ft. in $\frac{1}{32}$ of a second

or „ „ „ $\frac{60\ 32}{64}$ *i.e.*, 30 feet in one minute.

If at 16 inches from the shoulder there is a fall of 30 feet per minute, then at 11 inches from the shoulder there is a fall of $\frac{11\ 30}{16}$ feet per minute.

The arm in this case was held steady, and doing what may be called static work, as distinguished from that which is dynamical or kinetic Dr. Haughton took very great pains to ascertain the exact weight of these muscles in the shoulder. This was done thus :—There is a large muscle called the "deltoid" muscle ; a portion only of this muscle is engaged in the work. After careful examination in various ways Dr. Haughton concluded that 10-36ths of this muscle is employed in the experiment. It would be out of place to enter into these details here ; it may, however, be of general interest to place this investigation before you in a tabular form.

	oz avoir.
Average weight of superspinatus muscle	1 671
Average of portion of deltoid	2,830
	4,501

Therefore 4,5 oz. perform, on an average, 1206 5 ft. lbs.
" 1 oz. performs 268 ft. lbs. before being exhausted.

As this exhaustion is complete in 8,29 minutes, the average duration of endurance, 1 oz. in 1 minute does $\frac{268}{8,29} = 32,3$ ft. lbs.

On one occasion these muscles were weighed and measured within 40 minutes after the execution of a criminal, so as to ascertain the exact size of them under circumstances where there had been no wasting from exhaustion. With the shoulder unloaded, the muscle was tired out in 8,29 minutes on an average of experiments. The weight of the muscles employed was 4½ oz., and the work they did on an average was equivalent to the lifting of 1,206 lbs. through a foot. The weight lifted through one foot for one ounce of muscle would be 32 lbs. He then put a weight of 2 lbs. in each hand, and held them out as before until fatigued, and he found the muscles were exhausted in four minutes, but the amount of work which each ounce of muscle did was 46 lbs., so that it did more work than it did before. Now, the power of the heart to send blood into the muscles, to keep up the action there, is not, in this case, equal to the action or work required from them ; hence they began to fail in four minutes, whereas, in the other case, they kept at work for eight minutes. In fact, the power exactly balanced the work in the eight minutes ; but it fell rather short in four minutes. An experiment was tried in another form, namely, hanging a weight on the wrist and keeping the elbow close to the side, a different muscle (biceps) came into play. This muscle weighs about eight ounces ; the power lasted 9¼ minutes, and the weight, per ounce of muscle, lifted was 41.

STATICAL WORK DONE BY MUSCLES.

Muscles used.	Work in foot pounds.	Duration of labour, in minutes	Weight of muscles in ounces avoir.	Rate of work in foot lbs. per oz. per min.
Unloaded muscles of shoulder	1206	8·29	4·50	32·3
Loaded muscles of shoulder	842	4·05	4 50	46·2
Loaded muscles of forearm	3170	9·29	8·21	41·5

Now, coming to dynamical work, when the muscles are engaged in producing motion, the muscles of the trunk of the body are employed simply in supplying the other muscles with that upon which they live during the time they are at work ; they do no external work themselves. This was alluded to in an early part of the lecture, when told that there are certain muscles which act involuntarily ; for example, if the heart cannot propel blood as fast as the muscle needs it, and if the will insists upon that muscle doing further work, then the heart is called upon to do what it cannot do, and death ensues. The two must be harmonised ; and where this harmony is broken, as sometimes happens, in a boat race and other cases of violent exertion, accident or death results.

DYNAMICAL WORK DONE BY MUSCLES OF THE WHOLE BODY.

Kind of Work.	Quantity of work in foot-pounds.	Duration of labour in minutes.	Weight of muscles in oz. avoirdupois.	Rate of work in ft.-lbs. per oz. per minute.
Boat race	61 040	7	575	15·17
Barrow lift......	2,038.400	480	575	7·39
Running with load	10.091	155	575	35·11
Day labour......	792 400	600	575	2 30

This table shows the results of experiments on different kinds of work. First, there is the case of a boat race which was rowed in seven minutes. The whole weight of the muscles employed in actually doing the work viz., those in the arms and legs, was 575 ounces ; the work done, making all allowances for the weight of the boat and the people in it, &c., was equivalent to 61,040 lbs. raised through a foot, giving an average of only 15 lbs. per ounce per minute, so that the contrast is very great between static work and dynamical work, the former being three times as great. Next comes an instance bringing into play all the active muscles of the body. It was a plan adopted in some railway works, raising rubble from a great depth. There was a pulley at the top of a shaft, over which passed a rope, and a stage at each side large enough to carry a barrow. One barrow was filled at the bottom, then a man stepped into the empty barrow at the top, and his weight in falling to the bottom of the shaft lifted the barrow full of earth. He then ran up a ladder to the top, and was ready to descend again. By that means his own weight lifted up the full barrow of earth. With work like that a man worked for 480 minutes, and he did two millions of units of work. Compared with the boat race he was only half as industrious, and the length of time was very much greater, but he only did 7·39 foot lbs. per oz. per minute. In the next case a man ran with a load upon his shoulders, and his muscular power was knocked up in half a minute, but the work he did was 35 foot lbs. per minute, approaching very nearly the static work. Last comes a day labourer, who generally takes it very easy, and it appears he only does 2 foot lbs. per oz. per minute, so that if he complains of getting small pay he does little work for it ; it must be remembered, however, that he works for 10 hours a day at it.

Time warns me to close. It may, however, be of interest to state that, calculated as machinery would be calculated, the heart receives and propels the whole amount of blood in the human body in forty-two seconds.

To those who care for the subject of this evening's lecture, and have not altogether laid aside their mathematical knowledge, the information in Dr. Haughton's book will prove both instructive and interesting. To follow up the investigation, they may study the action of a horse in walking and drawing a load, also the construction of carriages so that the animal may most easily raise a loaded cart over an obstacle on the road, and, further, decide upon the inclination of the traces to the roadway. These being done, the investigator will find much scope for original work in examining the various ways in which horses are harnessed

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Therefore the work done by one arm is $\frac{8\cdot11\cdot30}{16}$ ft. lbs. per minute.
" " " 165 ft. lbs. " "
Therefore total work by both arms before exhaustion is 165·6·2 ft. lbs., or 1,980 ft. lbs., that is nearly 18 cwt. lifted through one foot in six minutes.

so as to utilise their vital energies. This done, boats and bicycles, as means of utilising muscular energy, are worthy of thought. Perplexity and confusion seem to be stamped upon modern usages in these matters, and the conclusion is forced upon us that the utilisation of the vital energies has not yet been reduced to a system.

ANNUAL INTERNATIONAL EXHIBITIONS.

THE AUSTRALIAN COURT AT THE INTERNATIONAL EXHIBITION.

Stimulated apparently by the example of Queensland, the older Australian colonies are advancing rapidly towards maturity. The Victorian and South Australian sections are almost ready to be presented to the public; but New South Wales is much behind. There, all is yet chaos.

South Australia is very proud of her wheat. During the past year South Australia has produced an excess of one ton of cereals per head of population, after feeding her own inhabitants. This power of export was well exemplified in 1871, when this colony contributed 103,430 tons of wheat and flour to the cereal wealth of the outer world. In preserved meats, beef, mutton, and kangaroo; in corn, and especially in wine, this flourishing young colony steps boldly to the front. Many fine fleeces are exhibited, one of them weighing ten pounds. This is the fleece of a two-tooth Merino ewe, of 365 days' growth. Mr. W. H. Dutton sends some fine samples of wool from Merino sheep, grazed on native grasses. Dried grapes, raisins and currants; dried fruits, such as apricots, also speak well for the climate of South Australia, but it is in her mineral wealth that the strength of this colony is most apparent. Interesting specimens of gold imbedded in quartz are shown, and a magnificent lump of malachite will not fail to attract many observers. The copper ores are deserving of more than a passing word. The Moonta Mine produces some superb blocks of copper ore. This mine has been an immediate, steady, persistent, and brilliant success. It produces yearly no more than 18,000 tons of ore, but this is of such rich quality that since the mine was opened—ten years ago—£900,000 has been paid in dividends. The great bulk of ore is yellow sulphide, but an admixture of richer ores brings the average per-centage of the mine up to the extraordinary figure of 21 per cent. Fine specimens of purple sulphide and quartz range as high as 50 per cent., and the admirably named peacock ore (copper pyrites) obtains 30 per cent. Chloride of copper touches 45 per cent., but these fine specimens are outshone by purple sulphides from 30 fathoms level. These reach 60 per cent., but are again excelled by some exceptional specimens of red, black, and crystalized oxide and malleable copper with a little sulphide. These and some fine samples of grey sulphide and quartz reach 75 per cent. The Wallaroo Mine produces 28,000 tons of ore per annum, but as the ores only average 11 per cent., the Wallaroo venture has in eleven years paid her shareholders no more than £360,000. Wallaroo ores consist chiefly of green carbonates and yellow sulphides. Green carbonate of copper is found on the surface, and extends downwards about thirty-two fathoms, when it is replaced by the yellow sulphide. It is a remarkable fact that no mine in South Australia, from which surface green carbonate was absent, has proved a success. The Doora mine, opened only two and a-half years ago, is another fortunate venture in the same district as Moonta and Wallaroo. The main outcrop of copper in this rich section of South Australia lies nearly due north and south, the lodes running east and west. Bismuth is another product of this country, and is mined extensively at Mount Balhannah.

Victoria exhibits models of the famous "Welcome" and "Blanche Barkly" nuggets, the former of which weighed 2,217 ounces, and realised £9,325. Fine specimens of auriferous quartz have also been sent. Many of these are of immense size, and completely overshadow the samples of carbonate of copper, galena (sulphide of lead), sulphide and oxide of antimony, micaceous iron ore, and iron pyrites, black oxide of manganese, and zinc blende. New Zealand and Natal are classed with the Australian Colonies. The former of these exhibits the *Phormium tenax*, or New Zealand flax, in various stages of manufacture. Rigid in fibre, this material has long resisted every effort to confer upon it a commercial value, but the perseverance of Mr. C. Thorne, who has devoted much time to the utilisation of the *Phormium tenax*, will in all probability be crowned with success. Kauri gum is another singular antipodean production. In its fresh state, as it exudes from the tree, it has no commercial value; the Kauri gum of commerce is obtained from swamps formerly covered by Kauri trees. It is reached by spearing the ground till gum is "struck," and then dug out. Kauri resembles amber in a state of transition, and is of great value in the composition of varnishes. Natal sends tea, coffee, sugar, and arrow-root. Among these the samples of coffee will probably attract the most atttention. The Australian department will be thrown open to the public on or about the 15th of July.

The number of visitors admitted to the Exhibition on Thursday, 26th ult., was as follows:—Season tickets, 166; on payment of 1s., 3,749; total, 3,915. On Friday, season tickets, 187; on payment of 1s., 2,870; total, 3,057. On Saturday, season tickets, 187; on payment of 1s., 3,170; total, 3,357.

The number of visitors admitted to the Exhibition during the week ending Saturday, June 28th, was as follows:—Season tickets, 1,142; on payment of 2s. 6d., 1,201; on payment of 1s., 15,210; total, 17,553.

The number admitted on Monday was, season tickets, 151; on payment of 1s., 2,581; total, 2,732. On Tuesday, season tickets, 127; on payment of 1s., 2,616; total, 2,743. On Wednesday, season tickets, 248; on payment of 2s. 6d., 1,039; total, 1,287.

EXHIBITIONS.

English Artisans and the Vienna Exhibition.—On Wednesday ten artisans, representing various trades of the town, and selected by the Birmingham Chamber of Commerce to report upon their respective industries at the Vienna Exhibition, left for Vienna. The names of the trades represented are as follows:—Gold, silver, and electro-plate, construction and design; saddlery, whips, and leather work; leather and portmanteaus; tin and japan wares; ironmongery examination, price, and, as far as posible, comparative value; general report on guns, jewellery (excluding gilt toys and trinkets), brass foundry in general, cabinet brass foundry in particular; the table and other glass, of all countries; railway carriages, waggons, &c., of all countries; design, as applied to jewellery, glass, iron, &c.; inquiry as to habits of German workmen, wages, and amusements.

In a letter on "Prevention of Fires," in last week's *Journal*, Professor Grechi, the inventor of a fire alarm, was mentioned as Professor, of Lima, instead of Siena. The instruments alluded to are now on view at Mr. C. de Tivoli's, 10, Austin Friars.

A new college has been opened under the name of the London Civil Service and Military College. The principal is Dr. Heinemann, F.R.G.S., who has been for some time a lecturer and professor at the Crystal Palace School.

AUSTRALIAN MEAT FOR THE WORKING CLASSES.

A movement, set on foot a short time ago by a committee of noblemen and gentlemen, among whom are His Imperial Highness Prince Louis Lucien Bonaparte, the Marquis of Downshire, Sir Antonio Brady, Sir Andrew Fairbairn, Sir Henry de Bathe, Colonel G. H. Money, Captain Hans Busk, and many other political and gastronomical celebrities, was, on Wednesday last, submitted to the test of a practical experiment. It was considered that the dislike of the working classes of England to Australian and other "tinned" meats was more truly referrible to ignorance than to prejudice, and it was therefore proposed to introduce at once the "canned" meats to the homes and hearths of the labouring classes. A committee of working-class representatives was appointed, and by their hearty co-operation greatly facilitated the conduct of an experiment on a large scale. Nine hundred meals made from Australian beef and fresh vegetables were distributed in the morning in the various working-men's clubs and industrial centres of the metropolis. The method adopted was to mince the Australian beef finely, to add to it potatoes, onions, carrots, turnips, pease-meal, the small maccaroni known as *paté d'Italie*, shalot, sweet herbs, essence of meat, and a little pepper and salt. These ingredients were put into cooking-kettles holding several portions each and conveyed to their destination. On the arrival of the food at a club or private house, water was added to the contents of the kettles, and in one hour it was fit for use. It may, perhaps, be best described as a sort of Irish stew—with the important exception that the meat, being minced, is not so palpable as might be desired. Its flavour was appetising enough, but the appearance of the dish was calculated to deter all but very hungry people. In the evening a meeting was held at the Cannon street Hotel. Sir Antonio Brady presided, and was supported by several members of the Committee. Reports from the various recipients of the Australian stew were read to a somewhat thin attendance, and the experiment, though well intended, will probably fail in convincing the artisan that a dish can be wholesome and strengthening without showing visible signs of meat.

CORRESPONDENCE.

PURCHASE OF RAILWAYS BY THE STATE.

Sir,—I have read with great interest Mr. Galt's thoughtful paper on the State purchase of railways, and the consequent remarks of other speakers. It seems to me that many objections, such as the inadvisability of Government trading, of increasing the national indebtedness, of State labour on a large scale, of increased State patronage, and opportunities for jobbery, &c., might be obviated or mitigated in great measure by the State becoming the owner of the permanent way and stations only, leaving the rolling-stock and all the trading part of the business in the hands of companies. The advantages of this arrangement would be that Government could make the national iron highways join and branch in such directions as were most suitable for the development of the national resources. The lines could be leased on such conditions and for such periods as experience proved best. Where lines were parallel, one might be specially devoted to passenger traffic and another to goods, so as to increase the safety of travelling at high speed, and avoid extra wear and tear, and consequent loss to the public, which is a natural result of over-driving goods trains to get them out of the way of passenger trains. There are other advantages, and there are disadvantages, of course, but I should extend this letter to an unreasonable length if I were to notice them.

If this plan has been proposed before, I wish you would kindly let me know the fact through the Society of Arts *Journal*, and also the main objections.—I am, &c.,

John Colby.

Pantyderi, Blaenyffos, R. S. O., South Wales,
June 26th, 1873.

CENTRAL ASIA.

Sir,—The following short account of the Yarkund Mission, sent to me from Simla, under date 1st June, will doubtless interest our friends who were connected with the deputation to the Duke of Argyll relative to opening of the trade on the frontier of India:—

"The party consists of seven European officers, including Mr. Forsyth, in command; Dr. Stroliczka, geologist and naturalist, known for his paleontological researches; Colonel Gordon, an acknowledged oriental scholar; Captain Trotter, R.E., a trigonometrical surveyor; Dr. Bellew, an antiquarian; Lieut. Chapman, R.A., secretary. (The name of the seventh is accidentally omitted.)

"The party hopes to leave Srinuggur about the end of July, and to reach Yarkund in October. From that point they expect to push on to Aksu 41° N. 79° E., and there to establish themselves in winter quarters. Provided no objection is made, they will then move eastwards, and examine existing and abandoned trade routes, running directly to China and S.E. to Lhassa. Two of Montgomerie's pundits will accompany the party, and it is probable that one of these will be sent directly from Khotan toward Lhassa. The party is large enough to divide. A severe, but with proper precautions, a very bearable climate, is anticipated.

"In the spring of 1874, if all be well, they will have to visit Khota and Karghar, and endeavour, from the latter place, to make the Tareek Pass, and strike across the Pamir Pass into Badakshan, where it is intended, if possible, to obtain some security for the travellers, who may push up to Yarkund by this route. The Karakorum route will probably, at all times, offer very serious difficulties, and it is considered that the opening up of a line of trade through Cabul and Badakshan is of main importance.

"To winter at the fort of the Tian Shan sounds rather a serious matter, but it is expected that the party will receive a warm welcome; and in returning with Yakoob Khan, the envoy, the acknowledged heir of the present Mahomedan ruler of Yarkund, is guaranteed a great deal, for he has fully appreciated his reception in India. Photographic apparatus will be taken with the party, and it is hoped that negatives yielding reliable pictures will be brought away. The mule-carriage for scientific instruments, chemicals, and so forth, is a difficult matter. The presents, selected with great care and success by Major Burne, sent by the India-office for the Atalik Ghazee, will accompany the expedition."

Then follows a short statement of some anticipated difficulties from intrigue and other causes; but, after the statement of the Secretary of State, it is not to be supposed that anything but temporary annoyance can arise from them. When once an expedition is fairly started, it is not likely that the nation will tolerate failure from other than insuperable causes. Central Asia, in spite of all the compilations and lectures with which we have been favoured, mostly traceable to but very few authorities, is still almost an unknown land, and it is of essential importance to the future of India and the Indian trade that the attention of the country should be still directed to the progress of the work.—I am, &c.,

F. Eardley-Wilmot, Major-General.

Victoria-road, Clapham-common, S.W.,
July 1st, 1873.

It is estimated that if coal working machinery were universally employed, 60,000 colliers would suffice to raise our annual extraction of 120,000,000 tons. About 300,000 colliers are now said to be employed.

GENERAL NOTES.

Art in Australia.—The colony of Victoria does not seem to hold out much encouragement to the diffusion of art productions, seeing that a duty is levied on entry, ranging from 5 to 20 per cent., on various classes of paintings and engravings. Thus we find in the year 1871—£1,591 value admitted free; £1,683 subject to 5 per cent. duty; £753 subject to 10 per cent. duty; £417 subject to $12\frac{1}{2}$ per cent. duty; and £378 subject to 20 per cent. duty; the total amounting to £4,822. £8,083 was warehoused. Silver plate pays a duty of 1s. per troy ounce, and plated ware (of which £12,840 in value was imported) 10 per cent.

Education in the Argentine Republic.—The Governor, in his speech lately received, states that "four thousand pupils are now receiving public instruction in the National colleges. Two provinces have claimed the prize of ten thousand dollars granted by law, and various provinces have passed laws providing resources for the support of schools. According to the official census, at 1,645 public schools there are 97,549 scholars, of which Buenos Ayres alone gives 32,000, and if to these we add the Universities and other schools, 103.000 Argentines are being educated. One hundred and twelve libraries have been established. The normal school in Parana has now been two years in existence, and gives great satisfaction. A similar school is about to be started in Tucuman."

Coal Supply.—Apparently the greatest resource for coal in the future will be the deposits of the United States of America, which have an area of coal formation extending over 200,000 square miles. More than 20 coal-fields in America can be enumerated, some of which are small, others very large. Pennsylvania possesses no less than 12,656 square miles of bituminous coal and 470 square of anthracite; while West Virginia has 15,000 square miles; Illinois, 30,000 square miles; Michigan, 13,400; Iowa, 24,000; and Missouri, 21,000 square miles of coal. Add to these the great coal-fields lying within the ancient Appallachian Basin, amounting in all to 203.000 square miles. It will, however, be a long time before we can look to America for a supply, inasmuch as she requires rapidly increasing quantities to satisfy the demands of her iron manufacturers.—*Engineer*.

A Government Mining Engineer for Central India.—After making upwards of 20 bore holes, and sinking two shafts, the Government have been successful in finding coal of an excellent quality for locomotive purposes in the Central Provinces of India, about 300 miles to the east of Bombay, and 200 south of Nerbudda, and it is now called the Wurdah Valley Coal Field. One shaft has proved 52 feet of coal at a depth of 149 feet, and the other 32 feet at a depth of 180 feet; whilst every one of the bore holes has revealed coal. The mineral extends over a surface area as much as 60 miles in length, by from 15 to 20 in breadth. To develop and superintend the working of this wide district the Indian Government have appointed Mr. Walter Ness to be their mining engineer. Mr. Ness is the gentleman whose name is so well known in connection with the heroic efforts to reach the entombed miners in Pelsall Hall Colliery.

Peat as Fuel.—It is announced that the Irish Peat Fuel Company is in a fair way to solve the problem of working the Irish peat bogs to practical advantage. The directors have secured a large bog within easy access of Dublin, and in every way suitable to the manufacture. The Midland Railway Company, on whose line the bog is situate, have given every assistance to the undertaking. The machinery has been purchased, and some of it is already in the country. The directors are resolved to leave nothing undone to make the company a success, and it is to be hoped the result will show that the confidence in the feasibility of developing in Ireland a new and profitable industry has been well founded

New Use of Manganese—The very high price of the metal nickel has led to some suggestions that metallic manganese might be employed in its place in the manufacture of German silver. Dr. Percy has written to the *Times*, stating that more than twenty years since he manufactured an alloy with manganese which so perfectly resembled German silver that it was sold as such to electro-platers without their detecting any difference.

Preservation of Food.—Mr. James Harrison, of Melbourne, whose patent for supplying ice has been worked for some years, has also a freezing invention for meat preservation. In order to test the question as to whether it could be carried out on a large scale, and throughout a voyage to Europe, to make it remunerative, a number of gentlemen have subscribed £2,500. Mr. Harrison does not propose to encase whole carcases in cylinders reduced to a freezing temperature, but the meat, cut into quarters and joints, is reduced to a frozen condition, and decay thereby intercepted. Some instances of preservation of carcases by natural cold in Sweden, and their importation into this country in a frozen condition, have already been noticed in these columns.

NOTICES.

SUBSCRIPTIONS.

The Midsummer subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

THE LIBRARY.

The following works have been presented to the Library:—

Thirteenth Annual Report of the Association of Chambers of Commerce.

Report of the Inspectors of Factories for the Half-year ending 31st October, 1872.

The Purchase of the Railways by the State. Speech of Mr. Lea in the House of Commons, on 20th May, 1873.

The Proportions of the Human Figure as handed down to us by Vitruvius. By Joseph Bonomi, F.R.A.S. Presented by the Author.

Reale Instituto Lomdardo di Scienze e Lettere. Rendiconti, Vol. 5, Fascicolo 8 to 16. Presented by the Institution.

Memorie del Reale Instituto Lombardo de Scienze e Lettere. Classe di Scienze Matematiche e Naturali. Vol. 12, Fascicolo 5; e Classe di Lettere e Scienze Morali e Politiche. Vol. 12, Fasicolo 3. Presented by the Institution.

Proceedings of the Academy of Natural Sciences of Philadelphia for 1872. Presented by the Academy.

Transactions of the Royal Scottish Society of Arts. Vol. 8, parts 3 and 4. Presented by the Society.

The Law of Private Enterprise in its Relation to Railway and other Works. By Charles F. Cotterill. Presented by the Author.

Memoirs of the Geological Survey of India. Vol. 8, parts 1 and 2, and vol. 9, parts 1 and 2. Palæontologia Indica, vol. 4, parts 1 and 2. Records, vol. 5 part 1 to 4.

The following work has been purchased for the Library:—

England's Improvement by Sea and Land. By Andrew Yarranton. London, 1677.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Entomological, 7.

Wed. ...Charity Organisation Society, 3. (At the House of the Society of Arts)
Royal Literary Fund, 3.

Fri ......Working Men's Club and Institute Union. 4. (At the House of the Society of Arts.) Annual Meeting.
Quekett Club, 8

Sat ......Working Men's Club and Institute Union. 3. (At the House of the Society of Arts.) Conference of Delegates from Working Men's Clubs.
Royal Botanic, $3\frac{3}{4}$.

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FRIDAY, JULY 11, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

COUNCIL MEETING.

The Council, at the first meeting after the Annual Election, chose Major-General F. Eardley-Wilmot, R.A., F.R.S., as Chairman for the ensuing year.

PRIZE FOR STEEL.

The Committee met at Gore-lodge. Present:—Major-General F. Eardley Wilmot, R.A., F.R.S., Chairman of Council, in the chair. Mr. F. A. Abel, F.R.S., and Mr. J. Nasmyth, F.R.S. The Committee decided that, having inspected the collection of steel specimens sent in to the International Exhibition, and looking at the conditions laid down with regard to this prize, they can only regret that there is not such a display as to amount to a competition, and they therefore cannot recommend the award of the medal.

CAB COMMITTEE.

This Committee met at Gore-lodge on June 27th. Present—Major-General F. Eardley Wilmot, R.A., F.R.S., Chairman of the Council, in the chair, the Duke of Beaufort, Lord Arthur Somerset, Colonel Henderson, C.B., and Andrew Cassels. The Committee made an inspection of the cabs entered for competition, and submitted them to a practical trial in the western annexe of the Exhibition.

On July 3rd the Committee again met. Present—Duke of Beaufort, in the chair, Captain Candy, Andrew Cassels, and Henry Cole, C.B. The Committee made a second careful inspection of the vehicles, and selected six for further investigation, the proprietors of which were requested, if willing, to make such alterations as would meet various objections made to the different cabs by the Committee. With a view of affording time for the adoption of such suggestions the Committee adjourned till a day in September next, to be hereafter named.

PROCEEDINGS OF THE SOCIETY.

CONVERSAZIONE.

The annual conversazione of the Society was held, as usual, at the South Kensington Museum, on Friday, June 27th.

The Art Library, the Raphael Cartoons, the Sheepshanks', and the National Gallery's Picture Galleries were open, and the visitors were able to make the tour of the Art-Schools both on the first and second floors. The courts and corridors of the ground floor were also open. The reception was held in the South Court, by Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman, assisted by the following Vice-Presidents and Members of Council:—Mr. F. A. Abel, F.R.S., Mr. G. C. T. Bartley, Mr. Edward Brooke, Lord Alfred Churchill, Mr. Hyde Clarke, Sir Daniel Cooper, Bart., Colonel A. A. Croll, Mr. C. J. Freake, Mr. James Heywood, F.R.S., Vice-Admiral Ommanney, C.B., F.R.S., Admiral the Right Hon. Lord Clarence Paget, K.C.B., Mr. Robert Rawlinson, C.B., Lieut.-Col. A. Strange, F.R.S., Mr. Seymour Teulon, and Mr. E. Carleton Tufnell.

A Promenade Concert was given by the Band of the Grenadier Guards in the North Court, of which the following was the programme:—

March	"Gravelotte"	Speer.
Overture	"La Dame Blanche"	Boildieu.
Valse	"Casino Tanze"	Gung'l
Fantasia	"La Timbale d'Argent"	Leon Vasseur.
Old English Glees	"The Hardy Norseman"	Pearsall.
	"Here in cool grot"	Earl of Mornington.
Selection	"Geneviève de Brabant"	Offenbach.
Valse	"Christine Nilsson"	D. Godfrey.
Selection	"Elijah"	Mendelssohn.
Fantasia	"Les Brigands"	Offenbach
Valse	"Galatea"	H R.H the Duke of Edinburgh.
Selection	"Ne Touchez pas à la Reine"	Boisselot.
Galop	"Iris"	Kuhner.

"God Save the Queen."

A Vocal Concert, consisting of glees, by the London Glee and Madrigal Union, directed by Mr. Land, was given from 9 to 11 o'clock, with intervals, in the Lecture Theatre. The programme was as follows:—

From 9 to 9.30.

Glee (5 voices)	"O! Bird of Eve"	Lord Mornington.
Glee (male voices)	"Strike, strike the lyre"	T. Cooke
Four-Part Song	"When the West"	Mendelssohn.
Madrigal	"Who shall win my lady fair"	R. L. Pearsall.

From 9 45 to 10 15.

Glee	"See the chariot at hand"	W. Horsly, M.B.
Glee	"How sweet, how fresh this vernal day"	S. Paxton.
Glee	"The Fisherman's Good Night"	Sir H. Bishop.
Humorous Old May-pole Ditty	"Strike it up, neighbour"	From Thomas Weelkes' "Ayrs or Phantastic Spirits," A D. 1608

From 10 30 to 11.

Serenade	"Sleep, gentle lady"	Sir H Bishop.
Catch	"Ah! how Sophia"	Dr. Callcott.
Madrigal (5 voices)	"O! by rivers"	Wilson and Savile, A.D. 1667. Arranged by Sir H. Bishop.

All the other arrangements were as usual. There were in all 3,952 persons present.

PURCHASE OF RAILWAYS BY THE STATE.

The discussion on this subject was resumed on Thursday evening, July 3rd, the Marquis of CLANRICARDE again occupying the chair.

Capt. Tyler, R.E., spoke as follows:—There is, I sincerely believe, no more important question to the future well-being of this country than the question which is now before us for discussion, and it is important for very obvious reasons. The prosperity of the country rests on its manufactures and commerce, and these again depend, and will hereafter still more depend, upon our railway system and upon the facilities of communication, and cheapness of rates and fares which it may supply. In the same proportion that our means of intercourse and transport are improved and cheapened, just in that proportion, *cæteris paribus*, will the prosperity of the country increase; and, on the other hand, as they are fettered by obstructions or high prices, so will it be injured. In the struggle for supplying the markets of the world which will hereafter have to be encountered between our merchants and manufacturers and those of other nations, there is no element which it is more important to watch over, or which is more under our control, than that of providing greater facilities and cheapness for communication and transport; and just as much as we neglect to take the best means of improving them, just so much shall we endanger and injure our position relatively to other countries, and just so much shall we detract from our usefulness, and tend to diminish the degree of our prosperity. None of us have, I believe, an idea of what this country is capable of doing under a system of free railways. It is with these convictions, and looking at the subject from the highest point of view, that I approach this discussion; and I wish it to be distinctly understood that I do not appear here in anything but my private capacity, and that I do not appear as an advocate of any particular course to be pursued. An honourable member, indeed, during a recent debate in another place, stated that I advocated the State purchase of railways, and that I did so in the hope of obtaining promotion by that means for myself. I wish Mr. Julian Goldsmid were here to-night, because I should like to tell him that nothing is more unparliamentary than to impute motives, and to ask him to answer my arguments rather than to attack me personally. He entirely misconstrues all I have said or written on the subject, when he attributes advocacy to me, and my own feelings and convictions in regard to it are far above any miserable personal ambition. If I were to undertake the advocacy of the State control of railways, I should go to work very differently. I should marshal such an array of facts, figures, and arguments as would, perhaps, astonish him; and I should not, I believe, find, if I were really to try, much difficulty in persuading those who are our masters—who possess the voting power in this country, and who are more interested in this question than any of us—of the objects to which their efforts should be turned, and the points to which their exertions should be directed. But, my Lord, there is another reason why I am no mere advocate in this matter. It has been with me, during many years, a question, not whether the State control of railways was desirable, but whether it was avoidable; whether, sooner or later, it would not become inevitable. The arguments which lead to that conclusion I have often enough advanced, but have never heard answered; and as they are at the bottom of the whole question, and may be stated in a very few words, I may, perhaps, be forgiven for again repeating them. Competition between rival railway companies, in construction or working, or in both, has long been regarded as the proper and legitimate weapon in defence of, or the guardian of the public interest in Great Britain. But the principle of competition, which is excellent as between butchers and bakers, which is generally good in trade and manufacture, which holds good by sea, where the way is open to all, cannot be considered to have succeeded hitherto, and threatens to die out as between the railway companies of this island. It is true that the controlling authorities of different companies have been, from time to time, foolish beyond conception in expending the money of their shareholders in fighting and competing with one another, and that the shareholders have not had the wisdom to direct, or the means to enforce, a policy more in accordance with their pecuniary interests. Vast sums of money have been wasted in Parliament, in law, in engineering, in construction, and in working, which might, properly directed, have been better employed in facilitating communication and improving accommodation. Competition may, therefore, be said to have failed as a principle; but, not only so, it is, further, in process of dying out. Combination has already proceeded with giant strides, and it is easy to foresee the ultimate result. The London and North Western, the Lancashire and Yorkshire, and the Caledonian companies, working in intimate alliance with one another, already share between them one quarter of the railway capital, and one-fifth of the railway mileage, of Great Britain. Other large and counteracting combinations loom in the distance, and there is every reason to believe, as a matter of plain probability, that before many years are past, the railway system of Great Britain will be in the hands of a few companies, who will again combine to form one huge joint-stock monopoly. It is true that the Parliamentary Committee of the present session has refused to legalise the amalgamations on a large scale which have been brought before it; but it does not necessarily follow that another committee will, in another session, adopt the same course; and even if Parliament were to refuse henceforth to sanction further combinations, it would by no means result that alliances would cease to be formed. Neither Parliamentary nor any other authority can compel railway companies to persist in quarrelling and competing with one another, to their mutual disadvantage, when once their directors and managers determine to adopt a more sensible and profitable course. It is only in the nature of things, and in the ordinary course of events, that combination should go on in the future as it has gone on in the past, and that there should be in the end ultimate and total, as there is now partial, monopoly of railway communications. This is the first step in the argument, viz., that competition has failed in the past in providing for the general public a maximum of accommodation at minimum rates and fares, and that, whether it has failed or whether it has succeeded, the time is coming when, for good or for ill, it will cease to exist altogether; and this leads to the further question, How this joint-stock monopoly, which appears to be inevitable, is to be controlled in the interest of the general public—in fact, whether any good, practical system of State control can be devised, short of taking the railways, or a part of them, over altogether? This is the question which I have not seen answered, and which it is so difficult to answer; and the more it is studied the more do its difficulties come to light. There are, of course, grave political and other questions to be weighed in considering the matter from the other point of view, as to what would be the result of State control, and these questions have been put forward by certain of the speakers, and notably by the noble earl who was good enough to address us on the first evening of the discussion. Some of them have been already met; and it would be impossible to explain more lucidly than was done in the leading article which the *Times* devoted to Lord Derby's speech, the fallacy involved in the expression that by the purchase of the railway system we should double our National Debt. The strangest confusion between the acquisition of property and the accumulation of debt is evident in such an assertion. The French nation, unfortunately, doubled its debt by going to war with Germany, and it will suffer heavily and proportionately by its load of taxation in future years. But if, in place of engaging in that war, it had upon fair terms acquired complete control over its railway system, the result would have been so far different that it would have made a constantly increasing profit, instead of an overwhelming loss, by the transaction. All experience has shown that railway property is on the whole an improving property; and the liability which a guarantee of interest on fair terms on such a property involves is, therefore, very small indeed. As to the possibility of railways being superseded in future years, or in future generations, that is not worthy of practical consideration. There are only three modes of travelling—1, along the earth; 2, through the water; 3, through the air. With those who contemplate the possibility of transporting an excursion train, laden with 1,000 passengers, or the contents of a heavy goods train—say 200 tons—even from London to Birmingham, or London to Edinburgh, under all circumstances of wind and weather, through the air, I, for one, hardly care to hold discussion. Inland water carriage has already been superseded for most descriptions of traffic by railways. And the only means of travelling which remains to us is in some way along the earth. It hardly seems likely that we shall discover better materials than iron and steel for rails, and it is still less likely that rails will go out of fashion for wheels to travel over. The prophecy that "men should run to and fro, and knowledge should be increased," appears to be now in sufficient course of fulfilment; and I think we may fairly conclude that railways are the latest improvement in locomotion that this earth is likely to see during the remaining term of its existence, and reject as impractical the proposition that railways are destined to be superseded by other means of locomotion, and that it is undesirable, for that reason, that a State should acquire control over them. The other difficulties which are, or are supposed to be, in the way of State control, I shall pass over lightly, not to take up too much of your time on this occasion. They involve questions of cost, of patronage, of the labour market and strikes, and of political pressure from different localities. As regards the cost, it has no doubt been much exaggerated. But railway purchase is perhaps an unfortunate expression, and railway control by the State a better one. The purchase need not be more than a guarantee of dividend and interest, and the fairer way to look at the question of cost, is, perhaps, to compare the estimated amount of the guarantee with the estimated amount of net earnings. The number of railway *employés* has also been exaggerated. It is difficult to ascertain it precisely, but the companies returned in 1869, for 9,796 miles and £25,743,502 of gross receipts, 116,270 *employés*. The proportionate mileage increase to the end of 1871 would give 182,499, and the proportionate increase in receipts would give, to the same date, 220,823. There cannot, probably, be more than 250,000 at the present time; and this only a small proportion of the total number of *employés* now in the service of the State, including the army, navy, police, constabulary, civil service, &c. In the Post-office alone the number directly employed is upwards of 40,000. The comparison between the *employés* of companies and those of the Government in a similar service is hardly worth making, though it has been receiving some warm attention. As regards railway work, the same officers and servants would do the same work for probably the same salary, and wear, no doubt, much the same uniform. The only difference being the initials on their cap, it is difficult to see why they should be more or less efficient. Their interest, in the same way, would lie in the way of pleasing their superiors, with a view to increased pay and promotion as early as circumstances would permit. Strikes are, as a fact, less difficult to deal with in the Government than in any other service, and especially when there are pensions to be obtained by remaining, and forfeited by sacrificing employment. Why political pressure should be of more avail in obtaining railway than other advantages has never been explained. But, lastly, I come to the remedy which may reasonably be expected, and which might practically be applied. If State control be, as would appear only too plainly, sooner or later, inevitable, what form should it assume, how far should it extend, in what way should it be introduced, and when should it commence? On these questions, there are two main propositions before us. 1. Mr. Galt winds up his valuable paper by quoting a question by Mr. Gladstone, and an answer by Mr. Glyn, then chairman of the London and North-Western Railway, before the committee of 1844, to the effect that there was nothing to prevent the Government from making railways to compete with the railways of companies, and to the further effect that he (Mr. Glyn) would much rather see a competing line in the hands of the Government than in the hands of a company. And Mr. Galt advocates the construction by the State of new lines to compete with the old ones, by way of reducing to a reasonable figure the demand for consequential profits, which have by some speakers and writers been so exorbitantly stated. 2. Mr. F. Hill, in his able speech, setting forth his own views and those of his distinguished brother, proposes that the State, having first acquired the control of the railway system, should proceed to let it out for working to contractors. Mr. Hill proposes that the contractors should engage to pay to the proprietors of the shares and securities of the railways the sum guaranteed by the State, and should, subject to that condition, compete with one another, those who would undertake to work on the lowest tariff, and generally on the most advantageous terms, obtaining the contract. These propositions deserve, both of them, serious consideration, but both involve considerable difficulties. It will probably be a long time before a serious proposition will be made to Parliament by any Government for the construction, by the State, of a new line from London to Liverpool, or between any other great centres of traffic, to compete with existing lines; and when such a proposition is made to Parliament there will be, at least, a possibility of its being rejected. The leasing of State lines to contractors on a very large scale would also involve very difficult questions, and do away, to a great extent, with the advantages of State control to be first, by the means of a guarantee of dividend and interest, acquired. Mr. Hill would require, it is true, "proper security for keeping up the plant in good order, providing against accidents, and so on." But these conditions, which seem to be so simple when thus stated, would be beset with innumerable difficulties and disadvantages in practice. The permanent way, the works, the engines, the carriages, waggons, and vehicles of various descriptions used on railways, are all objects which may be kept more or less in a state of efficiency. There may be thousands, nay, hundreds of thousands of pounds, of difference in their value, over a series of years, in a great railway system, according to whether they have during these years been kept up or run down. It would be a matter of enormous difficulty to obtain a fair valuation of them when handed over to the working contractors at the commencement of their lease, as compared with their valuation when taken over by the State at the termination of the lease. And, not only so, but the advantages of State control would, in a great measure, be done away with. The reduction of rates and fares to a minimum consistently with undue risk and fair working profit to pay guaranteed interest, must necessarily be an experimental process, extending over a long series of years. Every such experiment in any district would interfere with the profits of the contractors. Every question of additional accommodation of extra trains, of alterations of speed, or of further facilities would be an interference with their profits; and the difficulties of settlement in regard to such cases, involving constant references to arbitration, would be practically insurmountable, and would also be a great bar to the improvements which might otherwise be effected. And, further, the country would again be divided into districts, each of which would be in the hands of a leasing contractor or company. Each leasing contractor would be working for his own interest, and not for the common good. The rolling stock would be distributed in the hands of different contractors, and would not be available for universal employment. And, in fine, the ultimate result would be a worse state of things than if by combination all the railways came at last to be worked by three or four, or even one, large joint-stock company. These two propositions being, then, the former very unlikely of accomplishment, and the latter very undesirable to attempt, there is a third proposition which I would venture to bring under your notice as being also worthy of consideration. Even if the conclusion were at any time arrived at that it was desirable for the State to acquire control of the railway system, there seems no good reason why such a process should be carried out suddenly, but every reason why it should be done gradually and tentatively. Whatever risk might be incurred in taking over the whole railway system at once, very much less could accrue from an experiment upon one system; and it is easy to imagine many advantages which might be obtained if the State were to guarantee a rate of interest to be agreed upon to the proprietors of *one* railway company, and to acquire the control of its railway. Every desirable experiment might be tried as to additional facilities, as to reductions of rates and fares, and as to further accommodation. The State railway managed in the interests of the public would have all eyes upon it, and its managers would do their best, so as to compare as favourably as they could with the management of other railways by companies. Experience would be obtained, and evidence would be furnished, as to whether it would be desirable to extend the principle of State control at a later date. An opportunity would be afforded of giving instruction to a certain number of officers and soldiers, which is so much needed, and of the formation of a railway corps, which the War Department have not apparently seen their way as yet to accomplish, but of which we might feel the want most seriously in a future war. I would, therefore, venture to suggest to Mr. Galt the propriety of amending his proposition for the State to construct a new railway, and of substituting for it the project of acquiring the control of an old one. The former was perhaps more appropriate in 1844; the latter would appear to be, at the present time, the more prudent, the more feasible, and the wiser course for discussion and consideration. The object of such an experiment would be to give, under the circumstances of this country, the greatest possible impetus to railway employment and railway utility, with a view to the public interest, whilst the object of company management is, or ought naturally and properly to be, to obtain a maximum of net profit for shareholders.

Mr. David Ker stated that he was the author of the paper on this subject which appeared in the *Journal* of the Society for April 24th, and that he had been for the last three years advocating the purchase of railways by the State. He had done this by correspondence, addressed to members of both Houses of Parliament; and Lord Derby in a note, acknowledging his communication, and written before Mr. Galt's paper was read, concluded by saying:—"The difficulties which occur to me are not those which you have noted." The summing up by Lord Derby of the first day's discussion probably contained, therefore, the difficulties which pressed upon his lordship's mind, and these he would now shortly deal with, first remarking, however, that he did not consider the Earl of Derby as an opponent of State purchase, for, probably, if his objections were removed, he would be in its favour. His lordship first said—"Was it wise to make the State responsible for 600 or 800 millions of debt?" But it had been clearly proved that the transaction would be the conveyance, not of a debt, but of positive possessions in land, buildings, and tangible property of increasing value. Then, with regard to railways being superseded, and locomotive power being adopted to common roads, though it might seem a bold thing to say, he ventured to assert this was impossible. How could the enormous mineral and commercial traffic of the country be carried on by road-steam-engines, limited to a speed of six or eight miles an hour, leaving on one side the question of passengers? Collisions would be the rule instead of the exception, and the blocks would be innumerable. There must be a guiding rail, to keep the up and down traffic separate, and why should not the present railroads be made use of? Every improvement, then, would tend to the advantage of the Government which possessed the rails. Aërial navigation he dismissed as too ridiculous for serious consideration, at any rate, for goods traffic. No doubt improvements might be made in the means of locomotion, as, for instance, by the use of compressed air instead of steam, and this he apprehended would some day be adopted, to the great saving of fuel; but in such a case the State would be not a loser, but a gainer, by the improvement. Mr. Bramwell had said that the inventive powers of the mechanic would be stopped, and a particular form of locomotive laid down as a pattern never to be deviated from. Surely this must be said in joke, when it was remembered that Government had adopted numerous inventions in small-arms, and even advertised for more. The same with ironclads, big guns, and forts. As to the relations between the State and labour, he did not apprehend that any complications would arise; on the contrary, the Government would have a great advantage over private companies, for strikes took place in the latter case a hundred times to one in the former. In his former paper he had suggested a plan by which soldiers, after a period of short service, would be employed as porters and policemen on the railways; there would thus be a large reserve army, at no cost to the country; and under military law strikes could not take place. Then his lordship referred to what he conceived would be a difficulty arising from the exercise of local patronage, in the making of railway extensions; but it appeared to him that the extensions yet remaining to be made were so insignificant, as compared with the fifteen thousand miles already existing, that the question was not worth considering. His lordship then said, in conclusion, that he had always assumed that if the State had to buy railways it must also take the canals, steamboats, &c.; but he saw no necessity of the kind. The argument used by those against amalgamations—and the State purchase was only amalgamation on a large scale—was, that the canals must be kept separate from the railways, in order to compete with them. In the same way, if the State took the railways, they must compete with the steamboats and canals. When he first joined the Devon railways, in 1846, third-class trains were run with every train, so that the Midland Company were not, by any means, the originators of the idea. Again, when he went to Ireland, in 1852, as manager of the Waterford and Central Ireland Railway, he carried passengers from Kilkenny to Thomastown, eleven miles, for three-pence, rates which were, no doubt, too low for England; but he found trains were empty, and by lowering the fares he induced the people to travel instead of spending their money in the public-house. What merchant would send out his waggons four or five times a day, with a load of five hundred-weight each time, when they could very well carry a ton each journey? A locomotive, like a horse, should be made to do its full duty. He did not propose that fares should be lowered to such an extent as only to cover the working expenses, because he considered that would be unfair to the very large class of persons, including children and many married women who never travelled at all. It would be much preferable that profits should be made which would go in reduction of taxation, and be a benefit to all. He had prepared a plan by which all the fares throughout the kingdom could be very easily arranged on a system of mileage. A person could go to a post-office and get a ticket for 10 miles, which he could use at any time or in any direction. Carriages, parcels, dogs, and horses could be managed in the same way. He thought it would be more trouble for the Government to lease the lines than to work them themselves; the latter plan would be much safer for the public, and better for the *employès*. If anything went wrong it could be called attention to in Parliament, and would soon be set right. As to taking the railways gradually, he did not think it would answer at all, because of the disturbance it would occasion in the value of the shares whilst the process was going on. In conclusion, he begged to refer to his former communication to the *Journal*, the statements in which he had never heard controverted.

Mr. W. J. Gwynn expressed his conviction that it was absolutely necessary, in the interest of the public, that the Government should take possession of the railways. Any danger of loss in times of depression could easily be guarded against by forming a reserve in times of prosperity; and he did not apprehend there would be any financial difficulties in the way of making the purchase.

Mr. Grazebrooke said he had been for many years interested in this subject, and had paid great attention to it from a political point of view. The first of all benefits to a nation was cheap and easy communication. The prosperity of the present day was well known, and was often attributed to free trade, but it was really attributable to the railroads, steam-boats, and telegraphs, which contributed so much to the growth of commerce and increase of production. He was always anxious to agree with Lord Derby's conclusions, knowing the ability of that nobleman, but on the present question it seemed to him those conclusions were altogether erroneous. He agreed with Capt. Tyler that there were only three possible modes of communication; but he could not agree with him that railway communication had reached its ultimate point of excellence, or that the present system would never be superseded. Considering the growing intelligence and constantly increasing scientific knowledge of the present day, he saw no reason to doubt that the time would come when 100 miles an hour would be looked upon as slow travelling. By slightly increasing the width of gauge, and lowering the weights, this speed could be attained with safety, so that distance would be much more completely annihilated. Railroads, however, would still be required, and he must take exception to the assumption of Lord Derby that if they were superseded the loss ought to fall on individuals and not on the community in general. If they were superseded, it would be by something more advantageous to the public, and consequently the State should stand the loss arising from such supersession. Whatever means of travelling were adopted, in all probability the existing railroads would be available in part at least. It was a self-evident axiom that the Government ought to have the control of the arteries of communication, the railways, canals, and navigable rivers, because these means of communication ought only to be used for the common weal, and not for the advantage of directors or shareholders, however numerous. There was only one real solution of this question. Although it might be delayed, it must come at last. Day after day the process of amalgamation was going on between the various railways, and this could only result in the public being more and more at their mercy, in the rates and fares being raised, and in the public being mulcted for the benefit of the shareholders. That such a condition of things was being brought about it did not require much argument to prove, and that it was rapidly approaching was self-evident. Therefore the sooner Government took the matter in hand the better it would be for the nation. He quite agreed that it was not wise to give too much patronage to Government, but he did not very well see how it could be used for political purposes in the case in point, being so widely distributed. There would probably be a permanent railway board, which might be elected by the very men who now held the railway stock. No doubt there would be a responsible minister, who would be the creature of party, but he would only be the ornamental head of the department, the permanent Board having the real management. No doubt there were advantages and disadvantages to be considered in such an important matter as this, as in all others, but there were very many evils under the present system of railway management. For instance, if a person took a return ticket, and was not able to return so soon as he anticipated, it was very unjust that the company should make him pay the full amount of the single fare without allowing for the extra half-fare he had paid for his return-ticket. He believed the acme of railway prosperity would never be reached until railway fares were immensely reduced, so that a workman would have no difficulty in going 40 or 50 miles for a job. But these facilities would never be given by the present managers of railways, who considered only the interests of the shareholders. Nor could it be expected; for, although he had not the slightest doubt that in the end such a reduction would be remunerative, there might very probably be a transition period of two or three years, during which the dividends might be lessened. Only a Government could be far-sighted enough to carry out such an important change, knowing that it could afford to wait until the return came in due time. The same principle applied to extensions; there were large districts in Scotland and other parts of the kingdom which might with great advantage be opened up by railways to civilisation, but which could not be expected at first to yield profitable returns on the capital expended.

Mr. Muir said the proposition before the meeting appeared to be that the State should not only control but work the railways, and the majority of the speakers seemed in favour of it. He, however, took a different view, that the present system, which had arisen from private enterprise, should not be lightly interfered with. He deprecated handing over the public to the control of a body of Government officials, whenever they wanted to leave home. They had heard of the soldiers being porters, but if they were called upon for active service where would the railways be? At the present time the railways were, in theory, looked upon as highways, and anyone might, theoretically, place a locomotive and carriages on any railway, and carry passengers. The difficulty, however, in carrying out any such idea was that, though railway companies were compelled to allow the use of their lines, they were not obliged to give other facilities, such as booking accommodation, water, and coke. The theoretical right, therefore, had not, practically, been of any use. His view was that if Government interfered in the matter at all, they should only do so to the extent of acquiring the permanent ways, supplying booking-clerks, &c., and issuing tickets to anyone who chose to place trains upon them. The trains, of course, must be run at proper times, and on payment of the tolls, which would be amply secured by the money paid for the tickets. The only objection he had ever heard made to this plan was that the trains would run into each other, but he thought this was just the way to prevent such a thing. If he were the conductor of a train leaving Euston-square at ten o'clock, and knew that one belonging to another proprietor left at five minutes after, he should take very good care to keep a-head, knowing he would be answerable in damages if he occasioned delay. It appeared to him that the responsibility of each train proprietor would lead to great punctuality and safety, especially when there were Government officials at each station and junction checking them. Something very much akin to this was tried for about twenty years in Pennsylvania, the trains being run over the lines by different proprietors at different times. By this means they would secure the advantages both of government control and of private competition, and the latter was a point, in his view, of very great importance. For instance, the railways charged three shillings for the smallest parcel from Glasgow to London, but the Globe Parcel Express, a private carrying company, would perform the same service quite as expeditiously for one-third of the sum. Thus private enterprise beat the railways in the conveyance of goods, and he did not see why the same principle should not be applied to passengers.

Mr. Campbell Johnson thought the argument adduced by the Earl of Derby had been pretty well disposed of, but one or two points might bear to be touched upon once more. His lordship asked what would have happened if the Government had purchased all the canals and coaching businesses of the country? But the fact was there was no reason whatever why the Government should go out of its way to interfere with commercial transactions of that sort. The railways were now the highways of the country, which the canals were not, and that was why the State ought to have the control of them. Then a fear was expressed as to the result, if railways were superseded by some new invention; but he apprehended means would be taken, by the establishment of a sinking fund, to provide against any contingency of that sort. How could he agree with the proposition that if there were any loss from such a course it ought to fall on individuals? It appeared to him that in a free country the Government and the people were the same—the welfare of the one was the welfare of the other—and saying that it was better for individuals to suffer than the State, seemed to him drawing an impossible distinction. This error unfortunately was constantly arising, and lay at the root of what was often said about the antagonism between labour and capital, or accumulated labour. He was, however, astonished to hear Lord Derby give his support to such a confusion of thought. Some persons said it would be better for Government to control than to possess the railways; but it must be remembered that, beyond a certain extent, the more Government interfered the more they diminished the responsibility of the joint-stock companies, and if any accident or catastrophe should happen, the latter would be very apt to disclaim the responsibility, and say that the action of Government had taken the control out of their hands. He thought the Government should take the whole matter into their hands at once, and not little by little, because of the disturbing influence it would have upon the money market, which might lead to something like national ruin. There was always a great reluctance on the part of the mother country to follow the example of the colonies, probably under the idea that it would be derogatory to her dignity; but the experience of India, the Cape of Good Hope, Australia, and other colonies, showed the advantage of the State acquiring the possession of railways. The case of Ceylon, however, was particularly instructive; a company had began to make the railway, but, fearing they were going to be ruined, gave it up; the Government then took it up and finished it, it being supposed that it would pay for itself in about 14 years The experience of a few years, however, had now shown that it would repay its cost in a much less period.

Mr. Lansdown remarked that no one could wish the State to take possession of the railways unless the public would gain something by it, and the question was what would the gain be? The public wanted cheap fares and uniform treatment, neither of which they enjoyed at the present time. Mr. Galt had been twitted with not bringing forward an overwhelming case in favour of the purchase, but he apprehended the difficulty would be to find anyone who was satisfied with the present system; and if cheap fares could not be secured in any other way, then, undoubtedly, it would be advantageous for the government to purchase the railways. The present managers said it was impossible to concede cheaper fares, but it had been calculated that about 35 tons of dead weight were carried for every ton of paying weight, and if that proportion could be reduced to 3 to 1, it was evident that the fares could be reduced to one-tenth their present amount, with the present locomotive power and rolling-stock. The railway companies would not do this, because it paid them better to carry one person for ten shillings than ten persons for one shilling. The public, on the other hand, would much prefer to travel ten times for 1s. instead of once for 10s. On this ground he hoped that this discussion would lead to some practical result, and that a committee would be obtained to go into the question, and see whether something could not be done. It had been suggested that amalgamation would lead to a reduction of 25 per cent. in cost, but that would not result in a reduction of more than five per cent. in fares, and therefore that, by itself, would not answer the expectations of the public of what could really be obtained by uniformity of management. Railway managers received large salaries, and no doubt earned them, for they were a very able body of men, but their energies were not directed to the benefit of the public—not being the public servants; their interest, in fact, was to get as much as possible out of the pockets of the public and to give as little as possible in return. As regarded the mode of purchase, he saw no reason why it should not be gradual, in the same way as amalgamation had proceeded amongst the railway companies, and if the Railway Board were established, with powers of arbitration, he did not think there would be any great difficulty in arriving at a fair basis of exchange—not a uniform basis, of course, because it would not do to give the same for a company with depreciated stock and plant, as for one in which it was all new, or had been kept up to the highest standard of efficiency. He did not apprehend that the gradual system of transfer would of necessity lead to stock-jobbing, or at any rate such a thing might be prevented by refusing to recognise any factitious value in the stock of railway companies not representing a real improvement in the property.

Mr. Bourne said he had been anxious to say a few words on the comparative merits and demerits of Government management, for on this the whole question must turn; but being unable to do so at that late hour, he would communicate his views to the *Journal* in writing.

Mr. Campin thought that, as an abstract question, all must agree that the railways, which were now the main high roads of the country, ought, in some way or another, to be under the management of the State; still there were many practical difficulties which would have to be seriously considered. He had enjoyed considerable opportunities of learning the views of the representative working men on this question, and, generally speaking, he believed they were in favour of the nationalisation of the railways, but then they were also in favour of the nationalisation of the land, so that they were perfectly consistent. Some, however, regarded the nationalisation of railways with a certain amount of distrust, fearing they might be used for political purposes, by the coercion of *employés*—not so much the clerks and higher class of servants as the porters, platelayers, and workmen, in whose case it was considered this kind of abuse was more likely to be exercised. It must be borne in mind that this scheme, if carried out, would put the railways in the hands of a Government such as at present existed, not of some Utopian perfect Government, which would spring up immediately such a change was decided upon; and Government action was not always the most pleasant to ordinary people. Those who had had anything to do with the Stamp-office, or any other department, would know that there was a great deal of routine, and what was called red-tapeism, connected with it, which was not very pleasant to those who came in contact with it. Two points, in particular, would have to be considered which had not yet been alluded to. One was the question of responsibility for accidents, the ordinary rule being that the Crown paid compensation to nobody; and the other was, how would the State deal with inventors? No railway system could be expected to work well, unless encouragement were given to mechanical improvements; but every one knew the way in which Government treated inventors, and it had even been said the Government claimed, and intended in future, to exercise the right of using inventions without recompensing the inventors. If such a system were adopted, he need hardly say it would not tend to the improvement of railways under Government management.

Mr. Galt, in reply, said:—The paper I read on the purchase of the railways by the State, which has been the subject of discussion at four meetings of the Society, was necessarily of a very discursive nature, and to do anything like justice to the subject I had to travel over a great deal of ground. That the question at issue might be fully understood, it was necessary to give a sketch of the several phases of our railway legislation, to notice in some detail the manifold grievances which the working of our railway system inflicted upon the public, and to discuss at a greater or less length the principal arguments in favour of and against the project of purchase. Thus, by the introduction of so many collateral subjects, the principal facts and arguments brought forward in support of State purchase have been, to a great extent, evaded in the course of discussion, by those gentlemen who spoke in opposition to the measure. Might I be permitted, then, briefly, passing over all other matters, to re-state my arguments and reply to the objections to them so far as they have been urged? First, I contend that, in the words of M. Rozier, the Belgian Prime Minister, in 1834—"Whoever holds the railways holds a monopoly, and, therefore, the principle of competition cannot apply." The British public, as we all know, determined when railways were introduced in England that competition should apply, and that there should be as free traffic on railways as on ordinary roads. Well, we know how the companies laughed at that remarkable project. Then followed competing lines. The companies were for a short time disconcerted, but they soon turned the tables on the British public, and made them pay pretty dearly by vexatious, exorbitant and differential rates and charges for the useless expenses they had been put to. Under these unfavourable circumstances, another change took place in the British mind. It was thought desirable to pass a Bill giving government, with the assent of the Legislature, power to purchase the railways twenty-one years after date if the Legislature should so desire it, and the Bill was accordingly passed. But in passing through Parliament it was so manipulated by the companies' representatives, that the only intelligible part of the Bill was a clause under which the companies claim, in the event of purchase, "consequential profits" to the amount of £400,000,000, beyond the present value of the railways. This was the Act of 1844, of which we had heard so much. After this Act was passed, it was thought advisable to conciliate the companies, by allowing them to amalgamate, and this they had done at such a rate that if the Legislature had not taken fright and stopped them, they would by this time have divided Great Britain into four or five sections, and become supreme masters of the whole traffic of the country. The Legislature however, thought there was one way left to establish something approaching to free trade in our railway system, and in the present session of Parliament an Act has been passed for compelling hostile companies to afford due facilities to other companies by giving them running powers over their lines, and a board has been constituted to carry this object into effect. I will read an extract from the evidence of Mr. Macpherson, the goods manager of the North British Company, given before the joint committee, from which an opinion might be formed of the task this Board has before them, and the probability of their being able to accomplish it in opposition to the owning companies. The North British had running powers over the Caledonian line, and Mr. Macpherson thus describes the "facilities" afforded by that company in the exercise of their rights:—"They ran their trains in front of the North British and fixed the time for starting their own trains from the same places and the same hours, with the North British trains. They detained North British trains upon the ground of testing the carriage wheels, and on other unreasonable pretexts, in order to give precedence to their own competing trains. They refused to recognise North British tickets, and forced passengers to leave carriages going by the North British route into carriages going by their own route. When North British trains arrived at Perth, with passengers for the Dundee railway, or for the line leading to Aberdeen and the north, the corresponding trains for Dundee and Aberdeen were then started for Perth without North British passengers, although the North British trains had reached or were within the precincts of the station. They refused the statutory accommodation for North British clerks and agents at the stations on the said railway. They refused to recognise the North British Company's right to issue season or contract tickets to passengers. They raised fictitious claims at their stations against North British passengers for excess fares. In winter they would not allow foot-pans to North British passengers, while they provided them for their own. They refused to insert the times of arrival and departure in their time-tables, as required by the Amalgamation Acts. Instead of delivering parcels from the North—addressed to places in England and elsewhere, or beyond the North British system—to the North British Company, at Perth, they carried them over the West Coast route. They declined to carry on through carriages belonging to the North British Company from Perth northwards. These are all findings of the standing arbitrator with reference to passenger traffic. As regards the goods traffic the arbitrator found that the Caledonian Company opened the North British Company's letters and invoices at stations, and made use of the information thus acquired to secure delivery by their own carting agents, and to canvass the consignees for their return traffic. They used their own forwarding notes for North British traffic coming into Caledonian stations, and so secured the forwarding of such traffic by their own and the London and North Western routes. They took possession of North British goods traffic arriving at the stations on their railways, and delayed its delivery so as to give precedence to delivery of their own, in consequence of which traders using North British lines have been induced to use Caledonian instead. They usurped the powers and duties of North British agents and clerks at Caledonian stations, and so manipulated the invoices and forwarding notes as to prevent the traffic going by North British routes. They took the addresses from the waggons loaded with North British traffic and re-addressed the traffic so that it might go by routes most profitable to themselves. They insisted on settling traders' claims against the North British Company for damages to and delay in delivering traffic, and so created dissatisfaction among traders using the North British route. Those are also all findings of the standing arbitrator, and the result of all was that we were not able to compete for the conveyance of traffic under facilities of equal terms with them." This is a very fair specimen of the success that has attended the determination of the legislature to apply the principles of free trade to railway traffic, and by giving running powers to rival companies, thereby promote competition. In those few cases where they do not unite, the owning company has such advantages that successful competition is hopeless. It could not be denied that the railway companies must necessarily have a monopoly of the inland traffic of the country, and all that is now attempted is to mitigate some of the worst abuses which result from the exercise of this monopoly. We have, in the second place, to consider by what means the State could interfere, so as to give the public the full benefit which cheap and rapid means of communication are calculated to afford. Now a monopoly is not necessarily an evil—so far from being an evil it may be the means of effecting a great good, as, for instance, in the working of the postal system. We have, in regard to the Post-office, a highly centralised system of management, extending over the whole of the kingdom and connecting the most distant cities, towns, villages, and districts with each other and with the metropolis. Would it be desirable then that the Post-office, as a national institution, should be abolished, and that the duties now performed by that establishment should be left to the operations of free-trade and competition, as we find it developed in the working of our railway system? The Post-office has the monopoly of the conveyance of our letters on one system, the railway companies that of the conveyance of our persons and property on a system totally opposite. Which is the better of the two? If the Government monopoly of conveying letters was abolished, we would have no difficulty in tracing the course of the future post-office companies so soon as they were established. They would act, no doubt, as all other railway or trading companies act. Each company would charge whatever rate of postage paid best. We should, no doubt, have a hundred different companies battling through the kingdom for business; they would assert, like the railway companies, their "territorial rights;" they would repel invasion, they would not submit to be robbed of their "postal traffic," they would combine against each other and the public, and the postage would rise or fall from day to day, as they might be successful or otherwise in their several combinations or arrangements. The cities and towns would be well attended to at the charges that best paid, and the villages and districts which would not pay would be deprived of all postal communication. There would be no control, authority, or combined action throughout the country, till the companies would find it to their advantage to amalgamate their several interests, and finally by successive stages become one great company, having in their hands the whole postal traffic of the country, and charging what they thought proper for letters, newspapers, and parcels. Would any one in this country wish to exchange that system for that of the present Government monopoly? If not, it only proves that there are cases in which a monopoly can be managed by a Government greatly to the benefit of the public; and there could be no better illustration of that principle than a comparison of the system which formerly existed with that now adopted since Sir Rowland Hill's plan of reform was carried out. The conveyance of letters at that time was conducted without any more regard to the general interests than was necessary to extract the greatest amount of money from the public. In this respect the unreformed post-office was not a whit behind the most obnoxious of its compeers. It laid on the most exorbitant rates; it guarded with the utmost jealousy any attempt to infringe on its patent-right to carry letters, and prosecuted with the utmost rigour trespassers on its domain. Although the cost of conveying a letter from one end of the kingdom to the other did not amount to half a farthing, the Post-office charged half-a-crown, and so in proportion for lesser distances. All this was abolished when Sir Rowland Hill had the system changed, and the public benefit made the primary object, and commercial success only secondary. In the paper I read I referred to my evidence given before the Committee of 1844, which proved the enormous reduction that could be made in railway fares with comparatively slight loss; and I furnished the Committee with a tabular form, with an exact statement of the loss or gain to each company in consequence of the great reductions in fares. I will give a short extract from my evidence in which I referred to this table. On that occasion I said, "Now, if they would refer to these railways of which I gave the returns, viz.:—Leeds and Selby, Manchester and Bolton, Dundee and Newtyle, Glasgow and Greenock, Glasgow and Gankirk, Paisley and Renfrew, London and Greenwich, London and Blackheath, no matter to what extent the directors had reduced their fares—and in the cases I have given the reductions ranged from thirty to seventy per cent.—there was not a single company in all those cases had their dividends affected to a greater extent than ¾ per cent. per annum." I quoted to the Committee, in confirmation of the probable gain by the general adoption of low fares, the report of the board of directors of the Glasgow and Greenock railway, who had reduced their lowest class fare from 1s. 6d. to 6d., the distance being 22½ miles. The directors, in their report for the half-year ending the 30th of June, 1842. say:—"It has been found that the increase of working expenses for an additional number of passengers is scarcely appreciable, and with the present number of trains fifty per cent. more passengers might be carried with a very trifling increase of outlay. So successful has the operation of the third-class fares been that it enables the directors to state to the shareholders that had the modifications of the tax been obtained before the commencement of the present year, the result of the year's traffic would have been very different from that which they now lay before them. In the week ending the 21st of May, before the reduction took place, the number of passengers was 12,133; the next week they had increased to 17,332; the week after that to 19,621, and so on, increasing till the period in one week in the summer there was 33,887 carried, and with a very trifling outlay fifty thousand might be carried." As the strength of a chain is tested by its weakest link, so the third-class fare must to a great extent govern first and second-class fares, reference of course being had to greater speed, as well as superior accommodation. I stated to the Royal Commission in 1865, that I considered the following scale would fully meet the wants and wishes of the public:—Express—First class, 1½d.; second class, 1d. Ordinary trains—First class, 1¼d.; second class, ¾d.; third class, ½d. Goods or slow trains (once a day)—First class, ¾d.; second class, ½d.; third class ¼d. per mile. Excursion trains about half the present fares. These reductions are not to be compared with those made in the Post-office, but the circumstances are quite different, nor could the proportionate increase of passengers be expected to be anything like the proportionate increase of letters. Previous to 1865, the Board of Trade, in their annual returns, gave the average fares charged by all the railway companies in the kingdom, and anyone who had never studied the subject would be surprised at the wide range of fares adopted by the several companies. According to the returns for 1863, the lowest fares charged in the kingdom was on the North and South-Western Company's. Their charge per mile for the several classes was $\frac{6}{10}$d., $\frac{5}{10}$d., and $\frac{3}{10}$d., which for 100 miles would amount to 5s., 4s. 2d., and 2s. 6d. The highest in the kingdom was the Carmarthen and Cardigan Company. They charged per mile 3½d., 2d., and 1d., or taking 100 miles, £1 9s. 2d., 16s. 8d., and 8s. 4d.,—the fares of one company having, on an average, more than quadrupled those of the other. In the work I published in 1865, I quoted from these returns the fares of forty of the principal companies in the kingdom, all intermediate between those I have noticed, drawing especial attention to the fact that the North and South-Western Company, even with their exceedingly low fares, was actually paying 6 per cent. to the shareholders, whilst the Carmarthen and Cardigan Company did not pay half that dividend, so little does the difference in fares affect the dividends. It would be almost impossible to over-estimate the value of the boon that would be conferred on the mercantile community, and, indeed, on the public generally, by the establishment of a low, and, to some extent, uniform tariff for parcels and packages throughout the kingdom. The annual charge to the public for the conveyance of parcels is very small in amount compared with that paid for general merchandise, and does not probably amount to half a million. The exact sum, however, cannot be ascertained, as it is mixed up with receipts for general merchandise. Great, however, as the difference is between the two sums, I am almost inclined to believe that a low tariff for parcels, packages, hampers, &c., throughout the kingdom, would, with the general public, be even a more popular measure than a general reduction in the charges for merchandise. It would come more home to each household, and partake more of the nature of an abatement in what might be called direct taxation, than almost any other reduction of a similar nature that could be mentioned. The charges by many companies are exceedingly high, and in some cases almost prohibitory. If the railways were in the possession of the State, a uniform tariff for parcels throughout the kingdom would probably be one of the first measures adopted; say for a parcel not exceeding 3 lbs., 4d.; 7 lbs., 6d.; 10 lbs., 9d.; and 14 lbs., 1s.; and for every additional 7 lbs., or fraction of 7 lbs., 6d. As regards the conveyance of merchandise throughout the kingdom, and the manifold grievances under which the mercantile community suffer in consequence of exorbitant and differential charges, no other remedy has been suggested of any practical value than the transfer of the railways to the State. In the paper I read I noticed in some detail the benefits which would accrue to the nation from the possession of the railways, provided that they could be obtained at a fair price, and on that subject I have little to add to what I have already said. It was assumed throughout the discussion which took place a few months since at the Statistical Society that, as the Act of 1844 was a failure, the companies had the power of imposing what demands they thought proper, and it was then delared that £400,000,000 beyond the actual value of the property was the lowest that would be accepted by the companies. Now, as a matter of fact, the right of the State to make competing lines in opposition to the companies had not only never been disputed, but the Chairman of the London and and North-Western Company stated in his evidence before the Committee of 1844, he should prefer opposition lines being made by Government, rather than by opposing companies, as in the latter case the old companies might be ruined, whilst the Government would never carry their opposition to such an extent. The assumption, therefore, on the part of some who profess to represent the companies, that in the event of the public coming to the determination to have low railway charges established throughout the country, that the companies have power to prevent that intention being carried into effect, is an utter delusion. Lord Derby said he "had not the slightest doubt that if the public really wanted the railways purchased by the State it could be done; the question of price would not present any insuperable obstacle." We need not, I think, discuss the terms of purchase further. Should the occasion arise, the legislature and not the companies will be the supreme master of the situation, and will no doubt act equitably. When the Act of 1844 was passed, it was the intention of the legislature that, in the event of purchase, the shareholders should have a bonus of 10 per cent. on the value. We have heard the opinion of Mr. Bass in this matter; he is one of the largest, if not the largest, holder of railway stock in the kingdom, and he says he will only be too happy to sell it at 10 per cent. beyond its market value if he can find any one willing to give it; but I am afraid he must wait some time before he meets with such an offer. Captain Tyler says, very truly, that the legislature would be very unwilling to construct lines in opposition to those of the companies, and such, no doubt, is the fact; but I only refer to the dormant power possessed by the legislature to exercise that right should it ever become necessary, in answer to the gentleman who spoke at the Statistical Society, and assumed that the companies could evade the Act of 1844, in defiance of the public and the legislature, and refuse to part with the railways should the nation wish to possess them, except on such terms as they thought proper to dictate. It is satisfactory, however, to find that in the several meetings held here, no allusion has been made to such preposterous claims by any advocate of the power and rights of the companies. As to the *modus operandi* of purchasing the railways, there can be, I should think, but little difference of opinion. It must be by a gradual process from year to year, according to the state of the money market and the inclination of the shareholders to take Government stock at the market price, with ten per cent. bonus in exchange for their shares; and the operation might therefore extend over some years, or it might be brought to a conclusion in a comparatively short space of time. It is not necessary to go into a minute calculation of the saving that would be effected by the substitution of the credit of the State for that of the companies. In the very able paper read by Mr. Martin before the Statistical Society, in which he went minutely into the financial position of every class of railway securities, he calculated that the annual surplus revenue would be nearly seven and a half millions. According to the highest railway authorities, there would be a saving in working expenses by amalgamation of 20 per cent., that would amount to five millions more; but let us assume that both calculations are somewhat over-estimated, and that the amount saved would not exceed ten millions per annum, even then an enormous sum would remain towards meeting any supposed deficiency that might be caused by the adoption of low fares and charges. Now, so far as regards passenger fares, some gentlemen who have taken part in this discussion have objected strongly to what they consider the high fares I have proposed, and urge that no loss would be incurred by adopting a much lower tariff. They refer to the success of the penny postage, and contend that a proportionate reduction should be made on fares as was made in postage. The cases, however, are not by any means parallel—to send a letter from one end of the kingdom is one thing, and to go yourself is quite another. There are ten letters sent by post now for one that was sent formerly, but he never should expect such an increase in the number of passengers; perhaps they might be trebled. Our object at the present time should be to have such a tariff that all classes might be accommodated according to their wants and their pecuniary means, and that no person should be prevented from travelling who has the occasion or the wish to do so. Now, I consider that the tariff for the middle class, at the several fares of $1\frac{1}{4}$d., $\frac{3}{4}$d., and $\frac{1}{2}$d., with return tickets at a fare and half, would fully meet their wants. As regards express trains, they are attended with great expense, and as the number of passengers is limited, there cannot be the same reduction in fares as by other trains, nevertheless a charge of $1\frac{1}{2}$d. and 1d. per mile would be a large reduction on the present fares. A train once a day for the poorer classes, especially those who have occasion to make long journeys, would confer on them a great boon. It has been suggested by Mr. Bidder that carriages might be attached to a goods train, and third class passengers carried at a farthing a mile with good profit. I don't know any other matter that more deeply affects the interests of humble classes. Take the case of a working man who has occasion to remove with his wife and family—say, four children—from here to Liverpool, for which at present he would pay £3 6s. 8d. But what a difference it would make to him if he had only to pay 16s. 8d., although he should be three or four hours longer on his journey! It is to be hoped that those who possess great influence in the country, and use that influence to benefit the working classes, will direct their attention to this phase of the question. Besides the working classes there are many of the middle classes to whom a saving, in a long journey especially, is a matter of some consideration, and if they are satisfied to avail themselves of a slow and cheap rate of travelling, there is no reason why they should not be accommodated. With the above tariff, and excursion trains at half the present fares, I think the country would be fully satisfied. It is quite possible, with these reductions, that in the course of a few years there might be a greater revenue from passenger traffic than there is at present, but, if not, there would be the reserve fund to supply the deficiency. As regards the goods traffic, I have gone so fully into that branch of the subject in the paper I read, in which I detailed the heavy grievances under which the mercantile community labour, that I cannot venture to trespass further on your time. I will only say in reference to that subject, that all the rates and charges require the most careful revision, and large reductions when the circumstances of the case warrant it. It is admitted by all parties that, as such a system would affect the interests of the companies, it can never take place under the present system. But, with the large reserve fund that would be in the possession of Government, there would be a reasonable expectation that the charges on merchandise could be reduced, on an average, 25 per cent. Each class of cases would require special investigation by those best qualified to undertake such an onerous task. In some cases the reduction in charges would be very small, in others very large, but the main object to be attained should be a greater equalisation of rates throughout the country, and a reduction of charges in those cases in which the cost of transport greatly augments the price to the consumer, or prevents, either entirely or partially, the transport of merchandise. In all the discussions which have taken place in reference to the purchase of railways by the State, the subject has been treated as though the State was a stock-jobbing company, of which the Government were the managers, and that if the saving to be effected by purchase and amalgamation would be insufficient to meet the deficiency caused by low fares and charges, the State would be an absolute loser by the transaction in the same way as any trading company. It is scarcely necessary to expose the utter fallacy of this assumption. How does the matter stand? It is calculated that the railway receipts for the present year will amount, in round numbers, to fifty-two millions, viz., twenty-three millions for passengers, and twenty-nine millions for goods. Now any reduction made in these charges is equivalent in every respect to a reduction in our taxation, whether direct or indirect. Travelling, and the conveyance of merchandise, are as much necessaries of life, as tea, coffee, sugar, tobacco, spirits, wine, &c.; and in some respects a good deal more so, for some of these we might do without, but poor and rich alike must travel, and have their merchandise conveyed by railway, the cost of which must eventually fall upon the consumer. The payment of fares is as direct as the payment of income-tax, with this difference, that many people manage to evade the one, or pay an insufficient sum, whilst any one who attempts to evade the other soon finds himself in a police-court to answer for his conduct. Thus the enforcement of the passenger-tax is somewhat more stringent than the enforcement of the income-tax. As regards the amount of our payments to railway companies, it exceeds that of our payments in customs, excise, and income-tax combined, and in the course of a few years will exceed the whole of our present taxation. A reduction in railway charges equally affects all classes of the community, and is therefore in every respect analogous to a reduction in taxation. Now, if our fares are reduced to one-half of their present amount, and the charges on merchandise reduced 25 per cent., the saving to the country would at present amount to nearly twenty millions per annum, which would be increased year by year, as the traffic of the country would increase. It, in this respect, is a simple debtor and creditor account. If the saving that would be effected by State-purchase, whatever that amount might be, would be insufficient to meet the loss, the difference would be a deduction from the nation's gain; if more than sufficient, the difference would be added to the nation's gain; and if it should so happen that there would be no loss whatever, the entire savings by purchase would be added to the savings by reduction in fares and charges. I am only speaking of the financial part of the question as regards the nation. I say nothing of the great benefit that low rates would confer on the country in respect to its commerce, nor how the wants and convenience of the public would be met by moderate and uniform fares. The last question I have to deal with is, perhaps, the most important of all:—To whose hands should the management of the railways be intrusted? Is it to Government, or must we look to some other quarter for that management which would give more confidence to the nation? Now, it is very remarkable that, in all the discussions which have taken place here and elsewhere, there has not been one word said by those who are opposed to the purchase of the railways by the State against the general principles we contend for. 1st. That by the amalgamation of the railways under one management a great saving would be effected in working expenses. 2nd. That as the credit of the State is so much better than that of private companies, the difference of that credit would enable the State to obtain the railways on very advantageous terms, if purchased at the market price and adding a liberal bonus to the shareholders. 3rd. From the experience we have had for forty years of the working of our railway system, that the difference in profit between high fares and low fares is comparatively so small that under a proper system of management, a very large reduction in fares and charges could be effected without having recourse to taxation to make up a deficiency. Now all this has been tacitly admitted, but it is contended that these advantages would be more than counterbalanced by Government mismanagement. There are in addition many other reasons urged against the management of the railways by Government. "The really serious part of the question," said Lord Derby in his comprehensive speech, "was this—how would it be possible for the State to avoid exercising enormous local patronage, which would affect every district and town throughout the country. What he feared was the position of dependence into which every town would be brought towards the railway board or administrative body with which the decision would rest as to what new lines, stations, or extension of railway communication should be made. Every town in the country might ask at the same moment for extended railway communication, and it was quite clear the request of all could not be complied with at the same time. It would be necessary that a choice should be made, and that choice might be governed by political preferences. At any rate, whether it was so or not, you would never get it out of the heads of the people that it was so. This was a control, not over individuals but over the constituency as a whole, which no extension of the franchise and no manner of taking the votes would affect in the slightest degree. It would be very difficult to constitute the railway board in such a way that it would not be dependent on the minister of the day. An administration controlling a property of 600 or 700 millions, and employing several hundred thousand persons, would make itself felt in every corner of the country; if detached from the executive it would be an *imperium in imperio*, and if attached to it, it would not be easy to detach it from political party." These were the principal arguments brought forward by Lord Derby, from a political point of view, against entrusting the management of the railways to Government, and they require very serious consideration. In addition to the objection of a political nature, so clearly stated by Lord Derby, against placing the railways in the hands of Government, there are other objections, considered equally weighty, of a different nature, advanced from other quarters. It is contended that Government management is inefficient and wasteful, and that any board, however constituted, under Government control would be utterly incompetent to fulfil the various and complicated duties it would be called on to perform. Now, without discussing whether or not these objections are well-founded, it must, I think, be admitted that they are generally considered so, and for all practical purposes we must assume that the public opinion of the country is opposed to Government management. The governing body into whose hands the railways should be entrusted must possess the full confidence of the public, not only as regards its administrative capacity, but in the perfect confidence that the great power which it must necessarily possess cannot be made use of for political purposes, or in any other manner not in accordance with the strict and honest performance of its duties. This confidence the Government certainly does not possess, and if ever the purchase of the railways become an accomplished fact, we must look elsewhere for the governing body, independent of Government, with all the qualifications which the nation would require. What, then, would be the necessary qualifications for the members of such a board? They would require to be men of the highest social position and character, well known to the country, of mixed politics, the majority of whom should be thoroughly conversant with railway management, and all be members of either House of Parliament, an equal number to be nominated by each House, as in the case of joint committees. Would such a board possess the confidence of the nation and the Legislature, and be qualified to fulfil all the onerous and important duties attached to their office? If we can form an opinion of the future from the experience of the past, we should certainly come to the conclusion that no board or council appointed by the Government could carry with it the same weight, authority, and respect as a similar body appointed by both Houses of Parliament. Some time since an Act was passed authorising the Board of Trade to report on the merits of the several railway bills presented to Parliament, but after a few years the Act was repealed, in consequence of the neglect with which their recommendations were treated. Compare that with the deference and respect paid to any recommendation coming from a joint committee. Take, for instance, the question of those great amalgamations which recently have so much engaged the attention of the country and Parliament. Government itself would not venture to give an opinion on the subject, but referred it to a joint committee, who soon disposed of it. Here we have a great decision given on the commercial policy of the country without a remonstrance or complaint from the companies whose bills were rejected, or that portion of the public whose interests their decision injuriously affected. For these reasons I consider no Board would possess such weight and authority as one nominated by the two Houses of Parliament, more especially as many members of both Houses have distinguished themselves as most able railway administrators.

Captain Tyler said it was not usual to pass a vote of thanks to the Chairman, but on that occasion he hoped the meeting would depart from the ordinary practice, and accord a vote of thanks to the noble lord who for three evenings had presided over the discussion.

Mr. Botly seconded the motion, which was carried unanimously.

The Chairman said he was much obliged to Captain Tyler and the meeting. He had long felt a deep interest in this question, and entertained a very strong opinion upon it, long indeed before he had ever heard it mentioned in public. He had always held it to be a well-settled maxim that the Crown ought to have the control of the highways of the country; and when the railroads became those highways for all practical purposes, the Crown ought to take possession of them. He begged to propose a vote of thanks to Mr. Galt for bringing the matter forward with so much ability, for it was only by such discussions that public opinion on any question could be enlightened and consolidated. It was very satisfactory to find that no one had expressed himself entirely contented with the present system of railway management, whilst the majority were extremely discontented; and he hoped, therefore, the time was not very far distant when the question would be seriously brought before Parliament, with a view to settling the details of a scheme for putting railway communication on a proper footing.

The vote of thanks to Mr. Galt having been passed, the proceedings terminated.

CANTOR LECTURES.

The fourth lecture of the second course of Cantor Lectures for the Session, "On the Energies of the Imponderables, with especial reference to the Measurement and Utilisation of them," was delivered by the Rev. ARTHUR RIGG, M.A., on Monday evening, February 24th, 1873, as follows:—

LECTURE IV.

The Energy of Affinity, especially with reference to considerations for the Measurement and Utilisation of it.

The energy of affinity assumes many Protean forms, embracing facts in very opposite phases. At one time it seems to hold elemental matter in adamantine chains so firmly that no appliances, such as heat or light or electricity, can undo the bonds; at another time there seems to be a repellant power of affinity (contradictory though the expression may sound) so influencing, that though every facility for voluntary combination be presented, yet none of these inducements accomplish this combination. For example, the oxygen and nitrogen in the atmosphere, which for all general purposes may be said never to enter combination whilst acting as atmosphere. Again, oil and water—neither shaking nor heating can cause mixture, let alone combination. This repellant power is utilised in vitality thus: The fluid which lubricates the eyeball would continually pass over the edges of the lids, and so run down the cheeks, were there not glands upon the edge of the lids that secrete a very little oil, and so by virtue of this "repellant affinity" the ordinary fluid is confined to its appointed channel. If this fluid be excessive, the oily boundary is overflown, and tears trickle down the cheeks.

On reference to the diagram on the wall, it is stated that the energy of affinity is manifested in mechanical action, and it is probably the source of the mechanical power utilised by men for manufacturing purposes. We find affinity operating under all circumstances in which the character of a resulting compound is different from that of the elementary bodies which constitute the compound. Affinity may be said to be kinetic when converted: and potential when in molecular relation. In other words, all the molecules of one body are somehow or other related by affinity to the molecules of another body, either directly or indirectly, when states of change are occurring. Under these circumstances, until the new molecular relations are called forth, there is potential energy: as these are brought about we get kinetic energy.

The term "Affinity," as employed in this course of lectures, needs an explanation. As a term in science it is fairly derived from that sense in which it ought to be used in conversation or ordinary writing. The word, when properly applied, is in reference to those connections which a marriage may have established between the relatives of the wedded pair. Prior to that marriage there were no relationships; after it, relationships enter by *affinity.* The relatives of the husband are connected to him by consanguinity, so are the relatives of the wife to her, but after the marriage these two sets of relatives are connected each to the other by affinity. This distinction makes clear that affinities are regarded only as between different bodies. No affinity can exist between lead and lead, or between oxygen and oxygen. As in social life, the legal relationships resulting from affinity and consanguinity are very different, so in science life, the atoms which constitute the elementary parts of a simple body, and the molecules which constitute the elementary parts of a compound body, are tied together in bonds of different kinds.

Between atom and atom, or molecule and molecule of a like nature, there are no affinities. True, these are held together, but it is by what is sometimes called the force of cohesion. If atom or molecule of one nature is, thus unchanged, held to an atom or molecule of another nature, then the bond is one of adhesion. If, for example, these two plates of smooth glass be slid one over the other and pressed together they cohere. If gum be dropped on one and the other pressed upon it, they then adhere. Water adheres to many substances of very different constitution.

To cohesion we are indebted for the strength of solids. The cohesive force operates, but in marvellously different degrees, in ice, water, and steam. To adhesion we are indebted for those unions effected by cements, &c. With the intensity of these two subsidiary agents in the work of affinity this lecture is not concerned, although they perform no unimportant parts.

Between affinity, if used as a term in physics, and if used as a term in chemistry, there is this distinction:— Students in physics might classify cohesion and adhesion as branches of affinity. Students in chemistry would not admit the term (affinity) unless the composing elements after the influence of affinity have undergone such a change as to obliterate all traces of the originals. Hence the phrase "chemical" affinity, thus, by the prefix "chemical," excluding the physicist's views.

An experimental illustration may make clear the use of the term "affinity," by the respective students in physics and chemistry.

Here are two solutions, the one of gum dissolved in water, the other of camphor dissolved in spirits of wine. These two are respectively mixed, nevertheless there is in neither case any chemical affinity. If we add pure spirits of wine to the mixture of gum and water, we should destroy what the physicist might call the affinity, but which the chemist does not admit to be such. On the other hand, if we add water to the solution of camphor we destroy the mixture there; a separation takes place, and in one case the gum, and in the other the camphor, is precipitated. The term "affinity," applied to the unions thus separated, would not to a physicist seem improper; the chemist would not permit the use of this word. It is in the chemist's sense that the word is used in the phrase "energy of affinity." He distinguishes thus—the term "combination" is applied by him to the results of affinity, and to that which has just been described as a phenomenon in physics the chemist applies the term "mixture."

These preliminary distinctions prepare us for an explanation of what we are to understand by those affinities whose energies are to be considered. Used in a chemical sense, affinity is that power which influences bodies dissimilar in composition, form, and character to combine. The consequence of this union is the formation of new compounds, which may or may not be dissimilar in colour, form, and every fashion, to any of the composing bodies, which may or may not be possessed of properties and characters that are not even traceable in the originals. These compound bodies, thus unlike their progenitors, also establish relationships of affinity, and we are soon surrounded with numerous compounds, so diverse that all traces of the originals are to ordinary apprehensions totally obliterated.

There is, however, amongst these bodies a kind of clanship or caste, similar to that amongst the people of India. Thus, simple or elementary bodies combine only with simple or elementary ones; compound bodies only with compound ones.

For example—Oxygen, which is a simple body, enters into the alliance of affinity with the metals, which are also simple bodies.

Here is some pure metal—lead—in a state of very minute subdivision. It is enclosed in an air tight glass tube. This lump of lead is exactly the same material. The difference is that in the finely subdivided metal in the glass tube combination with oxygen will take place the moment it is exposed to the air, so that the atoms of lead which are soon to be shaken out are brought into contact with the oxygen—atom with atom.

Thus, on breaking off the end of the glass tube and shaking out the contents, you see the black particles as they fall glow with heat owing to their rapid combination with the oxygen of the atmosphere. Here is a case of affinity, consequent on a state of subdivision—a case of affinity proper. Mr. Wills, who most kindly this evening gives us the benefit of his chemical knowledge and experimental skill, will now show you how strong is the affinity of oxygen for the steel blade of a knife; when heated and placed in a stream of oxygen the ignited particles of steel in the blade rapidly burn away. The same thing happens if a stream of oxygen is directed on any of the simple metals when raised to a red heat. In a hollow on this tile are some iron nails; by directing a stream of ignited hydrogen in oxygen upon them, the affinity is so strong that they not only melt but boil, and the ebullition is so powerful that a brilliant shower of molten metal is scattered around. Similarly, a piece of zinc when exposed to oxygen is rapidly consumed.

But when we deal with acids which are compounds, they do not ally themselves by affinity with the simple metals, but only with the oxides of the metals, which, like themselves are compound bodies.

The range of the energies of affinities is very great. For example, oxygen and the metals. Oxygen can with difficulty be induced to unite with gold and platinum, hence these metals do not tarnish in the air; with sodium and potassium the affinities are so strong that the union is rapid enough to generate both light and heat. Either to facilitate or prevent such union, and so promote or retard the energy of affinity, has led to the adoption of various compounds, under the name of fluxes.

It may be well to explain that to this energy of affinity we may be said to owe the variety which the earth possesses. Reduce its compounds into their elements, and a sample of each of all of which the world is made might be arranged on this table. There are now only 63 reputed elements: from the affinities amongst these 63, whether taken by twos, or threes, or fours, or more, every thing is made. Indeed, $\frac{99}{100}$ths of the earth is made of 13 elements; the mathematician's calculation is an easy one which could tell the number of articles that might be formed by combining these 13 by twos, then by threes, then by fours, and so on to 13. There would thus out of these elements be eight thousand one hundred and ninety-one different compounds. This number is very naturally increased from the operation of what may be called the law of combination in multiple and sub-multiple proportions. Allowing another 8,191 for these multiple and sub-multiples, there would be in the world composed of these 13 elements 16,382 articles. Such a calculation as this is exceedingly simple, and the mathematician would say must be correct. Affinity, however, enters with a "veto." It claims the right to determine the nature of any combination or set of combinations, and in the exercise of this claim the character and constitution of the combining elements are so completely altered as to have lost all obvious trace of their original, and, therefore, when the combination by threes takes place the result does not partake of the character of any one of the components. This change of character is what the mathematician's calculation does not reckon upon, indeed such a calculation is based upon the physicist's interpretation of the word affinity, and it ignores the chemist's views.

The problem which is now before us is to define a mode of measuring the transformations in every shape introduced by affinity amongst these thirteen elements; a problem very simple, as thus stated, but wondrously complicated, in fact only capable of an approximate or inferential solution, which is, practically, no solution at all.

In a homely way this difficulty may be illustrated within the walls of many a house. Assume the residents to be a father and mother and thirteen children. Who can tell the combinations consequent upon what may be called the mutual affinities existing amongst these thirteen children? Even from day to day the stability of that family cannot be ensured. The combinations of twos and threes, which yesterday gave promise of permanency, is to-day dissolved, and these molecular children form other alliances. This microcosm of a world is under the influence of new feelings, changed tastes; indeed, it passes, with more than electrical rapidity, from a summer-like happiness to a wintry gloom—from a peaceful calm to lurid flashes—sad forebodings of domestic storms!

Well, amongst the affinities of the thirteen terrestrial elements similar changes and relations are induced. Whilst we may be able to tell with unerring exactitude how any *two* may act, if left to settle themselves under the sole influence of their dual affinities, when three or four, or more, come together, certain perplexity results.

To progress from simple to compound is a most satisfactory procedure. Adopting this plan, and dealing with only two of the thirteen elements—ignoring the others—placing the two in such a relation that their mutual affinities may be fully exercised, the law as regards these two, and (as we shall see afterwards) the energy consequent upon this law, may be made fairly evident, and utilized in manufacturing industries as well as calculated with mathematical precision.

Let two be taken—any two—say, the gases oxygen and hydrogen. Place what we may call equal quantities of each apart from all other elements. Cause them to combine. It would be soon observed—*i.e.* if the experiment were repeated frequently—that this combination is not arbitrary, it is not at the experimenter's option. Although he may put different quantities of these gases in juxtaposition, yet by some means, and for some reasons unknown to us, they unite only in definite proportions. If more than 11 oz. of hydrogen be offered to 88 oz. of oxygen, the excess of hydrogen will be left uncombined, also the reverse.

As a case of estimation by measure, the nature of the affinities, their intensity, and the inexplicable results produce a comparison which is very striking; *e. g.*, 24 parts, by measure, of common salt contain 25·8 parts of sodium, and 30 parts of liquid chlorine. Such condensation, that is the condensing into (say) 24 cubic inches of solid matter so much as nearly 56 cubic inches would require the exertion of a very great mechanical force. To appreciate this, it must be remembered that the salt, the sodium, and the chlorine are all under the same atmospheric pressure, and consequently were there not certain inter-relationships among their constituent elements, of which we know nothing, such change of volume could not be accomplished.

The exercise of affinity, although definite as regards the proportions of the bodies influenced by it, is not called into action without either previous certain surroundings or the creation of influencing surroundings, such, for instance, as the presence of moisture or heat, or light or electricity. If, for example, we take these two white powders which are here mixed together, and add a little water to them, their affinities begin to operate, and a violent effervesence takes place. Again, the states of solid, liquid, and gaseous vanish under the energies of affinity. Mr. Wills will mix two gases, and they immediately form a solid. Now we will put two liquids together, and we find that they become converted into solids. In another case you see that the contact of two bodies suffices to change their state. If a little iodine is put upon this plate, and then a little phosphorus is added, the affinities are manifested by ignition, and the solids pass into the gaseous state. Nor are changes of state and temperature the only attendant phenomena of the energy of affinity. Electrical phenomena are often if not always present, although not always observed.

It is not improbable that if the energy of affinity is ever measured and brought within our means of calculation, it may be done inferentially, through some of these collateral manifestations which have not yet been so carefully observed, employed, and tabulated, as their importance would seem to justify. What it is that influences these affinities is as far beyond our present knowledge as to tell what it is that influences many of the affinities of social life amongst the thirteen children. The chemist not only endeavours to establish new relationships, but also to disentangle the relationships which affinities have already established. He fails today, he succeeds to-morrow. With bodies thus by the energy of affinity compounded and interlaced:—

> ———"In mazes intricate,
> Eccentric, intervolved, yet regular
> Then most, when most irregular they seem."

—we all are concerned. Although we know not their laws, we do know that they partake of the Medo-Persian character—they change not—and therefore, if once discovered, they are to be relied upon under all circumstances.

This Medo-Persian character of the laws which govern the energies of the affinities introduces into any calculation of them, when and where they are known, a precision and means of repetition, which give thus far to physical chemistry the character of an exact science. With a precision equal to that of the laws of gravity, it is found that in respect to combining proportions there is a mathematical order, perfect and exact. True, articles may be mechanically mixed in any proportions; they can be chemically combined only in definite proportions, and it is only when thus combining, in the chemist's sense of the word, that the "principle of least action" is brought into operation in affinity, and its results as economically utilised by men as the results of the energies of gravity and vitality were described to be in the last two lectures.

In mixtures the particles are still separate, and in many cases may be distinguished under a microscope. Here is an instance. If this bottle is opened, the character of the whole contents is changed. The mixture of the atoms of the air with the nitrogen gas changed the appearance of the mass instantaneously. Again, you are all aware that coal gas burns in air, but we can also make the air itself appear to burn. In the presence of such experiments, it might become a question whether we burn gas in air, or whether we burn air in gas. Here is a cork through which are passed two small glass tubes. One of these tubes is connected with the gas of the room by this flexible india-rubber pipe, the other is open to the air. Now, light the gas issuing from the small tube. Here is a glass chimney, similar to those used with paraffin lamps. The cork has been fitted into the chimney. Place the chimney on the cork, the jet of gas burns as before. Let the supply of gas be increased, the consequence is that the chimney is soon filled with an atmosphere of coal gas; and observe, when a certain quantity of gas has entered, the flame quits the glass tube and now appears upon the air tube. Apparently air is now burning with a pale blue flame in an atmosphere of gas, whilst the gas issuing from the top of the chimney may also be ignited, and will burn in the air of the room. At the top, then, there is coal gas burning in air, and within, air is apparently burning in coal gas.

Again, for example, if gunpowder be taken and well washed, the nitre may be dissolved in hot water, and if the water be evaporated the nitre will be found as ordinary crystals; further, if heat be applied, the sulphur may be sublimed, and then pure charcoal will be left, or the sulphur may be dissolved out by bisulphide of carbon. Thus we can get the three elements of gunpowder, and find they are what they were at first. On another process of manufacture, if the nitre be fused in a crucible, and sulphur added, there results an entirely new substance—sulphate of potash; if to the heated mass charcoal be added, there is formed carbonic acid, and this, with the potash, forms carbonate of potash. No washing or warming will separate these latter combinations. They are for all purposes entirely new substances; they are no longer a mixture, as gunpowder is, in which the affinities may by a spark be called into play, but they are in a combination in which the affinities have already done their work, and that under the influence of continuous heat and without explosive violence, and, therefore, no further development of affinities, either with or without the energy of explosion, can take place.

The utilisation of gunpowder, then, is the result of a process of mixing, such mixing being designed to facilitate the action of several affinities, by placing the elements of the composition in close approximation, ready at a signal from a controlling agent to operate. It seems reasonable to say that the closer these elements are to each other the greater will be the facility with which combinations may take place, and, therefore, the more readily can the affinities be utilised. Such *à priori* reasoning is not confirmed; no simple mixture of impalpable powder, however intimately the dusty particles may have been mingled, fulfils the condition required in gunpowder. It is possible, however, so to diffuse such impalpable powder in the air of a room as that each minute portion is surrounded with an atmosphere of oxygen. If when thus diffused explosion by detonation of any group of particles takes place, the entire mass may explode. In mills for the grinding of madder this accident has happened so frequently as to require special precautions. Herein is an example of many cases in which, whilst admitting our thorough knowledge of the premises on which our reasonings are based, we are found at fault when we apply the knowledge: consequent, apparently, upon ignorance of certain even unsuggested peculiarities in the affinities involved.

Some of you may remember that in July last there was a very serious accident in a flour mill at Glasgow. Property was destroyed to the value of £18,000 or £19,000, and 19 lives were lost. But how it happened, or why it happened, no one knew. The fire insurance companies deputed two scientific gentlemen to investigate the matter thoroughly, and they came to the conclusion, rightly or wrongly, that flour diffused through the air in the mill had become so uniformly or minutely mingled with the oxygen of the air, that the atmospheric contents of the room or rooms were in a state of what may be called gaseous gunpowder. The effect of a spark from the millstones or the machinery caused explosion of the aërial gunpowder by that most violent of all means—detonation. Such a conclusion of such a probable danger being only now surmised, shows how little we know of the energy of affinity. In this mill appears to be an example of the production of explosion from hitherto unsuspected sources.

We have in this bottle a diffused substance, and it is diffused in a liquid which rapidly evaporates. A piece of paper is immersed in the liquid, and we will now allow the paper to dry. When that is nearly accomplished the combustion of the paper with flame occurs, owing to the non-vaporizable solid being so minutely subdivided that the oxygen of the air is in contact with many atoms of the same material, and so energetically unites with them as to produce flame.

To apply the information already communicated to gunpowder, may perhaps make as clear the influence which a more detailed knowledge of affinities would give than any other instance. The action of gunpowder is simply this: in a condensed material are many gases, we will speak of these gases as one—*a gas*. The utilisation of gunpowder might at first sight appear to depend upon having the largest amount of gas in the smallest solid space.

Now, without entering upon any chemical question, it may suffice to say, that in this mixture of nitre, sulphur, and carbon are all the elements for (what we may name) the completion of the energies, though every other substance were excluded. We have here a jar of water, and if into that we put a mixture of gunpowder which has been ignited, you will find that water has no power to put an end to the combustion; it takes place as well under water as in air. From such reasoning and experiments as these, it might be anticipated that the cubic inch of gunpowder which on ignition produced the greatest number of cubic inches of gas would be the most valued. This, so apparently satisfactory conclusion, is very seriously in error. The amount of heat developed, and the rapidity with which the gas is formed, are important elements in guiding as to the mode of utilising the affinities called forth amongst nitre, sulphur, and charcoal. If the affinities are so intense that the development of all the heat and gas consequent upon the exercise of the affinities through the entire heap is instantaneous, then explosion of a very violent and destructive character takes place. Such an explosion for mining, and doubtless other purposes, would entail serious loss—the rock, or the shell, would be so shivered as to be simple dust; our coals would have to be as artificial fuel, for the powder produced must, by tar, rosin, or other ingredient, be formed into lumps. To loosen and disentegrate, but not to destroy, are the general requirements for blasting or mining. If the rate at which the affinities in the mass are permitted to come into play can be regulated, and so either retarded or accelerated, then the modes of utilising them may be planned. For example, if a ball is to be sent from a gun, that law should, if possible, be impressed upon the affinities which nature has impressed upon the energy of animal vitality. A horse accomplishes the dragging of a load by slow beginnings, a locomotive does the same, affinities must do the same. Hence the development of the greatest intensity of affinity in the case of a gun should be progressive until it attains a maximum, and the time occupied in so doing should be determined by the rate of travel of the ball and the strength and length of the gun.

Other cases, such as the blasting of rocks, demand a very different exercise of affinities. Here the object is simply to disturb, to unsettle, to break up; motion of the pieces to a distance is not required. Considerations such as these, simple as they may appear, are full of perplexity, consequent upon our ignorance of that in which these affinities consist.

Similar remarks apply to gun-cotton, dynamite, nitroglycerine, litho-fracteur, or any of the explosives which modern science has formed.

It is from an attempt to impress upon the affinities a law of time in their exercise that the various forms and compositions of gunpowder owe their origin.

We are much obliged to Mr. Abel, who has kindly lent the Society of Arts different samples of gunpowder. There is one bottle containing powder, the grains of which are nearly half an inch cube; there are various other forms, the object of these various forms being to develop the affinities at a rate to be determined by the purpose for which the respective gunpowders are to be employed.

The pressure at the time of explosion has been estimated at more than 4,000 atmospheres, *i.e.*, more than 4,000 × 15lb., or 60,000lbs. per square inch. This statical pressure being converted into a kinetic or velocity estimate, is more than 216 tons lifted one foot.

There are other substances on which this same law, determining the rate at which the affinities are to operate, may be impressed. Gun-cotton is one. We are again obliged to Mr. Abel for two illustrations on the wall showing the destruction of the martello tower at Dimchurch, in Sussex. It was accomplished with 186 lbs. of compressed gun-cotton. And the development of the affinities was such that the tower changed at once into the form you see in the second diagram. Had gun-cotton in the same state of combination and of the same character been put into a cannon, in all probability the cannon would have burst before the ball had time to move.

Some very peculiar and inexplicable affinities are presented by this ally or rival of gunpowder, viz., gun-cotton. In the first place, the rate of combustion and the consequences of it may be previously regulated, and that with much accuracy. Its energy may be mild or great at the will of the operator. The results of numerous experiments is that to obtain the full power of gun-cotton it must be exploded in a close chamber, in order that the gases and heat generated by the first part of the explosion may penetrate the mass. The records of experiments with gun-cotton show very plainly the absolute necessity for considering how affinities comport themselves. A bag of gunpowder nailed on the gates of a city would blow them open; a bag of gun-cotton so nailed would fail. Put the gun-cotton in a box, and it will shatter the gate to atoms. A box of gun-cotton flung down close to pallisades would open a passage for troops.

Spectrum analysis reveals the fact that the spectrum from the flame of a compound body, as chloride of calcium, is not the same as that observed in the electric spark passing over pieces of chloride of calcium. The explanation suggested is that certain chemical compounds, when they are heated above a given temperature, are decomposed into their constituent elements below that temperature. These compounds are capable of existing in a permanent state. It may be thus with the energy of gun-cotton. When discharged at the temperature of flame, the gaseous constituent elements are not formed, and therefore no explosion. When at the higher temperature producing concussion, then the constituents are formed, and explosion ensues.

You will find that the rate at which gun-cotton explodes depends upon the rate at which the affinities are called into play. Here is a specimen. If we bring the affinities of this gun-cotton into play by means of a spark, and thereby do not produce sufficient heat to develop its affinities rapidly, the rate at which the gun-cotton is consumed is comparatively slow. If we bring its affinities into a flame, the rate at which affinities are developed in consequence of the heat is great. If we bring them into play by means of detonation the rate at which they are developed is greater still. You see that when a flame is applied to this strip of gun-cotton it runs along it rapidly, whereas when a spark is applied to a piece of the same material, the combustion is slow, like touch-paper. If I hold up the string of spark-ignited gun-cotton, the heat gathers, the ignition becomes more rapid, the spark being converted into a flame. Now if instead of allowing the affinities to be exercised at that slow rate we cause them to develop immediately, we should have had a very different result. Here is some pulp gun-cotton, the very form in which it was used for the destruction of this tower. If we detonated some of that, we should none of us be here to tell the tale of how it went off. There is enough in my hand to send the walls of this room in all directions, but it must be by detonation. The effect of what is something like detonation can be shown in a different form. You are aware that in a coal mine there are fearful explosions. It has been found that these explosions often take place after a blast in a distant part of the mine. The question therefore is, what has that blast to do with the explosion, the two not being near together. Mr. Galloway, of the Meterological-office, has been investigating this matter for some time past, and it has been found that these Davy safety lamps, of which specimens are on the table, are not, when within the influence of a reverberation of the air from the effects of a blast in a distant part of the mine, always as safe as they are supposed to be.

The lamp consists of a flame within gauze; and when surrounded by an explosive compound, owing to the inability of the flame to penetrate the gauze, the explosive gas does not ignite. If, however, detonation takes place, even at a distance from the lamp, then we shall produce those conditions which are favourable to the development of chemical affinity. Here is a Davy safety lamp, lighted, and now placed in an atmosphere of explosive gas. The question is, what will happen in case a shot is fired in a distant part of the mine? In the case before you the lamp is placed at one end of a long tube, the other end of which is closed by a piece of indiarubber, and in continuation of, but detached from, the long tube there is a short tube of the same diameter. There is no communication whatever between the two tubes, and as you may notice there is a space between the ends of them. My intention is to fire a pistol at the open end of the short tube; the explosion will cause the india-rubber to be compressed, and so to act on the air in the longer tube. You probably know that if there were on the table a box with an elastic back, and a candle at the other end of the room, opposite to a hole in the front of the box, then by striking the box at the back, the candle would be blown out. Now, on firing the pistol, having its end in this short tube, the india-rubber is compressed, and the gas surrounding the Davy lamp, which is supposed to be in a distant part of the mine, at once bursts into flame. This is the same phenomenon that takes place when shots are fired in one part of a mine, and an explosion occurs in another part.

This is all well and good if it would help towards a solution of the question of regulation of the energies of these affinities if only we could delay the affinities as we delay them in gunpowder, because we might then do what Galileo did when he delayed the ball down an inclined plane; or what Kater did when he caused the pendulum to repeat itself frequently, and so record the effects of gravity; or what Atwood did when he took a small weight and caused that to fall by gravity, but distributed its effect through a large mass. The consequence was that they were enabled to observe what the law of gravity is. If, now, we could rely upon such a process of delaying the affinities as has now been mentioned, we should then have a chance of ascertaining their energies; but we cannot rely upon it for two reasons. In the first place there are a number of phenomena classed under the head of nascent actions, which constantly interfere. Let me explain what that is. At the time that certain substances are being formed, certain affinities exist which do not exist afterwards. If, for example, you manufacture hydrogen and then bring nitrogen, from another process of manufacture, into contact, they do not combine. If, however, you manufacture them both in the same vessel, they combine and form ammonia; and hence, in the case of putrifying vegetables, there arises that peculiar ammoniacal smell. Here is some permanganate of potash, which, when dropped into this tube of coloured liquid, will produce certain phenomena, which take place owing to this nascent action—the colour will be discharged.

Then there are another set of actions which are more peculiar still, which manifest great energy, but which actions interfere with our measuring the energy of affinity as utilised by men. We have here a piece of platinum, and here is an argand burner, connected by a flexible tube with the gas-pipes of the room. Over the argand burner is placed this copper cylinder on three legs, having a wire gauze top. The sheet platinum is now coiled and placed on its edge on the gauze. The tap is opened, and the gas now burns with a lambent blue flame. Observe, the platinum is now being heated; now it glows. Let the gas be turned off. The flame is now extinguished; the once glowing platinum has become black. Thus far is nothing peculiar. Again, the gas is turned on. The black platinum is passing to a dull red; now it glows again, but the gas is not ignited, and the platinum remains at this red-white heat without any apparent cause. If a glass cylinder, to protect it from currents of air, be placed round it, this apparent burning without being consumed will continue during the remainder of the lecture, and, were conjuring tricks an object, it might be said that light and heat were here produced without the destruction of any materials. This is a case of what is called catalytic action. Phenomena like these perplex very much in estimating the energy of affinities.

Here is another case, of a like peculiar character. This is a coil of platinum wire, and you will find that if made red-hot, and then placed in a vessel of ammonia, although there is no gas in it, the platinum continues red-hot. There is no reason, apparently, why it should continue in that red-hot state.

Gunpowder has been introduced solely for the purpose of illustrating the questions that might arise in reference to the physicist's and the chemist's views of affinity, and not for any purpose in reference to its use in mining or war.

If its introduction has made clear that the affinities amongst the atoms of which it is composed may be controlled, that the intensity and rate of its explosion (which is but another name for chemical combination) may be regulated—that it and its related explosive agents may exercise their affinities without danger—harmlessly and slowly, then the inquiry is at once suggested, on what elements do chemical combinations depend? Why are these combinations accompanied with devastation and ruin. Why are they peaceful and unperceived?

Those who were present at the first lecture will be prepared for the suggestion that these differences arise (in part, at least) from some of those results which in that lecture were said to be deducible from a consideration of the units of time, mass, and space. Those fundamental units form a combination on which all our knowledge of work and production of energy depends. It will probably be remembered, too, that in the lectures on gravity and vitality these units of measurement formed the object of research by the men who have given to society the mode of estimating these energies.

It may have been noticed that whereas in the other lectures of this series the titles have in them the words, "especially with reference to the measurement of it," these words are changed in the title of the present lecture, and there are substituted for them the phrase, "especially with reference to considerations for measuring, &c." It will now be not inappropriate if one or two of the causes which lead to this difficulty in estimating the energies of affinity be made as clear as the competency of your lecturer will permit.

Before entering upon this, it may be well to consider whether the actual putting forth of the energy of affinity is a phenomenon belonging to physics or chemistry. The answer, open to contradiction by many, is that the study of the energies of affinity is a purely physical question, and not a chemical one. For this reason a chemist deals with those combinations in which the constituent elements have passed through such changes that their identity is lost. The chemist is ever dwelling upon changes, and his equations are not the equations of the physicist and the mathematician; they are, by the use of mathematical symbols, the representatives of change, of what affinity has done and completed, and not of that energy with which it has been done and which is to be measured. The energy of affinity either causes or induces these changes, and until that energy has operated chemistry has no standing ground. The energy of affinity opens the gate which separates the domains of the chemist from those of the physicist, and as the physicist is in possession of the matter the chemist must look there before he can take note of those changes he so loves to contemplate.

It is quite true that when the physicist and mathematician attempt to apply those principles which serve so well in investigating the measurement and utilisations of the other imponderables, they are baffled. By the application and study of these principles it is moderately well known how to call forth that which we wish to call forth. The summons being issued, we can rely upon the same result, whatever may be the surroundings. Not so with the energy of affinity; it is now slow, now sudden, now destructive, now restorative, now brought out by heat, now by light, now by moisture, now by sound, now by time, now by the simple presence of another molecule.

It is similar to the other energies with which we are dealing, in that it seems to consist in a species of attraction or its opposite repulsion. Gravity has a power of attraction at all distances; electricity has both attractive and repellant powers, and we may say at all distances; but affinity is limited to molecules so near that we must say that the matters of which they consist are in absolute and perfect contact.

That there is what we call matter—that it is of such a character or nature as that no two particles of it can at one and the same time occupy the same space; that however much a lump of this matter be divided it may still by finer instruments be sub-divided; that by neither mechanical nor chemical means has any one ever yet obtained one such ultimate and indivisible particle of matter. These are assumptions generally received without controversy.

It is, however, in and amongst these ultimate and indivisible particles of matter, that the laws of affinity operate. If we could handle them as we handle the bulks, which the aggregation of these particles form, then, probably, all difficulties respecting the laws of affinity would vanish. We cannot handle them. The physicist gives it up in despair; the chemist, however, more venturesome, deals with them. In dealing with them he puts forth a proposition which the physicist knows not how to accept.

Such unions and interlacings as these seem to set at nought the postulate that no two particles of matter can occupy the same space. For the chemist recognises two, three, four, or five particles of matter, seemingly rushing together, and, as far as we know occupying the very space which a fundamental physical proposition states they cannot occupy. It may, however, be quite true, for telegraphic messages now-a-days run along the same wire in opposite directions at the same time.

If we could but reconcile these views (and they will be reconciled some day), what a change will come over the dreams of scientific theorists, and what a magnificent and splendid territory for scientific research will then be brought into possession.

To return to the difficulties which interfere with an enunciation of the laws of affinity.

It is plain that explosives, as they are called, vary in their manifestations to our senses in respect of intensity (the assumption that the energy of affinity always produces a species of explosion is not a very violent one). But it is not so plain that within themselves the intensity is a constant quantity, and admits of no variation—that whether gun-cotton causes a cliff to crumble as powder into the sea, or flashes harmlessly without even igniting the gunpowder laid on the palm of the operator's hand, the energy of the affinity in the two cases is exactly the same. In fact, affinity can neither be created nor destroyed—it may be resisted, and if the resistance could be measured at the moment affinity may be said to put forth its energy, and overcome the resistance; then this is the measure of the energy. Illustrations of this are numerous and convincing. Let a few minutes be given to one.

If a person raises 100 separate 1 lb. weights off the floor on to a table three feet high, then, as a measure of the energy expended, we take the work that is done, viz., 100 separate lbs. raised three feet, and call the product 100×3, viz., 300, as the measure of the energy of vitality which thus raised the weights. Suppose now the man had been ten minutes in doing this work, then the energy per minute would be measured by the figures 30. Suppose that instead of working at this rate he had lifted all the weights in one minute, the energy per minute would be still measured by the figures 300, and if the rate of work were continued there would have been expended in 10 minutes an energy represented by the figures 3,000. Thus we may reason until the work originally done in 10 minutes, is done in 1 second. The measure of the energy in that 1 second is 300, and in 1 minute 18,000, and in 10 minutes 180,000. The intensity of the energy in this last experiment is 6,000 times as great as in the first experiment. Let this illustration suffice to show that to measure the intensity of an energy time must be taken into account if we wish to utilise that energy, or to bring it into calculations.

It will be within the memory of those present at a former lecture that, in the case of the energy of gravity, Atwood brought time in by staying the sudden action of gravity and distributing the fall of a weight through a large mass. Kater brought time in by causing a pendulum to record the number of its vibrations. They dealt with gravity alone, but as we are dealing not only with the energy of affinity alone, but with such concealed and unknown energies as those which are taking place, whilst the phenomena we are observing are going on. If we could put two substances together, and could guarantee that neither nascent nor catalytic action should be taking place, then we should have an energy responding as a unit to the energy of gravity. So if we could prolong the time we might, somehow or other, get a record of the energy. But that we cannot do, and with all our modern appliances it seems almost impossible to notice the time when affinity begins and ends its work. Under any circumstances it is difficult to notice time, but when the interval is short, what is called the personal error is as great as though the time were long.

A digression may make this clear. Suppose the eye sees an event, a nerve of sensation conveys the impression to the brain, and then a nerve of motion directs the muscles of the fingers to record it. Now, in the case of affinity, before the nerve of sensation has telegraphed to the brain the commencement of the event whose duration we wish to record, the end of the event is there, and the retina has impression super-imposed upon impression, and the fingers fail to enter the records. This leads to another difficulty—the nerves of different persons transmit impressions at different rates, hence observations and records of the duration of things seen and heard by two people do not agree, and certain corrections have to be introduced consequent upon these personal differences in the speed of these nerve-conveying telegrams.

As regards mass. Assuming that our investigations are carried on in the same locality, then, speaking generally, mass is fairly measured by weight in vacuo. If the bodies we see and handle were units, then we might recognise mass as the weight of the visible body. These bodies are composed of elemental units, the masses of which we cannot see, and affinity deals with these elemental unit masses and not with the bodies themselves. Certain considerations, based upon numerous observations, led Dalton and others to conclusions in regard to the weights of these ultimate unit masses. Admitting all to be correct, they are not sufficient for the purpose of estimating the energy of affinity through the fundamental units of time, space, and mass.

The failure is thus—Dalton finding hydrogen the lightest substance compared all others with it. But what is the actual weight of a hydrogen atom? That we do not know, therefore we cannot know the weights of the other substances which are recorded in this.

If the absolute weight of one elemental unit of any simple body could be had, then, thanks to Dalton and others, the absolute weight of the unit elements of all other bodies is known.

For the purpose of making clear the value of these atomic or molecular elements in reference to their mass and the space between them, let me, at the risk of some repetition, remind you that knowing the weight of one atom or molecule of each of the bodies, the energy of whose affinities is to be measured, and knowing the space between them and through which space these atoms or molecules pass before they coalesce, then the product of these two elements gives the value of the energy in the form of work done. If with this product the time is combined, then not only the energy but the intensity of the energy is also known.

Now, if we cannot get at the unit *masses*, how can we possibly get at the distance between them; yet this distance is the *space* through which these little masses must be carried by the influence of that affinity whose energy is to be measured by the work it does.

When, however, we consider that the waves of light have been measured, the number of them, per inch, stated, their velocity ascertained, we have good grounds for assuming that the masses and distances of the ultimate elements of matter will also be ascertained; then the laws which regulate the energies of such affinities will, most probably, be also ascertained.

Such are some of the preliminary difficulties which present themselves to those who look in hope to establish the laws which govern the energies of affinity from first principles.

If, however, these laws be enunciated—if they be even approximately attained—it will most probably be through some indirect means, through some other energies from which these energies of affinity may be deduced. In this indirect way the mechanical energy of heat has been measured, and its value is as generally received and acted upon as that twelve pence make one shilling or twenty shillings make one pound.

The source of mechanical power, so far as men utilise it, is in the energies of affinities. To these energies, as formed by the Creator (inherent and primordial), we owe the means by which work is done. Indeed, it is no very bold suggestion to make, that to the exercise, even now, of these inherent affinities, we owe much—it may be all—of terrestrial magnetism and internal terrestrial change and heat; the progress, in the depths of the earth, of these affinities, may be the cause of the variation of the compass; nay, we cannot tell where speculations such as these lead. How the atoms disport themselves we know not; this we do know, that when some atoms meet some other atoms they are as Greek joined to Greek, for "then comes the tug of war."

Nearly 30,000 lbs. of arrowroot were imported into the colony of Victoria in 1871, of which 13,000 lbs. came from the United Kingdom, 9,000 from the Mauritius, 2,300 from Natal, 2,000 from Queensland, 1,100 from Hong Kong, and 2,000 from the Pacific Islands.

In 1870, 25,946 tons of oranges and lemons, valued at £211,739, were shipped from Palermo, and in 1871, 31,765 tons, valued at £280,256. Of dried fruits, 504 tons were shipped in 1870, and 1,215 tons in 1871. Of manna, 1,342 cwt. in 1870, and 2,530 cwt. in 1871.

One of the most important discoveries in economic geology made during the past year is that of tin in Australia, but the recent discoveries indicate far richer deposits than any before known there.

Manganese is spoken of as a substitute for nickel for industrial purposes, the high and increasing price of the latter metal making its use expensive.

A monster diamond has been received from the Cape, weighing 288⅜ carats. This is the largest diamond South Africa has furnished, and when cut it is estimated it will be half as large again as the Koh-i-noor.

ANNUAL INTERNATIONAL EXHIBITIONS.

The remarkable success of the School of Scientific Cookery, at the International Exhibition, has induced the Commissioners to establish a new additional course of eight lectures, by Mr. Buckmaster, on "High-class Cookery." The first of the series was given on Wednesday, June 25. The staff is augmented by an experienced French *chef.*

The number of visitors admitted to the Exhibition on Thursday, July 3rd, was as follows:—Season tickets, 151; on payment of 1s., 2,763; total, 2,914. On Friday, season tickets, 166; on payment of 1s., 2,576; total, 2,742. On Saturday, season tickets, 979; on payment of 1s., 4,551; total, 5,530.

The number of visitors admitted to the Exhibition during the week ending Saturday, July 5th, was as follows:—Season tickets, 1,882; on payment of 2s. 6d., 1,039; on payment of 1s., 15,087; total, 17,948.

The number admitted on Monday was, season tickets, 158; on payment of 1s., 2,495; total, 2,653. On Tuesday, season tickets, 162; on payment of 1s., 2,824; total, 2,986. On Wednesday, season tickets, 180; on payment of 2s. 6d., 1,254; total, 1,434.

EXHIBITIONS.

Vienna Exhibition.—Last week 33 artisans from the manufacturing districts of this country started for Vienna, under the auspices of the Society for the Promotion of Scientific Industry, Manchester. The purpose of the society is to obtain reports upon the Vienna Exhibition from the workmen's point of view, and the greatest care has been taken in the selection of the men. The society defrays the whole cost of the expedition. The arrival of these men was noted in the daily papers of Thursday. Mr. W. B. Woodbury writes to the *British Journal of Photography*, drawing attention to the fact that, though there apparently are no examples in the Vienna Exhibition of the well-known "Woodburytype," or the photo-engraving process of the same inventor, both these processes really appear, under new names, in the French Section, the first as "Photo-glyptique," and the second as "Heliographie-Rousselon." Mr. Woodbury feels justly aggrieved at this appropriation of his idea by the French exhibitors.—A meeting of her Majesty's Commissioners, for the above Exhibition, was held at Marlborough-house, on Tuesday last, under the presidency of his Royal Highness the Prince of Wales, K.G. There were also present:—His Serene Highness the Duke of Teck, G.C.B.; his Serene Highness Count Gleichen, Capt. R.N.; the Marquis of Ripon, K.G.; the Earl Cowper, K.G.; the Right Hon. H. C. E. Childers, M.P.; Sir Anthony de Rothschild, Bart.; Sir Richard Wallace, Bart., M.P.; Sir Francis Grant, P.R.A.; Mr. Henry A. Brassey, M.P.; and Mr. A. J. R. Trendell (acting for the secretary).

Northampton Exhibition.—The construction of the building for the forthcoming exhibition of leather-work at Northampton is being rapidly proceeded with. The design is for a wooden building, 364 feet long by 30 feet wide. The building will be lighted by a continuous lantern-light in the roof, and artificially by gas.

Military Exhibition at Aldershot.—The Aldershot Camp Military Industrial Exhibition was opened at noon on Wednesday by his Royal Highness Prince Arthur, who was received by General Sir James Hope Grant, commanding the Aldershot division, Major-Generals Herbert Park Smith and Sir Thomas McMahon, commanding the infantry and cavalry brigades, and a large and brilliant staff. A guard of honour of 100 men, with the band of the Royal Fusiliers, was stationed on the lawn fronting the Club House, and gave a royal salute, the band playing the National Anthem as the Prince drove into the grounds. A choir of 300 voices sang the National Anthem, after which his Royal Highness declared the exhibition open.

TECHNICAL EDUCATION.—THE POLYTECHNIC SCHOOL AT ZURICH.

At a time when there is so much discussion about the best way to provide our own working classes with that technical education in which, unfortunately, the natives of other countries have often a very great advantage over them, it may be of use to examine into the condition of a Swiss institution, which has now been employed for a considerable length of time, and with very great success, in the work of technical instruction.

The Zurich Polytechnic School is a truly cosmopolitan institution, as it numbers among its students natives of Switzerland, Germany, Austria, Russia, Italy, Great Britain, Holland, Greece, Roumania and Danubia, Sweden and Norway, Denmark, France, Turkey, the United States, the East and West Indies. In 1871-72, the total number of students was 689, divided thus—

Swiss	242
Foreigners	447
Total	689

In addition to the students—properly so called—there were 361 *zuhörer*, or listeners—a class of partial or irregular scholars, who do not undertake to go through the whole *curriculum*, but confine their attention to particular branches of study.

Regular students pay a yearly fee of 100 francs, an entrance fee of five francs, library five francs, and five francs to the sick fund. The system of instruction provided for £4 12s. is calculated to astonish the English reader, and the matriculation examination is not less likely to dumbfounder an English lad of seventeen. Under this age no students are admitted, and when we find what they are expected to know before admission to the Zurich School, we must confess that the youths must have made good use of their time. Each candidate has to state in writing his name, birthplace, and intended profession, and must then undergo a severe examination, whereof merely the heads are subjoined for fear of discouraging English students, who will probably find their want of proficiency in German and French a sufficient drawback.

As an important preliminary, every aspirant must pass an examination—in writing and *vivâ-voce*—in the languages in which the obligatory course of instruction is given, and must satisfy the examiners that he understands French and German well enough to comprehend the lectures.

As Heinrich Heine remarked of the Romans, touching the immense advantage enjoyed by that favoured people over the rest of the world in not having to learn the Latin language, the Germans are undoubtedly better off at Zurich than all other nationalities, inasmuch as although instruction is given in the French language, and literature and English and Italian are not altogether overlooked, the official language of the Zurich Polytechnic School is, as might be expected, German. That the ridiculous inefficiency of young Englishmen in modern languages acts as an effectual bar to their presence at Zurich is proved by a perusal of the list of students—out of 447 foreign students only 8 come from England.

The difficulties of the general preliminary examination having been overcome, the student has to comply with the severe "Special conditions of admission." These vary, of course, according to the department in which the aspirant wishes to study. Before admission to the architectural or engineering schools or to the technical-mechanical school, he must pass in arithmetic as high as proportion, and in algebra up to the binomial theorem, and the use of logarithmic tables. He must show fair proficiency in synthetical and analytical geometry, and also in plane trigonometry. He is expected to know something of field-practice and to have acquired the elements of mechanics and physics. He must understand the rudiments of inorganic chemistry, and show some skill in mechanical and ornamental drawing. Candidates for direct admission to any of these schools are required to pass an equally searching examination in mathematics, but in order to facilitate the admission of aspirants to the regular schools, a preparatory mathematical class has been established. In this department lectures are delivered both in French and in German. Including this class the school is divided into eight departments.

1.—An Architectural or Building School.
2.—An Engineer's School.
3.—A Technical-Mechanical School.
4.—A Technical-Chemical School.
5.—An Agricultural and Forestry School.
6.—A School of Mathematics and Natural Science.
7.—A School of General Philosophy and Political Economy.
8.—Preparatory Mathematical School.

Students in any of these eight departments are required to pay strict attention to the printed programme. "The whole theoretical and practical course of instruction in the departmental schools is in this sense obligatory, that it is the duty of every student to attend in turn every section set down in the plan of instruction." In some cases, however, exceptions are made, as, for instance, in those of students who can show that their studies are undertaken with some special object. Mere attendance at the "obligatory lectures" is not deemed sufficient, as all students are required to attend repetitions and examinations, and also to prepare written or practical exercises. The professors in the first five departments, and the professors of botany and geology, make excursions with their pupils for the better illustration of the principles inculcated. The excursion element has always been a favourite among Germans, as it not only admits of sound practical teaching, but affords an agreeable relief from the monotony of the class-room.

The plan of instruction laid down for the building school extends over three years, and a like period is demanded to ensure proficiency in engineering. Great stress is laid upon the importance of several "consecutive" hours being daily devoted to the preparation of drawings in the school of architecture, and care is taken that advanced students in the engineering school shall be given every opportunity of obtaining practice in actual construction. In the technical-mechanical school the summer season is devoted to the study of metallurgy and the chemical technology of building materials, while the laboratories attached to the technical-chemical school are constantly thrown open to diligent students at other times than those set down for "obligatory" teaching. In the forestry and agricultural schools the fine summer weather is made the most of. It is impossible to read the programme of this department without envying the students, and even the professors, engaged as they are in map-making, field-measuring, and researches into the nature of plants, trees, and flowers. The anatomy and physiology of farm-stock are not forgotten, nor is agricultural chemistry overlooked. The whole theory and practice of husbandry is agreeably mingled with botany, a special study of the diseases of animals, and the construction of roads and drains.

Without dilating on the peculiarities of the remaining departments, it is impossible for a visitor to avoid admiration at the excellent organisation and general thoroughness of this great school. This country can boast of no analogous institution at present, but the hope may perhaps be indulged that public attention once drawn to the subject, something will be done, and that in the place of small schools or colleges, as they are ambitiously called, scattered over the country, we may see some attempt made to carry out a great comprehensive scheme on the Zurich plan. Any attempt to approach the Swiss in price would of course be futile, unless, indeed, a rich endowment were diverted from its original purpose to the foundation of a technical school. The effort most heroically made by King's College, to establish a polytechnic school in London, has, in spite of the great energy exhibited, proved only a partial success; but the attempt shows the right spirit, and it is certain that a thorough discussion of this great subject can have but one result—the ultimate removal of a serious blot in the educational system of England.

COMPETITION FOR FEMALE TEACHERS OF DRAWING.—PARIS.

The first examination of female candidates took place last week at the Ecole des Beaux-Arts. The tests are severe, and the competition lasts more than a week. The pupils are not actually shut up in little separate *loges*, as they are in the case of the regular examination of the school, but isolated and overlooked in such a manner as to secure the individuality of their work. In the first place, they are required to execute in six hours, including luncheon time, a piece of ornament from the plaster, and their success or non-success determines their admission to compete this year.

Those admitted are required to produce an entire figure after the antique, such as the "Diane Chasseresse," the "Diane de Gabie," or the "Venus de Milo," three sittings of six hours each being allowed for each work. After this proof of the aspirants' classical attainments, they are required to produce an ornament derived from forms of the vegetable kingdom. The trials terminate with oral examinations, the pupils being required to correct a given design, point out its good and bad features, and quote the principles of art in each case, and rules observed or violated, before a jury.

The successful candidates will be employed either in one of the nineteen subsidised schools of design in the city, in the Thursday classes which have been established in each arrondissement, or, lastly, in the ordinary communal schools, according to the amount of proficiency exhibited.

The Thursday classes are only for girls who have already exhibited some talent for drawing, and are directed by the chief drawing mistress of the arrondissement; the lessons last four hours. The subsidised schools meet three times a week for three hours. In both, competitions take place at intervals, and prizes are given to create emulation amongst the pupils. The average artistic power cannot fail to be raised by such means as these, of which the authorities of Paris are prodigal.

Nickel facing for printing type is said to be about to come into general use. It is cheaper and much harder than copper, and forms a better surface.

Brittle gold is refined in the London Mint, by passing chlorine gas through the melted metal. The results of the process are entirely satisfactory.

There was received at Melbourne in the year 1871 jewellery valued at £22,496, of which £9,950 had to pay an import duty of 12½ per cent., and £12,546 of 20 per cent.

A company has been formed for the construction of a tunnel under the Hudson, between New York and Jersey City. The proposed capital is 3,000,000 dols.

A tunnel through the Rocky Mountains is now talked of.

CONCRETE SYPHONS ON THE CANAL "QUINTURO SELLA."

In consequence of the short time (four months) which was allowed for the construction of the extension of the branch canal, Quinturo Sella, from Mortara to San Georgia, and the scarcity of bricks, the Canal Cavour Company determined to accept the proposal of Signor Giuseppe Frattini (who has successfully introduced his use of concrete into Italy, for the construction of hydraulic works) to build all the syphons for the passage of existing irrigation channels under the new canal in cement concrete.

These syphons, which vary in diameter from 0·25 to 1·00, are circular in section, and are moulded on a wooden cone about six feet in length, which is drawn forward as the work proceeds. Three syphons, of oval section, 2·00 in width by 1·60 in height and 20 metres in length, have also been constructed by Signor Frattini, and are probably the largest works of this class which have ever been made.

The cement used is that known as "Ciment de la Porte de Franca," made at Grenoble, the quick-setting *(à prise prompte)* being mixed with the slower-setting quality, in certain proportions, according as it is required to hasten the setting of the work. The ballast and sand should be clean, and when easily obtained, the granite chips from a stone-cutter's yard add considerably to the strength of the work. A few hours after completion, such work, struck lightly with a hammer, was found to ring like a bell.

CORRESPONDENCE.

THE LATE COTTON SUPPLY ASSOCIATION.

Sir,—In the report presented to the annual meeting of the Society of Arts, on the 25th ultimo, I find that under the head of "Cotton" the Cotton Supply Association of Manchester is represented to have been "set on foot during the scarcity of cotton, arising from the civil war in the United States of America," &c. This statement is incorrect. The association was formed several years anterior to the American civil war, and the consequent scarcity of cotton, known as the cotton famine. It originated in the uneasiness occasioned by the dependence which prevailed upon one main source of supply, and in the desire which was felt to develop the cotton-growing capabilities of other countries, especially those under the dominion of the British crown. It has not, therefore, as is stated in the report, ceased its operations, because the special circumstances under which it was formed have passed away, but having diligently stimulated the increased production of cotton in all countries where it had previously been cultivated, and introduced it into others where it had never before been grown for export, it was thought that the work initiated might now be left to the operation of ordinary causes. I shall, therefore, feel obliged if you will allow this correction to appear in your next issue. In making this request, I take the opportunity of expressing my own opinion, that the Cotton Supply Committee which the Society of Arts proposes to organise, may find useful employment, especially as regards India. Many of the countries which, during the time of scarcity, were attracted to the cultivation of cotton by the high prices ruling in the English market, might doubtless, under favourable auspices, make its growth a success; but there are other branches of industry which have already taken root, and will continue to have the preference, so that from this and other causes cotton will only receive occasional attention. But it is otherwise in India, which is essentially an agricultural country, and cotton occupies the chief place amongst its products. Its present cotton exports equal in value the entire land revenue, so that the preservation and extension of such a trade is of paramount importance alike to England and to our great eastern dependency.

Sir Bartle Frere, in a letter earnestly deprecating the intended closing of the association, makes the following pertinent remarks, viz.:—"In the production of cotton I have no doubt we are, in India, at length on the right road; and, for being there, we owe much to the persevering efforts of the Cotton Supply Association. It is only by a body like the association keeping the matter perpetually before the public and the administrators of India that the naturally slow progress can be accelerated. Even the Viceroy himself can effect comparatively little, but very slowly, without the moral support which he will derive from the opinions of men who have devoted so much attention to the subject as the members of the association."

My own lengthened experience in connection with the association, and my personal acquaintance with India, as well as the private letters which I continue to receive from well-informed persons associated with cotton cultivation, lead me to the conclusion that there is still much to be done before India will be made a satisfactory source of cotton supply. I earnestly hope that the committee proposed to be organised may prove equal to the work which they intend to undertake, and that their success may greatly surpass their highest expectations.—I am, &c.,

Isaac Watts, Secretary,
Late Cotton Supply Association.

Manchester, July 1, 1873.

GENERAL NOTES.

New Photometer.—A simple arrangement, which may prove exceedingly useful for many purposes, has been devised by M. Yvon. A piece of paper or card is folded in the middle, and placed upright on a table in such a manner that the two halves form right angles. In the line bisecting the angle thus formed, and at some little distance from its apex, is placed a tube, blackened in the interior, through which the observer looks at the edge of the paper or card. The sources of illumination to be compared are placed at opposite sides of the card. So long as the two surfaces are equally illuminated, the observer has a perception of relief; when, however, the light falling on each is perfectly equalised, he sees what appears to be a plane surface.—*Iron.*

Preservation of Food.—Carbolic acid paper, which is now much used for packing fresh meats for the purpose of preserving them against spoiling, is made by melting five parts of stearine at a gentle heat, and then stirring in thoroughly two parts of carbolic acid; after which five parts of melted paraffine are to be added. The whole is to be well stirred together until it cools; after which it is melted and applied with a brush to the paper, in quires, in the same way as in preparing the waxed paper so much used in Europe for wrapping various articles.

Production of Gold in Finland.—During last autumn there were no less than seventeen companies engaged in extracting gold from the auriferous sand of Finland. The alluvial deposits at Toalo are said to be extremely rich in gold, the total production last season being estimated at from 50,000 to 60,000 grammes, representing a total value of 60,000 roubles (£9,500.) One of these companies returned a dividend of 70 per cent.; the largest nugget yet found weighed forty grammes.

Practical Geology.—Six elementary lectures on rocks and metallic minerals, adapted to a juvenile audience, will be given by Professor Tennant, at his residence, 149, Strand, London, W.C., on July 14th, 15th, 16th, 17th, 18th, and 19th, at 11 a.m. and 3 p.m. Terms:—Half a guinea for the course; five shillings for children of Fellows of the following Societies—Geological, Zoological, Chemical, Royal Microscopical, Royal Geographical, Royal Horticultural, Geologists' Association, and Society of Arts.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

H.M. THE SHAH OF PERSIA.

His Majesty the Shah of Persia having expressed, through Sir Henry Rawlinson, his readiness to become a member of the Society, the Council have great pleasure in announcing that they have (in accordance with the 74th Bye-law) elected His Majesty an Honorary Life Member, without the ordinary formalities of election.

PROCEEDINGS OF THE SOCIETY.

MUSICAL COMMITTEE.

REPORT OF A RECENT VISIT TO THE CONSERVATOIRE DE MUSIQUE AT PARIS.

1. The existing building, situate in the Faubourg Poissonnière, Paris, is not generally considered to be the type of a music school planned as well as possible. Many changes would be effected in it if the necessary funds were forthcoming. Still the rooms for study appear to be well suited for their uses, and from a hasty inspection it appeared that the accommodation was sufficient.

2. I obtained the following enumeration of the rooms from M. Chouquet, the director of the "Musée Instrumental":—

(*a.*) A large "salle de theâtre," allotted to theatrical and lyrical entertainments, and concerts. The scenery used for the theatrical and operatic representations consists of a semicircular Pompeian interior, which encircles the sides and back of the stage. Above the scenery (about 12 feet), and at the back of the stage, rises the organ, which may be left visible or not (at choice) to the audience. When concerts are given, an ordinary orchestral platform is placed on the stage, rising from the footlights up to the organ. The auditorium of the salle is constructed after the principle of that in an ordinary French theatre, in size like the Theâtre du Palais Royal, &c., only without a lofty gallery.

(*b.*) A smaller room, or salle, of an oblong form, with a raised stage, but without a proscenium, about 60 ft. by 25, is devoted to dramatic instruction, declamation, and examinations in those branches. M. Bressant, of the Theâtre Français, was giving a lesson when I visited this room. Three students were acting under his tuition, and the class of male and female students were spectators of the students' attempts to copy the finished posings and declamations of M. Bressant. At the back of the stage is a small organ, and this is used for the organ instruction classes.

(*c.*) On the *rez de chaussée*, as well as on the second floor, are small theatres—merely square rooms, fitted with a stage raised about 3 ft. or less from the floor, upon which is erected the framework commonly used for scenes. This framework is a fixture, and serves to accustom the students to the entrances on the stage, the general position of the wings, &c. One of these theatres is used for instruction in opera proper, and the other one in opera comique.

(*d.*) Of class rooms—each room being about 16 to 18 ft. by 14 to 16, by 11 ft. high—nine are allotted to male students, and ten to female students. Each of these rooms is intended to hold about 20 students. I saw one class under instruction (pianoforte), and there was ample room for them; they numbered however 16, and were chiefly boys from 14 to 16 years old.

(*e.*) There is one good-sized lecture room for solfeggio classes.

(*f.*) There are two salles d'attente, one for males, the other for females.

Precise plans of the building could be obtained by an official application to M. Ambroise Thomas, requesting him to get them from M. Lance (the architect), 15, Rue Treilhard.

3. *Number of Students.*—At the present time there are 700 students; 300 men, 250 women students, who have gained admission after examination; besides these there are 150 "auditeurs," who are permitted to attend the classes and to listen to the masters while they are giving their lessons. These "auditeurs" gain admission either by the nomination of the Minister of the Interior, or by passing an examination. Many of them ultimately become regular students.

4. *Number of Professors.*—There are 84 masters. 8 teach singing; 5 teach pianoforte (superior classes); 5 teach pianoforte (preparatory classes); 6 teach harmony; 3 teach advanced composition; 1 teaches history of music; 4 teach solfeggio to large classes of students by lectures; 12 teach solfeggio to students individually; 4 teach violin; 2 teach violoncello; 1 teaches the double-bass; and there is one master for each of the different wind instruments in the orchestra, such as trumpets, horns, trombones, flutes, clarinets, oboi, &c.; 1 master for organ; 1 master for the harp; 4 masters for lyrical declamation and study of parts in opera, &c.; 3 masters for dramatic declamation; 1 master for French grammar, prosody, &c. The professors of the highest class, which includes men of standing, such as M. Ambroise Thomas, Monsieur Chouquet, Monsieur Felicien David, all members of the Institute, each receive an annual payment of not more than 2,500 francs.

Elementary professors are paid 1,200 fr. each. Those who have been on the staff for some time, and have become more or less eminent, such as Messrs. Henri Herz, Alard, Dancha, Franchomme, Ernest Boulanger, Roger, Madame Viardot, Garcia, &c., each receive 2,000 fr. per annum. A professor gives at least three lessons a week, each lesson lasting two hours.

5. The amount of the State subsidy is now 210,000 francs, which is the sole support of the school. The State provides the ground and buildings. There is a considerable property in the "material," such as instruments, books, scores, &c., belonging to the institution. The whole of the subsidy, therefore, can be devoted to the payment of professors, for administration, and cost of necessary furniture, &c.

6. The students now board out of the Conservatoire, and practise at their own lodgings. The director, the secretary, the keeper of the museum, the two chief attendants, and messengers, live on the premises.

7. The classes begin at 9 a.m., and last until 4 p.m. Each class meets for two hours.

8. No fees whatever are paid by the students, who are permitted to enter only upon merit. There are scholarships, which are awarded by the government to the most distinguished students. They vary in value from £30 to £70 a year, and are destined for the support of the student. The return for this gratuitous instruction, &c., which the State derives from the students, is the use of students' services at certain principal theatres for four years after their education is complete. They are paid moderate salaries during these four years, and if they turn out to be great singers or actors the government is benefited to the extent of the advance upon the average receipts in the theatres.

9. A book entitled "Histoire du Conservatoire de Musique," by M. Lassabathie, Paris, Michel Lévy, 1860, contains a number of interesting facts about the establishment.

10. I should add that there is a spacious library above the museum. All kinds of musical works, full scores by composers of all times and countries, and original writings by former students of the Conservatoire are contained in this library. The collection of musical instruments, principally formed by M. Clapisson, is well known. Many important specimens are here, and new ones are added from year to year. Monsieur Chouquet is the keeper of the museum and the librarian, and is a learned critic. He will gladly assist in procuring further information.

Alan S. Cole.

May, 1873.

CANTOR LECTURES.

The fifth lecture of the second course of Cantor Lectures for the Session, "On the Energies of the Imponderables, with especial reference to the Measurement and Utilisation of them," was delivered by the Rev. Arthur Rigg, M.A., on Monday evening, March 3rd, 1873, as follows:—

Lecture V.

On the Energy of Electricity, with especial reference to the Measurement and Utilisation of it.

The energy of electricity is being manifested in phases new to men day by day. That which in the early part of the present century was unknown, is now so well known as to win neither surprise nor notice. The telegraph which girdles the earth—the electro-deposition of metals—the light which pales our brightest—the power which melts the most refractory metals (for I have seen a square bar of iron a foot in length, and about three-eighths of an inch on the side, fused into drops by a current of electricity in less time than this narrative has occupied)—these have been handed down by science to promote the commercial and social welfare of mankind.

What remains to be done by this energy, so recently harnessed, and as yet only partially trained, is beyond our present ken; but that it will—or, at least, that it can—be developed in a sufficiency to supply our coal-fields when exhausted, and take upon itself all that coal, and wind, and water now give of kinetic energy, no one who has watched the progress of the past need doubt; this, too, quite irrespective of the view that owing to the quantity of zinc consumed, electricity can never compete with coal in producing the same results. There is every reason to expect that long ere the coal-fields are exhausted, the tidal waves on our coasts will be supplying light enough and heat enough, and, therefore, power enough, for the requirements of Great Britain and Ireland.

Propositions better established than that which asserts electricity to be non-producible from sufficiently economical sources have faded into oblivion.

The energies of electricity are manifested whenever there is a molecular disturbance within or amongst bodies. Whenever any change takes place in anything whatever, and amongst any molecules whatever, an electric current is produced, and if not necessarily manifested to us, still it always is present. Probably there is not a single act of our lives, and it may be not even a thought in our heads, which is not associated with an electric current.

Kindly understand that the lecture is on the energy of electricity, and, therefore, time must not be occupied in describing instruments. Galvanometers are now-a-days made so delicate that if you lay one finger in one trough of salt water, and another in another, and simply tighten the muscles of one arm, a current of electricity passes through the galvanometer and deflects the needle. We cannot raise our hands to our head without setting free a current of electricity, and in that current is energy. Its energy is manifested in the moving of the galvanometer needle. How much of that energy is merely the balance between two energies of large amount—how much is not manifested, owing to the sluggishness of the instrument and from other defects, we know not, but that some is thus interfered with there is very little doubt. We usually speak of a galvanic battery as being formed of zinc and copper, or of metals in chemically different relations to a liquid; if, however, you take a piece of ordinary copper bell wire, and connect the two ends of it to the galvanometer, then cut it in two with a pair of scissors, and dip each cut end into salt and water, or put them into your mouth, an electric current passes, and the galvanometer shows that there has been some species or other of molecular disturbance which has caused a manifestation of electrical energy.

This energy of electricity becomes kinetic when it is allowed to pass freely. For example, in any bodies which are quiescent, it is kinetic, but it is potential when resisted. If, for instance, a current of electricity passes along a wire and the action is resisted, the wire becomes hot. If it passes through any compound body, as, for instance, water, then it is resisted, and the water is immediately decomposed. Consequently we are dealing to-night with an energy manifested in molecular disturbance, and having both a potential or stored-up power, and a kinetic power in motion. The question now is, how is this energy to be measured, for the subject of the lecture this evening is a mode of measuring the energy of electricity.

Towards the middle of the last century (about 1746) the first electrical machine was made. In 1650, Otto Guericke, to whom we are indebted for the air-pump, suggested the scheme, but Hawksbee was the first to make one. His machine consisted of a ball of sulphur, afterwards altered to a ball of glass. The hands were employed to rub it, and a large fly-wheel, about six feet high, was employed to turn it. Silk threads from the ceiling held what we now call the conductor; and by the exercise of a very large amount of mechanical power they were enabled to get a small spark, to the surprise of all, to the curiosity of many, and the dread of not a few. After that we come to the plate machine, which is arranged, as you are aware, with cushions; still we have those sparks which were supposed to have much energy in them. We then pass on from the glass plate machine to the vulcanite-plate machine. Here is a vulcanite-plate, and, as you are aware, by rotating it between cushions, the electricity is gathered upon this conductor. You see this large wooden ring—that was suggested by Winter; the object of it was, somehow or other, we do not know how, to condense the electricity, and to convert what might be a fine line spark into a solid whitish spark. How this ring acts, and the whole history of this machine, would be quite sufficient matter for one lecture; but that with which we are now concerned is not how to produce such phenomena, but how to attempt to measure the energy of the electricity which these machines, and other means, can develop. I scarcely need tell you that it is not, in any sense of the word, an electrical lecture in which we are to be engaged this evening, and these apparatus are only here as illustrations of the operations. Sparks pass from the conductor, and are usually charged into a jar of this kind—a Leyden jar. That was first done in the year 1746. The jars were charged and discharged, and although great shocks were felt, yet no measure was taken, and it was supposed that in the shock consisted the energy of electricity.

Now, the mode in which electricity thus presenting itself was ultimately measured was by a small jar of this kind, called a unit jar. This unit jar is in all respects the counterpart of the Leyden jar, only made smaller, and one is here mounted on glass and brass rods. There are two brass balls, one connected with the inside of the jar and one with the outside, which balls can be set at any distance apart. The inside of the jar is charged from the electrical machine, and as soon as it is sufficiently charged, according to the distance of the balls from one another, a spark passes. So passing, spark after spark enters the larger jar, and if we count the number of such entering, we have settled what was supposed to be the measure of energy contained in the large jar. We may put in 10, 20, 30, or 40 charges. It will be very obvious to you, however, that these unit jars vary. The same jar is always alike, but you cannot make two exactly alike. Even if this could be done, the state of the atmosphere and other surroundings would so influence the passing electricity that accurate comparisons and conclusions could not be made. Moreover, these jars vary on the surface, and in the character of the glass, and in other ways; consequently, this mode of measuring energy must necessarily be a failure. The unit jar, therefore, has fallen into complete disuse.

Hitherto the mode of producing the electricity to be measured has been by friction. Now, here is a machine, consisting of a thin circular vulcanite disc, capable of being put in rapid rotation, but there are no rubbers or other articles in contact with the plate. It is called a Bertsch machine. Here are three segments of thin vulcanite; one of these is rubbed with a piece of dry silk or fur, and, being slid in prepared grooves, the faces of the segment and rotating vulcanite are about one-quarter of an inch apart. These two other segmental pieces can be slid behind the first one; if the room and the atmosphere were not so damp we should probably get a four-inch spark from this machine. One segment is rubbed, and placed about a quarter of an inch from the disc, and by a process of induction, when it is rotated, there is a noise as of much electricity being brought forward and gathered by the conductor. Again, we have here no quantity of electricity—we have no kinetic energy. The difference between energy as it is used, speaking electrically, and intensity, as it is also used, speaking electrically, is this, there may be great intensity and little or no quantity—no power, in the proper sense of the word. For example, if a piece of iron were taken and formed into needles, and if those needles were placed points downward upon the hand, and a small weight upon them, we should find that piece of iron was possessed of great intensity; but if this iron in rough block form, with any weight upon it, be placed upon the hand, although there be a very much larger quantity of iron, yet there is little intensity. In such a sense the distinction is drawn in electricity between quantity and intensity. There is great penetrative power in electricity obtained from this machine, but there is no quantity of electricity moving, and upon the quantity in motion depends our ability to get energy. If all our iron appeared in the form of needle-points we should do very little with it.

There is another matter, also peculiar to electricity of this character, compared with the uses to which iron is now applied. Here is a small glass flask with crumpled pieces of tinfoil in it. If this flask were coated on the outside, as a jar is, the amount of intensity, and the shock that would be given by it, would be equal to what might be obtained from that large jar, for this reason, the electrical balances between the inner superficial metal surface and the outer coating of the jar depend upon the intensity on these two. Electricity of this character rests upon surfaces only; electricity of that other character, with which we are more concerned, enters below the surface, and may be said to reside and travel within the body. Whatever, therefore, may be the number of, say, square inches of surface within the jar, the electricity upon the whole of them would be balanced by electricity of equal intensity upon an outer surface covering the jar only. This may be illustrated by reference to the large quantity of water contained in a dock for ships. It is supported or kept at its level by a gate which in no respect is stronger than would be required for a dock of the same depth containing not one-tenth of the quantity of water. So with what is called the hydrostatic paradox, also so with Bramah's hydraulic press, and so with this little jar. There may be a large quantity of electricity within this jar if it have a large surface on which to distribute itself, and then it will be balanced or kept in equilibrium by a smaller surface on the outside charged to the same intensity.

The electricity here has been produced through physical exertion. We found, however, the other night that there is no physical exertion so great as that which takes place between the molecules of different bodies when chemical affinity is allowed to operate. If, therefore, instead of getting molecular disturbance in the muscles of our arms by turning these handles, we produce molecular disturbance between the ultimate atoms, or molecules of matter, forces are called into play as far beyond the power of our arms as those of the most colossal steam-engine are beyond the power of a mouse. By chemical arrangements we are enabled to obtain electricity of a totally different character from that hitherto noticed—so different that there is little similarity between them, excepting a common name. In fact, the earlier attempts at telegraphy failed in consequence of the promoters using electricity produced by machinery such as this—an electricity which is possessed only of intensity, and not of that energy consequent upon quantity.

Let us now pass on to the mode of obtaining electricity from chemical action. Before doing so a phenomenon should be noticed, which disturbs results very seriously, and which is, at present, not understood. Here is some copper wire, covered with cotton, coiled from end to end, say five or six times along this large bobbin of wood. Within the bobbin is a larger hole than usual. The two ends of this wire so coiled are connected with the reflecting galvanometer. The reflected light from this lamp is now visible and stationary upon the screen. You are aware that motion of that reflected speck of light will be the consequence of electricity passing through the coils of the galvanometer. Now, observe that, without either chemical or physical agency acting upon or in contact with the wire, we shall obtain a manifestation of electrical disturbance within the copper wire. Let the end of this steel magnet be introduced within the bobbin, you see that the speck of light immediately moves. Except in this manner, copper does not manifest electrical properties. Again, if the other end of the steel magnet be brought within the bobbin, you see the speck of the galvanometer moves in an opposite direction. Thus may be shown one form of electrical induction.

Now, with that phenomenon we are perplexed. This property of induction manifests itself at times and in ways of which we know nothing. For example, if a copper wire were laid upon this floor, and another copper wire were laid parallel to it on the floor below; and if any current of electricity passed through the wire on this floor, the one below would answer to it, although there was not any apparent contact or communication between them.

The laws which govern such electrical manifestations as these are very partially understood, and therefore the measurements of the results of these laws are for general use almost valueless. We must, however, for the present assume that the nature of the phenomena of electrical induction is clear.

The next stage in obtaining electricity is by means of what is called a galvanic cell. Such a cell usually consists of two different metals, and one or two liquids. Whatever may be the arrangement, the electricity developed may be estimated by the intensity of chemical affinity during the process, and at the time of the measurement. But the whole of this question of chemical affinity must now be assumed, and some of the affinities explained in the last lecture are probably the chemical affinities operating in this cell. A chemical action takes place upon a square inch of one plate, and it is met by an action upon a square inch of the other, therefore on every square inch an action is produced. Between the two plates there is something (say the liquid) which causes the action. It is in fact the presence of this liquid which calls the chemical affinities into play.

A word must now be introduced which will often occur during the evening, and it is one which performs an important part in the measurement of electricity of the character which men utilise, *i.e.*, resistance. Indeed, this resistance to the free passage of an electric current is our chief business to-night. Whilst the size of the plates in these cells is increased, the resistance to the free course of the manifested electricity is not decreased. Thus, for instance, from a square inch of one plate there is a current of electricity meeting or co-operating with that developed from a square inch of the opposite plate. Whatever may be the energy of the chemical affinity upon one square inch, it is met by the energy of the chemical affinity upon the opposite square inch of the other, and that energy has to overcome the resistance of the liquid between them. Now, then, assume that each of these plates is enlarged by the addition of another square inch. This introduces an additional quantity of liquid, and we have to overcome the resistance of this liquid. The difficulty of overcoming the resistance of the intervening liquid is such that, however much we multiply the number of square inches, we also introduce more liquid, and by so doing add further electrical resistance. Hence, however large may be the plates, we do not overcome the resistance more easily. That led to the contrivance of thus coupling up in what is called "a series" in the form you see here, that which is familiar under the name of a cell-battery.

It may perhaps make clear what is a difficulty to many minds if an attempt be made to explain how it is that an electrical current which passes when cells are coupled up "in series," that is, one after the other, is more intense than when they are combined as one large single cell.

Supposing these two plates, each one square inch in area, were the only two concerned, therefore there would be a certain resistance to be overcome. The chemical affinity of one such combination not only overcomes that resistance but leaves a surplus of electricity, which surplus is said to run along the outside wire, and may produce what we call a telegraphic dispatch. Now, suppose that in addition to those two plates, there are two others of the same size and material in a cell behind them. Between these second plates there is also a resistance similar to that between the first two. Those two second plates, however, also produce a surplus. Now as that surplus passes over it continues its way through the previous plates and wire, and the consequence is that when once the resistance of its own cell has been overcome, the surplus electricity can pass through the other cells without any resistance, and, therefore, we are enabled to add the surplus of one cell to the surplus of the next, and so on. Hence, when combined in the form in which they are combined in this battery, we are manifestly enabled to pass along the connecting wire successive equal amounts of electricities, and these flowing so very closely behind each other, produce an effect upon any resistance similar to that produced upon a slab of marble or of glass by the forcible driving against it of small grains of sand in a continuous stream. These grains penetrate, and, as it were, bore holes even in hardened steel; so these successive electricities are, as it were, continuous, and thereby overcome great resistances. It may, in connection with this, be remarked that, perhaps, in some such way as now described, the mighty energies of affinity may be accomplished by this clashing of millions upon millions of atoms and molecules. This may explain how and why it is that these cells thus arranged "in series" are under certain circumstances more effective than when the same amount of liquid and metallic elements operate as one cell only.

Electricity thus, or by other means at our disposal, is now to be measured. Two things are especially before us to-night. One to make clear how this measurement is made; the other to endeavour to make clear how the resistance of various bodies, be they wires or liquids, is also measured.

This electricity is measured in a very simple way. All the apparatus is here, but as it would take too long to show experiments in detail, perhaps you will kindly accept a statement of facts instead of a visible reproduction of them. In these cells is being produced a quantity of electricity which is to be measured, much as sugar is measured by the pound or liquids by the quart. The way it is measured is either by the chemical decompositions that it can produce, or by the amount of heat it can develop, or by other means, as for instance its effect upon the magnet in a given time.

This seems a convenient opportunity for directing attention to a galvanometer, which is arranged upon a plan by which is shown the amount of decomposition effected by the current indicated by the place of a needle on the dial. The gentleman who designed it had in view only a manufacturer's requirements. The measurement effected by such a galvanometer is not of that character with which this lecture is to be concerned, and therefore further reference to this particular one is not requisite.

To consider a mode of measurement we must recur to those elements—mass, space, and time. The apparatus on which my hand now rests consists of a wooden ring, about ten inches in diameter, having coils of copper wire round it. Within this circular box with a glass top is a small magnetised steel needle. Now, the small steel needle assumes a certain position in consequence of the influence of terrestrial magnetism. Such an influence as this is not unlike a stream of water in a brook upon a short stick, one end of which is tied to a stake by a string. So long as the stream flows steadily past the stick it is retained in the same position. Let a disturbance take place in the evenly flowing water, and the stick will no longer retain either steadiness or direction. Suppose, now, that this needle is retained in a certain direction by the influence of what we may call the stream of terrestrial electricity flowing through the atmosphere of this room. (That such a stream is so flowing through the atmosphere shall be made apparent presently.) From these four cells of a galvanic battery a current of electricity may be caused to pass along the wire which surrounds this wooden ring. The arrangements are made, and such a current is now passing. What is the consequence? The even flow of that which retained the needle is disturbed, and the needle answers as the stick in the water would have done to the disturbing causes. Clearly the nature and extent of the invisible disturbance may be estimated—indeed measured—by the motions of the visible needle, just as a new position assumed by the stick would measure the disturbing influence on the stream.

The promise to let you have proof that there are currents of electricity passing through the atmosphere of this room may now be redeemed. Here is a circular wooden ring, with wire round it as before. You may notice that it can be turned as a looking-glass in its frame. The ends of the wire coiled round it are now connected with the wires of the galvanometer, the mirror of which reflects that speck of light on the screen. The looking-glass mounted ring is placed in reference to the (so called) current of electricity always passing through the atmosphere, that were there a glass in the frame the current would beat upon that glass. If the frame be turned one-fourth round, then the current will pass parallel to the face of the frame. Or thus:—If the frame of the wire-enclosed ring be placed parallel to the direction of this magnetised needle, then the current of electricity through the atmosphere of this room is passing parallel to the ring. To move it, therefore, from this position to one at right angles to it, it is clear that the circumferential wire must, as it were, cut the stream of electricity, if there be one. Now, so cutting it, there will be a disturbance in the electrical condition of the wire, which may be manifested by a motion of that speck of light. Observe now, that every motion of the frame causes a motion in the needle of that galvanometer, which is placed on a stand far removed from the table on which the motion of the frame takes place.

The two experiments now made may satisfy you:—1st. That there is what, for want of another name, we may call a current of electricity passing through the air; 2nd. That disturbance of the uniform quiet flow of this current may be caused; 3rd. That this needle is sensitive to such a disturbance; and, 4th. You will perhaps accept my word for that which time alone prevents being illustrated, viz., that the amount of this disturbance may be measured by the needle; that is to say, the greater the disturbance the further will the needle be moved from its original position.

It will be obvious to all that the amount of motion in the needle for any given disturbance will depend upon its sensitiveness. Hence, two needles may or may not move equally from the same cause. A mode of measurement, therefore, which depends upon an artisan's capability to make either unit jars or needles equally sensitive cannot be one to be much relied upon. There is, however, a relationship between the motion of the needle and a totally different mode of absolute measurement of the quantity of electricity that may pass in a unit of time, which solves the difficulty now expressed.

The usual apparatus for the decomposition of water by an electrical current is standing here. It is in consequence of completing the wire circuit from this combination of four cells that decomposition takes place. The bubbles are rising regularly and rapidly. Patient and watchful experimenters have established this—viz., the amount of water thus separated into its constituent elements of oxygen and hydrogen is always in exact proportion to the quantity of electricity that passes. If, then, it were convenient to be thus always decomposing water, a measure might be had. Thanks, however, to the mathematician, we have a much more simple mode of gaining this knowlege.

Suppose one end of the wire from these four cells is connected with the decomposing apparatus—this apparatus connected to the ring already explained—then from the ring to the other end wire of the cells. With such an arrangement observations can be made both on the decomposing apparatus and the deflections of the needle, when each is under the influence of the same current. If the quantity of electricity in circuit varies, the amount of gas produced and the position of the needle vary also. These have been so frequently observed, that by looking at the needle the mathematician could always tell the amount of gas obtained; in fact, he could lay down a very simple rule for guidance. The application of this rule enables a person at all times to state what quantity of electricity is passing, even though he look to the needle only.

An arithmetical illustration may make this clear. Suppose that in one minute these gases, which may be seen coursing up the tube, filled a space in the tube marked ten cubic inches—observe where the needle pointed. Let us assume that it is pointing to 45°. Suppose on another and future occasion the needle is observed to point to 60°, now, either from memory or from tables, we find that the tangent of 60° is entered as 1·73. Then, if 10 be multiplied by 1·73, the result would be that 17·3 cubic inches of gases might be evolved. As there are in chemistry laws connecting the composition of bodies, such a result as this would enable a manufacturer to know how much silver, for example, this current of electricity would cause to be deposited in any fixed space of time. Thus may be measured the *quantity* of electricity passing in a unit of time.

But the deposition of gold and silver or other metals is not the only utilisation of electricity, and as other results of a very different kind are obtained from this "imponderable," it is time to turn to illustrations of another form.

Telegraphy seems at present to have taken the most important position in the manifestation of the energy of electricity. Telegraphists therefore naturally consider how they can measure the energy with which they deal. If there are any connected with telegraphy present, perhaps they will remember that this is not a lecture on the present advanced state of telegraphy, nor on modern instruments, it is simply an attempt to make as clear to a general audience as is in the lecturer's power the principles which govern the uses and measurements of electricity in relation to telegraphy. To enter into details in reference to those laws which the electrician and mathematician have been enabled to propound, would be not only very injudicious, but very unsatisfactory. A sketch of the broad principles on which they are founded, and an illustration of the application of them, may prove more useful than an attempt to show how details of measurement have been accomplished.

The first question that presents itself is what may be called the measure of resistance. It was soon observed that electricity passed along certain metal wires more freely than other metal wires of the same size and length. The observation admitted of a very important utilisation. For example, suppose the wire now stretched from one end to the other of this room was one mile in length, and that the little apparatus with which electricity is being produced at this end could produce a certain result at the other end. Now, let us take another metallic wire of the same length, and suppose the result produced in this case is much less than in the first. It will be admitted, without any detailed experiment, that by shortening again and again, the second wire may be reduced to a length which permits the phenomenon at the end of the first wire to be repeated at the end of the second. Now measure the second; it is only one quarter of a mile. Try a third and a fourth wire; perhaps they are respectively reduced to one-eighth and one-tenth of a mile. Evidently there is some property in these wires which hinders, retains, or resists the progress of electricity. The property is called "resistance," and is available for very useful purposes. The British Association for the Advancement of Science were so conscious of this that, in 1861 and 1862, there were grave considerations as to what steps should be taken in order to assign a value to this resistance. You have seen how the quantity of electricity may be measured, but then that measured quantity had not to convey itself to a distance. It quietly, as it were, staid at home and worked. When telegraphy entered then electricity had to travel to or act at a distance. This state of affairs rendered it very desirable to determine "resistance" from what is called first principles, that is to say, to deal only with the three units of measurement, mass, space, and time. It was needful, by some means or other, to get this resistance into the form of mass, space, and time. It was considered that if we could regard it as velocity we thereby involved both space and time, because velocity is measured by space and time. If one runs a mile in an hour, then it is only needful to divide one mile by sixty minutes, and the space run in one minute is known. That would be the measure, assuming the minute to be the unit of time. The British Association appointed a committee. The chief gentlemen concerned in the committee, and who had the designing of a mode of grappling with one of the most critical tasks of science, were Mr. Clark Maxwell, now Professor of Physical Science at Cambridge, Mr. Balfour Stewart, of Kew Observatory, now at Manchester, and Mr. Fleeming Jenkin, now Professor of Engineering in the University of Edinburgh. Their experiments were carried on in King's College, and the scheme now to be very briefly described is found in the report of the British Association for 1863.

It may here be remarked that perhaps there have been no lectures ever given in this room of a more important and scientific character than a course of Cantor lectures on electricity by Mr. Fleeming Jenkin. This course commenced in January, 1866, and will be found reported in the *Journals* published between 2nd February and 2nd March, 1866 (inclusive). It is well to make this further statement, that those lectures have frequently been appealed to by writers on electricity who regarded the phenomena thereof in the light of an accurate science.[*] The question, then, is, how are we to measure in velocity this resistance? How are we to convert that which is resistance in a wire into an electrical measure of velocity? [The lecturer here, by apparatus and diagrams, illustrated the principle upon which this mode of measurement was based, and in so doing referred to the currents passing through the room, as already described.] At Kew there is a record of these currents kept continuously night and day, and it is found that they are changing every minute. The main object, then, of the committee of the British Association, was to devise a plan by which they could ascertain the resistance that a given wire offers measured by comparison with the velocity of these currents. You may remember that Kater could not measure the law of gravity, owing to the fact that it was rapid in its actions, and he felt that he must have some means of causing that law to repeat itself. Kater adopted the pendulum, and recorded the number of times it oscillated in twenty-four hours, and thereby got at the law. If, instead of having a long wire and three others running along the bar, as in the apparatus before you, we had a ring of this kind, and caused that to revolve rapidly, say at the rate of 100 or 200 or even a thousand revolutions in a minute, we still get the laws of the magnetic force in the same way as described, similar to when the bar passed along the rods before you. This causes the magnetic force to act upon the needle, and in reality, in the experiments which determined what is called "the British Association unit of resistance," these currents acted upon a very small needle carefully suspended, so that they were enabled to estimate the resistance of this wire in an absolute measure of space and time. That led to the adoption of what is called the "ohm," or "British Association's unit of electrical resistance." This term "ohm" is a name given in compliment to one who suggested an important relationship among the elements of current, force, and resistance. Indeed, that table of electrical measurements which may some day be placed in books of arithmetic, with corresponding tables of weights, measures, and money, will be found to contain the names of men who have investigated special departments of electrical science, such, for example, as Ohms, Farads, Volts, Webers, &c.

In this little glass cylinder there is a coiled length of German silver wire, German silver being used because it possesses great resistance to electrical currents, and that resistance does not change much with change of temperature. This coil constitutes what is called half a British Association unit, which becomes the measure of electrical work, just as the standard pound becomes the measure for weight, or the foot is the standard measure for length. Being possessed of this measure, we have all that is needful for the measurement of resistance, and therefore for measuring electrical work connected with telegraphy.[*]

To show the way in which a knowledge of this measurement can be utilised, rather than to enter upon those investigations by which it was obtained, seemed likely to win so much more attention and interest, that these arrangements before you are for this purpose. The intention is to show how electricians determine the distance at which a deep sea cable is broken, so that they can tell how far the fracture is from the shore. Let it be understood that it is the illustration of a principle, and not the nature and modes of dealing with different kinds of "faults," that are to be our concern.

There is a wire, which may represent a cable, round the room. In this box there is placed a number of "ohms" arranged in three sets of nine each, so that by moving these pegs a current of electricity can be caused to pass through either one, or more of them. Assuming each "ohm" in the first set to represent one resistance, each in the second set ten, and each in the third set one hundred, the consequence is that if a current of electricity passes through all it would meet with a resistance of 999. If it passed through one of the first set it would only be one resistance; so that with the moving of these brass pegs there is the power of bringing in any number of ohms required. This flat board, about 3 ft. 6 in. long, with a German silver wire and broad bands of copper divided at intervals, but capable of being put into electrical connection by the insertion of pieces of metal, constitutes what may be called the beam of electrical scales. Resistance, however, is to be measured instead of weight. Along a wire at the back electricity can pass, and when connected with the galvanometer the speck of that instrument serves the same purpose as the pointer of a pair of scales. If the galvanometer speck points to nothing, we assume that there is equilibrium between the resistances at each end of the scale beam. If I put 999 "ohms" in what we may call one scale, and other resistances into the other scale, or that which we may consider as such, then if the current of electricity arranged as provided can pass one of these groups of resistances more freely than the other, the speck of light will be moved. This is the same as though one end of a scale beam were "kicked up." Therefore resistances, which in this case act the part of weights on ordinary scales, must be taken out or added as may be required.

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[*] Since the commencement of the publication of this course of Cantor lectures a volume has been issued, entitled, "Electricity and Magnetism," by Fleeming Jenkin, published by Longmans and Co., price 3s. 6d. In this volume the author has treated the subject in a novel and a practical manner, very different, indeed, from ordinary text-books on electricity. It will be found to contain matter of great value and interest to the thoughtful student of electricity.

[*] Those who are disposed to give the thought and application requisite for a clear comprehension of these principles of electrical measurement may refer to chapters ix. and x., extending from page 147 to page 165 in Jenkin's "Electricity and Magnetism."

This wire running partially round the room represents a cable. The two ends of this cable are in my hand. Let us assume that we want to measure the resistance the cable opposes to the energy of electricity, and to ascertain the value of its opposing power. Here is what is usually called a battery, consisting simply of a little salt and water, in a very small tumbler glass. "Battery" is a very misleading name in these days. This, with all its belongings, is really not worth sixpence, and it certainly seems a piece of pedantic magniloquence to call it a "battery."

The wires from this battery are so arranged that the current may divide itself between the cable that is round the room and this box of "ohms."

It may perhaps make the illustration more intelligible to those who have not familiarised themselves with terms of electrical science if for a while this current be regarded as consisting of passengers. Let it be represented by 100 passengers setting out from this battery, and having the choice of two routes, viz., one by the cable, and one by this box of ohms.

If the two routes are equally free, *i.e.*, offer equal resistances, then fifty of these passengers will pass-by one way and fifty by the other. Suppose that the resistance of one route (say the cable) is greater than that by the other route. Then that other route, or the way through the box of ohms, will be available for some of those passengers who cannot readily pass by the cable. Here is a wire connecting these two routes; indeed the large letter A may convey a clear idea of the plan. Consider what is likely to happen if fifty of these electrical passengers set off from the top of the A down the thick stroke, and fifty down the thin stroke. We may say that those passing down the thin line cannot pass so freely as those down the thick one. Hence finding the course down the thick line clear, some of these delayed passengers by the thin line may avail themselves of this cross-wire bridge, viz., the stroke in the A, and go to the place appointed for them by passing down the thick stroke. In this homely illustration the thin stroke is the cable—the thick stroke is the box of ohms. Clearly by moving these brass pegs, the resistance in the box of ohms is increased; that is, the thick stroke of the A is made more nearly the same as the thin stroke. Now introduce into this cross-way—this bye-path, as it were—the galvanometer. Then if any electrical passenger avail himself of this bye-road, the bright speck of light will tell the tale, and by noticing whether the speck moves to the right or left, the direction in which the passenger travelled is known, and therefore the electrical pathway which offers the greatest resistance is also known. By moving the pegs in the box of ohms, an equality of resistance may be established, and then passengers will not pass along the bye-way through the galvanometer; therefore the speck of light will not move.

Nor is this indication of an electrical traveller the only use which may be made of the galvanometer speck. You are aware that the extent of deviation of this needle is the measure of the quantity of electricity in transit; therefore the extent of deviation tells the number of passengers; in fact, the galvanometer becomes an electrical tell-tale turnstile for counting the number passing through, and so indicating or measuring the difference in resistance between the two courses.

Let us leave this figurative mode of expression. In the experiment before you the pegs in the box of ohms read 505; the speck of light is steady; therefore we know that the entire length of cable, of which the two ends are here, also offers a resistance of 505. Before this cable was laid a comparison with these ohms had been instituted, and it was found (say) that one mile of the cable offered a resistance to the passage of electricity equal to one ohm, therefore there are 505 miles of cable, because there are 505 ohms.

Now let us break the cable by cutting the wire. There! one end has fallen to the bottom of this large pan of salt and water. This pan must, for the present, be looked upon as an Atlantic Ocean, one end of the cable is at the bottom of it, and we wish to know how far from the end in my hand the separation has taken place. To compensate for the portion of the cable hitherto used, but now detached, the earth is available this sheet of copper, in and on the shore of our Atlantic Ocean, is buried. Soldered to the copper is a wire, o which the end is in my hand.

There are therefore in my hands the ends of two wires; one, that of the broken cable—the other, that connected with the buried sheet of copper. Let us deal with them as we did with the complete cable. [After various trials the pegs in the box of ohms were so arranged that the speck of the galvanometer was steady.] The speck is now steady, and the pegs read 350. This means that there are 350 miles of cable, or its equivalent. Now, the cable and the earth are the only elements on the one side; and since the earth is as a large reservoir of electricity it offers no appreciable resistance; hence the only resistance is that of the broken cable. The length of this is pointed out as 350 miles; this, therefore, is the distance of the fracture from the shore.

It is perhaps superfluous to state that many circumstances arise differing from those described, and many precautions have to be taken to which no allusion has been made. If, however, the general principles be made clear, that is accomplished which was intended to be done, and those who are desirous of further information may consult the higher class of books which treat on practical telegraphy. It may be of some interest to let you see how delicate and perfect a test even this loaded galvanometer speck is. One or two illustrations will show how electrical currents are set in action when we are at least aware of them.

Here is a small piece of zinc, like the blade of a penknife, attached to one end of a wire passing round the galvanometer; and here is a piece of copper attached to the other end. The zinc is now pushed into this apple. Observe, the speck moves so soon as the copper enters the apple. Repeat the experiment with a potato; the same phenomenon takes place. The potato forms a very good battery. There is another mode that is really more extraordinary still. If the galvanometer were sensitive, it is no fiction to say you can send a kiss across the Atlantic. Here are two little bits of zinc and copper attached to the ohms and cable combined as one length, and the galvanometer is now in circuit with them. If I kiss these two ends the speck moves. Therefore that mysterious something which is called electricity, and which has its origin at the lips, has exerted an energy sufficient to move the needle; indeed, sufficient to travel by the cable from one side of the Atlantic to the other, and move a needle when it arrives there.

Again, here is a small beef-steak and a knife and fork. These latter are connected by two thin copper wires with the galvanometer. One wire is attached to the blade of the knife and the other to the prong of the silver fork; by watching the speck you see that even one mouthful of meat cannot be cut without causing a current of electricity quite sufficient to manifest itself on the other side of the Atlantic.

Thus, surrounded by ever-active phenomena, which seem to have escaped the notice of men until the present age, he would indeed be more bold than prudent who ventures to speak confidently of what may or may not be done by one or other of the energies of the imponderables. How novel and delicate are the instruments employed, how accurate are the measurements obtained, and how marvellous are the uses to which electricity has been applied; yet these are not consequences of a blind rule-of-thumb following of that which has been long known. Patient research, persevering labour, and much thought have not only "put a girdle round the earth," but they promise fair to enter upon and possess electrical territories of vast extent and luxuriant social fertility. When will the people of England recognise this? Echo answers, "When!"

ANNUAL INTERNATIONAL EXHIBITIONS.

The Council, having been informed that her Majesty's Commissioners do not intend to publish Reports on the different departments of the Exhibition of the present year, and looking to the great importance to Arts, Manufactures, and Commerce that these annual displays should not pass away without some record, have decided to undertake that duty, and for this purpose have engaged the services of gentlemen specially skilled in the subjects of the several sections, to prepare such Reports for publication in the Society's *Journal*. The Council, however, desire it to be understood that, in publishing these reports, they do not necessarily adopt all the views expressed in them, which must be taken as those of the writers only.

The following report is the fifth that has been issued. The remainder will appear as soon as they are complete.

REPORT ON FOOD PRESERVATION.

CLASS XII.

(Including Refrigerators.)

An exhibition of substances used as food must necessarily be incomplete, unless it can be daily supplemented with displays of the three articles of daily consumption—bread, meat, and vegetables. How far such a display might be arranged for on a future occasion we will not now stop to inquire. The food exhibited on the present occasion, in accordance with the ten-years' cycle arranged by the Royal Commissioners, may be divided technically into three divisions—namely, Grocery, Drysaltery, and Preparations of food; and these will include the chief forms of food exhibited, such as teas, sugars, spices, fruits, cocoa and coffees, confectionery, biscuits and bread stuffs, Italian warehouse goods, and preserved meats, the last term comprising "fish, flesh, and fowl." Thus the food presented to us is mainly in a dried, manufactured, or preserved form. It is with the latter that the present paper is concerned, requiring as it does special explanation, in consequence of the great bulk of it being hidden from the eye in tin cases, and therefore possessing but little interest to passers by.

The preservation of flesh, including that of fish and fowl, has for many years engaged much attention. As long ago as 1691, John White and William Porter obtained a grant from the Crown to hold and enjoy for fourteen years the sole right of preserving animal food, which they warranted would keep sweet for any number of years in any climate. But the process does not seem to have produced any great result, nor was much progress made in the matter in the eighteenth century, during which only three patents are described. In the first half of the present century nearly a hundred patents were specified; but since the year 1850 they have been greatly multiplied, at the present time numbering many hundreds, though in numerous instances only varying in detail, and not in principle.

The several methods of preserving flesh may be classed under four heads:—

1. The simple process of Drying.
2. The use of Cold.
3. The use of chemical Antiseptics.
4. The expulsion by Heat of atmospheric air.

The *Drying* process is a very old one, and probably almost contemporaneous with man, either as an herbivorous or carnivorous animal. But it can hardly be looked upon as a scientific one in connection with food preservation, though a large number of patents have been taken out for its application. The expression of water from animal and vegetable substances by artificial means, or their dessication by exposure to the sun or hot air, leaves their fibre and a great part of their dried juices in such a state that they are incapable of destruction by the natural process of decomposition, and only affected by time, like other inorganic matter. Thus we can, at the present moment, see dried poultry in the British Museum, which has been taken from Egyptian tombs, where it was placed some thousands of years ago. Charqui, or South American beef, is the form of dried meat best known, perhaps, in this country; but we do not notice any specimens of it in the Exhibition. We have, however, samples of dried and powdered meat, in the form of meat biscuits, and combined with dried vegetables, in solid soup squares. These are exhibited by Messrs. Whitehead, of Lime-street-square, E.C., whose various productions in this line have thoroughly established themselves through their excellency as well as cheapness; by Geylin, of Argyle-square; by Messrs. Hewetson and Co., 17, Harp-lane, E.C., whose solid cakes of pea-soup, in the shape of large night lights, are valuable contributions to this kind of preserved food; and by Mrs. Warriner, of Sonderburg-road, Seven Sisters'-

road. Mr. J. Johnston, of 1, West Newington-terrace, Edinburgh, also exhibits beef powder and "Ebswurst," or portable soup, as supplied to the Prussian troops in the late war with France. Dried and compressed vegetables, combined with dried beef, and in a simple form, are also exhibited by Messrs. Whitehead, Messrs. Gillon, of Aberdeen, and other Scotch preserving firms. We often wonder that these vegetables, in their simple dried and compressed form, are not more widely used in our households for soup-making purposes. They are very cheap, there being no waste in their use; and but little of their flavour is lost in the process to which they have been subjected.

Of food preserved by means of *Cold* we have no specimens, with the exception of a joint of meat, some fish and butter, in one of the refrigerators exhibited by the Atmospheric Churn Company, of 119, New Bond-street, which can be seen through the plate-glass doors of the safe. But this is only a partial or temporary preservation of food. That animal flesh can be preserved by ice, for an almost indefinite period, is well known. Animals have been found in a perfect state of preservation in the Arctic regions, where they *must* have been buried for centuries. Some few years ago the entire body of a mammoth was found in the frozen soil of Arctic Siberia, where it must have been for ages. In Russia, Canada, and other northern countries, it is a common practice to slaughter fat animals and preserve their carcases, by burying them in the ice or frozen earth, from the middle of November to the early part of May. Our markets are supplied with fish and poultry, especially in the winter months, packed in ice from many different countries, and it is only the cost of natural, and even of artificial ice, which prevents our obtaining fresh uncooked meat from Australia, South America, and elsewhere. Probably the time is at hand when still further improvements will be effected in the artificial manufacture of ice, and vessels will be constructed to act as floating ice-houses, and convey fresh joints of meat to our shores, capable of being retailed at a third, or at least one-half, the price we are paying for ordinary butchers' meat. But then it must be remembered that such must be consumed within a short time of its landing, as it tends to decay much more quickly than ordinary meat when brought into a warmer atmosphere.

While speaking on the subject of the preservation of food by means of cold, it may not be out of place to add a few remarks on the Ice safes and Refrigerators exhibited in the Eastern Quadrant. Among these, a conspicuous object is the ice safe with plate-glass panels in the doors, showing the large block of ice in the right-hand compartment, with a shelf for bottles and decanters above it, and the provisions on the left. These latter generally comprise a leg of mutton, butter, and fish; a salmon cutlet, with prawns round it, being exhibited on the occasion of our visit. These articles of food will remain sound and sweet for many days, during the hottest weather; and that the food-chamber is perfectly dry is shown by the fact that the lucifer matches which lie on a plate in the same chamber will light when struck against its sides, the ventilation being kept up by holes pierced in the sides. This safe is exhibited by the Atmospheric Churn Company, 119, New Bond-street, who also show freezing and ice-making machines, the practical working of which is demonstrated by an attendant; and visitors can taste the admirable results produced. Messrs. Chevasse and Co., 505, Oxford-street, exhibit one of their "dry cold-air" refrigerators (Clifton's patent), the chief feature of which is that the ice-chamber is at the back, and from it the cold-air is communicated to the food-chambers by means of two valves, which by the action of a rod open when the doors are closed, but close when the doors are opened. Thus, any large bulk of external air is prevented from entering the ice-chamber when the doors are opened, and when closed a circulation of cold air is effected by the two valves, which circulation can be increased by means of ventilators in the food-chambers, which can be opened or closed at pleasure. Messrs. Howe and Shoppee, of Pancras-street, Tottenham-court-road, exhibit one of their "Arctic Ice Safes," which does not pretend to be constructed on any new scientific principle; but the inside being lined with white glazed porcelain tiles, which have the advantage of being non-conductors of heat, presents a very nice appearance, and is capable of being easily and effectually cleansed. The Piston Freezing Machine and Ice Co. show several articles of their manufacture, for which they are so justly celebrated, Mr. Ash, whose various patents are their property, being well-known for his scientific knowledge of all matters connected with refrigeration. His most recent patent was taken out last November; and his "Self-feeding Cabinet Refrigerator" is an excellent article. In this he seems to have attained a great desideratum, in the fact that the lowest temperature is maintained throughout the safe till the block of ice is almost entirely consumed. This is effected by the bottom of the ice-hopper or compartment being constructed on an inclination of about 30 degrees, so that one face of the ice, as it dissolves, presses equally on one side of the metal division of the safe, and as it decreases, on a still larger superfices, a V-shaped well receiving it gradually. This principle is applicable both to block ice and rough ice, though the safes for each are constructed somewhat differently. We next come to speak of the exhibits of Mr. Kent, of 199, High Holborn, so well known for his production of various articles of domestic utility. He shows various sizes of his Patent Ventilated Ice Safes and Refrigerators, among which we notice the "Restaurant Ice Safe," divided into five compartments with as many doors, so that each can be got at without disturbing the others; and a Patent Bottle Refrigerator, which must prove a very useful article for licensed victuallers and confectioners, as each bottle can be separately withdrawn when required. In 1868, Mr. Kent patented his "Ventilated Ice Safe," the chief feature of which is that, by means of a ventilator at the top of the safe, the external air is introduced in the ice chamber, or, as it should be expressed in this case, the ice "cradle," with apertures in the sides, and so conducted through the safe, finding its exit through an aperture at the bottom. We are not about to enter into the "Battle of the Refrigerators," or into a discussion as to who is to be credited with the now acknowledged principle of ventilation, in order to keep articles of food untainted in refrigerators, but we think it due to Mr. Kent to say that he was the first to thoroughly develope and establish the principle. In his patent safes he has further improved upon it by constructing them on the known fact that cold air is heavier than warm air, and therefore descends. Thus, by making a ventilator at the top, and in immediate connection with the ice cradle, he purifies the atmosphere before it reaches the provisions, intercepting all particles which would otherwise settle on them and hasten decay. This "downward draught" is the main principle of his patent, and is carried out in no other refrigerators we have seen; and that it is not a mere theory can be easily ascertained by placing a lighted taper at the lower aperture, when the flame is seen to be driven from it, and still more effectually by filling the safe with smoke, which will escape by this aperture, without a particle finding its way out through the ventilator at the top. In these safes a fresh-killed leg of mutton may be kept for more than a fortnight, in a temperature of from 40 to 45 deg.; cream will keep sweet for more than a week; and a sweetbread, which butchers know turns bad in hot weather more quickly than any other meat, will keep good for nearly a week. With the refrigerators is exhibited a model of the large ice-room constructed in the Peninsular and Oriental Company's ship *Cathay*, showing how carefully and regardless of expense the Company provides for the comfort of their passengers; also a model of Brainard's patent ice-house (4, South-street, Finsbury), as used in America and on the Continent.

The use of *Chemical* agents, called antiseptics, in food preservation, has been attempted in various ways, but with partial success, the agents employed giving more or less an unpleasant flavour to the substance to which they have been applied. Foremost among these agents is common salt, which has been used from the earliest times; but it tends, to a great extent, to extract the soluble constituents of meat, depriving it of its stimulating and nutritious elements, and rendering it hard and indigestible. The constant use, too, of salted meat has most injurious effects, as was shown by the prevalence of scurvy in our Royal and Mercantile marine, before fresh-preserved meat and preserved vegetables were supplied to them. Other saline substances, such as saltpetre, acetate of ammonia, sulphite of potash, or soda, muriate of ammonia, &c., have also been employed as preservative agents, but by no means successfully, though several patents have been taken out for their use. Moreover, bisulphate of lime, sulphurous acid gas, and dilute sulphuric acid, have been employed in various ways towards bringing about the desired end; but notwithstanding our advanced state of chemical knowledge, it cannot be said that the use of chemicals has given us a fresh meat, that is in an uncooked state, acceptable to the taste. A learned professor has made experiments in subjecting animals to a chemical process, even before death, with a view to the after-preservation of their flesh. They are caused to inhale carbolic oxide gas, which renders them insensible in about two minutes, when they are killed, and their carcases hung in a chamber full of carbolic oxide and boxes containing charcoal charged with sulphurous acid. Those who, like Dr. Johnson, often "take a walk in Fleet-street," may have noticed from time to time, hung at the entrance of a well-known shop, the carcass of a pig, labelled "A Perfect Cure." The cure has been undoubtedly "perfect," and caused either by the inhalation before, or injection of some chemical at the time, the animal has been "stuck," which has been powerful enough to permeate the entire frame, so that the bones, hoofs, and hair have been impregnated with it. But the result of the process has in reality been too perfect, the chemicals being decidedly traceable in the taste of the flesh so cured. Of meat preserved by antiseptics we do not notice any samples in the Exhibition, and it is doubtful whether, by the use of chemicals alone, the object in view can ever be satisfactorily attained.

We now come to the fourth process of preserving mentioned, namely, by the expulsion of atmospheric air. This is effected by the application of *Heat* to the substances to be preserved when placed in tins or other receptacles. Without entering into a scientific controversy as to whether the true theory of this process of preservation by applied heat may not be that the "microscopic germs," which are alleged to cause putrefaction, are destroyed, we shall take it for granted that the oxygen gas is entirely expelled by the heat, not only from the receptacle in which the substance has been placed, but from the substance itself. That this is the case may be deduced from the fact that the tins containing the preserved food show a concave depression on top and bottom, and some even "collapsed" sides—an evidence that a perfect vacuum has been obtained, as is also the audible rush of external air into the tins, when the opening knife is first inserted. The breakages also of earthenware and glass jars, the former of which were once extensively used in this process, tend to establish the same conclusion. But, however this may be, it really matters not. It is certain that the preservation of both animal and vegetable substances in a cooked state by this method is perfect, the only objection to the process being that in the majority of instances an over-cooking of the substances seems unavoidable. The process may be thus briefly described. The meat, fish, poultry, or vegetables are put into tins of various sizes, and then placed in "baths," which are raised to a temperature considerably above that of boiling water by the addition of chloride of calcium, a small orifice being left in the lids for the escape of steam; or hermetically sealed, they are entirely immersed in the baths, being let down into them on iron frames or "gridirons," by means of cranes; while in some cases only salt is added to the water, and in others steam-ovens are used. But the object and result are the same. In the chloride of calcium baths, where the tins are not immersed, the small "pin-holes" are soldered up when the cooking is completed; but when they are entirely immersed, they are drawn out of the baths once, twice, or even three times, according to the size of the tins and the nature of the substance to be preserved, and the small apertures in the lids, which have been previously made, but soldered over, are opened by touching the spot with a hot-iron, and, after the steam has escaped, and before the external air can re-enter, again closed. Thus, though there are various modifications of the process, which takes from one to three hours for its completion, it is substantially the same in all cases, and is known by the name in this country of the "Aberdeen process," though to M. Appert, of Paris, must be attributed the credit of having really established it, in 1810.

We now proceed briefly to direct attention to those firms who have sent samples of their preserved provisions to the present Exhibition, where they are displayed in the Western Arcade. As might have been expected, from the fact that Aberdeen has been the centre of the food-preserving trade for many years past, the Scotch preservers make the greatest show. To enumerate the various articles which are displayed in the different cases, and on the side stands, would fill a volume, there being hardly any form of fish, flesh, fowl, and vegetables which is not shown, or at least the tins which enclose them. The trade lists of any of the great preserving houses would give the best idea of the extent to which this branch of trade has been carried, and of the numerous forms of preserved food which are so plentifully used by those who "go down to the sea in ships," by travellers on land, sportsmen, and by others who have not a ready access to shops, and which, we may add, might be used to much greater advantage than is now the case by those who have.

The most conspicuous display of preserved food in the West Quadrant is that of Messrs. Moir and Son, of Aberdeen, which city has for many years past been the head-quarters of the food-preserving trade, owing mainly to the fact that the best beef and mutton in the world, as well as large quantities of fish, can be obtained there at the cheapest rates. Having recently paid a visit to their establishment, and spent some hours in inspecting every branch of manufacture there carried out, we can testify that only the best articles are employed for the purpose, and the utmost care and cleanliness observed in their manipulation. The firm was established as long ago as 1822, directing its attention at first chiefly to the preservation of salmon for the foreign market, but soon after adding other kinds of fish, meat, poultry, soups, and vegetables, as well as fruit preserves, and a variety of potted meats, which at the present time cannot be exceeded for excellence. As a proof of this, it may be mentioned that Messrs. Moir's goods have for some time commanded a higher price in the markets than those of any other house. The establishment in Virginia-street, Aberdeen, covers a large area of ground, and employs nearly 250 hands. The quantity of meat preserved has reached as much as two millions and a-half pounds in a year, but recently, on account of the great increase in its price, more attention has been paid to the preservation of fish, poultry, and game. To give some idea of the enormous trade done by this house, it may be mentioned that during last year no less than four millions and a-half pounds weight of provisions were put up in tins; and for the present fishing season Messrs. Moir have already orders for 400,000 1-lb. tins of herrings alone. We are glad to find that this firm has recently opened a branch establishment in Commercial-street, Whitechapel, and that their goods will shortly be seen in a very large number of grocers' shops in the Metropolis and its suburbs. If housekeepers would take the trouble to make themselves acquainted with the contents of their tins, especially those of various soups, they would find that their cheapness would tend materially to lower their household expenses, to say nothing of their intrinsic excellence, and the convenience of being able to put a dinner of several courses on table at a few minutes' notice. It is very seldom, indeed, that the contents of any of these tins are found bad, though this may sometimes happen through the tin having become damaged by some accident, and consequently the atmospheric air having found entrance. As a rule, they remain perfectly sound and sweet as long as the tins remain air-tight. When at Aberdeen, we saw opened a tin of beef which had been put up during the Crimean war, and its contents were as sound as when they were first placed in it; and in Messrs. Moir's stand in the Exhibition, which, by the way, is one of the handsomest in the whole building, may be noticed a 3 lb. tin of soup and bouilli put up in the year 1834, and a 6 lb. tin of beef bouilli sent to the French army in the Crimea, and re-purchased after the war. Messrs. Hogarth, of Aberdeen, exhibit specimens of food preserved in glass jars, including English and Australian beef and mutton, a large variety of fish, soups, made dishes, and vegetables, thus enabling us to see how such preserved food would really look if the tin plates were as transparent as glass. Many persons have a prejudice against preserved food in tins, and decline purchasing it on the ground that it is not good policy to "buy a pig in a poke." Messrs. Hogarth enable such persons to see the pigs in the poke, and their appearance will probably do much towards overcoming a foolish prejudice. Messrs. Whitehead exhibit their Australian meats, in which they have recently effected an improvement by preserving the fat in a more natural state than is usually the case, the ordinary process of preservation tending to reduce it almost to dripping. On their stand will be seen the solid soup squares already mentioned, cakes of dried and compressed vegetables, and a most excellent solid essence of beef. The Ramornie Company of Crutched Friars, the first public company established in London for the sale of Australian preserved meat, have a large display; and it is not too much to say, that from their first establishment, up to the present time, the uniformly good quality of their meat has given them a position in the market to which they are fairly entitled. Their Australian mock-turtle, oxtail, and kidney soups are most excellent, as are also the ox-tongues and palates, rump-steaks, minced beef, and beef stew, all of which are now very largely consumed. Passing on westward, along the southern side of the quadrant, we come to the varied display of Messrs. J. M'Call and Co., 127, Houndsditch, agents to the Melbourne and other meat-preserving companies, whose goods they exhibit, as well as some beef from Uruguay. We notice on this stand Kangaroo-tail soup, Kangaroo and bacon, and Kangaroo à-la-mode; and we would strongly recommend all, who like Jeames de la Plush, are wearied of the changes rung on beef and mutton and pork, and long for some "new hanimal to be invented," to try this marsupial. We make bold to say that those who will experimentalise on it will not be disappointed, unless they allow their fancies and prejudices to get the better of their palates. Messrs. M'Call and Co., being also preservers of meat, fish, poultry, soups, and vegetables, after the "Aberdeen process," show a variety of their goods, among which we notice turtle-soup in tins, which contrasts very favourably as regards price with that sold by confectioners and the large London dinner-providing firms. The quality is excellent, some being made from the live turtle brought to this country, and some from the flesh of the turtles killed as soon as caught and dried in the sun. Strips of this are exhibited, having somewhat the appearance and consistency of thin cakes of glue, those taken from the back of the turtle being the calipash, those from the belly the calipee, which is of a somewhat lighter colour. They require soaking in water for two or three days before they can be made into soup; the process of drying and soaking, however, taking from them nothing of their real nutriment or flavour. Before leaving this stand, the "ring" dishes, invented and patented by Mr. John M'Call, should be noticed. They are made of earthenware, and of two sizes, which exactly receive either two or or four pounds of meat, as turned out from the tins. Their object is to keep the meat together, and render it more easy of being carved into thin slices, the rings being removable one after another as the meat is cut down to them. These dishes are very ingenious, and admirably serve the purpose for which they are intended. We next come to Bennet's (Melbourne) meats, and those of the Ballarat Meat Preserving Company, whose agents are Messrs. Kaltenbach and Schmitz, of 1, Alderman's-walk, Bishopsgate. In a glass stand by themselves are tins containing curried fowl, put up by Mr. J. Halford, of 12, Upper-street, Martin's-lane, once *chef* to a former Governor-general of India, and, therefore, likely to be well acquainted with all the mysteries of curry preparations. Mr. Halford has certainly turned his knowledge to account, having produced one of the best forms of preserved food which have as yet come under our notice. Receiving, as he does, the fresh herbs (so essential to a perfect curry) in tin cases hermetically sealed from India, he is enabled to produce a curry which the most fastidious Anglo-Indians must pronounce perfect; and to endorse its goodness, it is only necessary to add that Messrs. Fortnum and Mason and Messrs. Crosse and Blackwell have it already on their lists of goods. Moreover, as a tin containing a single fowl can be bought for 4s. 6d., and two fowls for 7s. 6d., the price of this form of food contrasts favourably with those of ordinary fowls obtained from a poulterer's. The contents of these tins can be warmed in ten minutes, and, with the addition of rice, are then ready for the table. The display of Messrs. Gillon, of Leith (whose agent is Mr. House, 76, Minories), comes next, and consists of a variety of samples of preserved provisions similar to those shown by Messrs. Moir and Co., and Messrs. Marshall, another large preserving firm at Aberdeen. Messrs. Gillons' establishment we also visited when in Scotland, for the express purpose of investigating this particular branch of manufacture. It has been in existence since 1817, and now employs 150 hands; and we can in this case also bear witness to the excellence of the various articles used for preservation, and to the extreme cleanliness with which all the processes are conducted. The essence of beef produced by Messrs. Gillon has gained for it a well-deserved reputation, being not only a stimulant, which is the chief feature of the late Baron Liebig's production, but a powerful nutriment. It is, as Professor Christison has testified, "much in the same category as beef-tea;" and he adds, "no good beef-tea can be made so cheaply as with this meat-juice, a tin of four ounces making sixteen of strong beef-tea." The mutton and chicken juices, prepared after the same process by this firm, are invaluable in cases of serious illness and convalescence, and can be advantageously used in the preparation of soups and broths. Like other Scotch firms, Messrs. Gillon put up a variety of national dishes, such as Scotch broth, cocky-leekie, hotch-potch, sheep's head and trotters, and haggis, which are sent from Leith to all parts of the world, so that Scotchmen in all climes can be gastronomically reminded of the culinary delicacies of their native land; and Englishmen, too, perhaps for the first time in their lives, make acquaintance with Caledonian luxuries. Of Messrs. Gillon's firm we may add, without wishing to cast any reflection on others, that it has for years enjoyed the good name of always giving full weight and measure. Returning along the north side of the quadrant we come to the array of white-painted and blue-labelled tins of the Food Preserving Company (late Forbes and Co.), of Aberdeen, and 99, Houndsditch, who put up most of their goods by Jones' Patent Process. The feature of this method is the application of tubes to each tin when in the bath, whereby they are connected with a vacuum, the tubes meeting at a tap close to the vacuum chamber. By turning the tap once, twice, or thrice during the time the tins are in the bath the air is drawn from them, and thus the duration of the time of cooking is diminished, and consequently, to a great extent, the over-cooking of the article to be preserved is avoided. This process has more than once been discussed before the Society of Arts, which has expressed a very favourable opinion of it; and certainly the results obtained seem considerably in advance of the ordinary processes, the meat, fish, and poultry being firmer and more like ordinary cooked articles—the fish especially turning out very dry after it has been years in the tins, which is not the case when it has undergone the usual "Aberdeen process." Some months ago we were shown samples of Australian meat preserved at the Queensland Company's manufactory by the use of this patent, and it certainly struck us as superior to any we had before tasted. Mr. P. Forbes, whose services have been retained as manager to the Food Preserving Company, went out to the River Plate last November, taking with him a small plant and some old Aberdeen hands, to thoroughly test the process on cheap foreign beef. From letters received, he seems most sanguine as to the result, and a consignment of the meat he has put up is already on its way to this country, samples of which will be added, on their arrival, to the display on the company's stand in the Exhibition. We notice that Mr. Anthony Trollope, in his recent work, recounting his experiences in Australia, mentions having had some beef set before him preserved by Jones' patent, and of it he says:—"What may be the specialities of Jones' patent I did not learn, but as to that special joint, I protest that I never ate better cold roast beef in my life. It was not overcooked, and, judging from its colour, appearance, and flavour, it might have been cooked and put into the larder on the previous day." We witnessed the working of this process during our visit to Aberdeen, and can fully certify that it draws no nutriment, as has been alleged, from the substance in progress of preservation, the condensed liquid, which came from the vacuums when the process was complete, not having the least perceptible taste either of the beef or fowls which we saw subjected to the operation of this patent. A model of the apparatus used is exhibited in the eastern quadrant. Passing by the stand on which M. Chauffourier, of Sackville Street, exhibits some of the best brands of sardines, patés, and terrines de foies gras, and other preserved delicacies, we come to a display of various preserved forms of that delicious little fish, the anchovy, sent by Mrs. C. C. Myhrvold, 9, Kirkegadon, Christiania, Norway, who also exhibits Scandinavian butter. H. C. Bergstrom, of Lysekil, Sweden, contributes to the Exhibition in a similar manner; and both vie, in the excellence of their articles, with John Burgess and Son, of 107, Strand, of almost world-wide fame, who also have an interesting display of anchovies preserved in a variety of ways, an oaken tub with a glass bottom showing silvery rows of this appetising fish in an appetising form, being a conspicuous object. The next attraction are the bright red tins of Mr. D. Tallerman (113, Cannon-street, Australian Meat Agency), to whom the credit must be given of having been most energetic in bringing the claims of Australian preserved meats before the English public, and of having in various ways removed the prejudice against them. He exhibits the goods of the Adelaide Meat Preserving Company, of which he is the agent, as also those of other companies, the specially guaranteed meats being branded with the label of the Australian Meat Agency. A specialty exhibited by Mr. Tallerman is spring lamb, with the bone in it, the great excellence of which we can vouch for; but, notwithstanding the delicacy of this article, we should almost be sorry for it to become very popular, as it might lead to an undue slaughter of lambs in the colonies, and tend to bring about a scarcity of mutton, even though Australian flocks seem inexhaustible. There can be no doubt but that the demand for lamb and veal in this country has had not a little to do with the increased price of beef and mutton. But Mr. Tallerman's enterprise has led him not only to be content with an exhibition of the preserved meats in tins; he is also at a considerable expense, in the western part of the building, daily exhibiting the process of meat preserving by the use of the chloride of calcium bath, a succession of tins being filled, placed in the bath, soldered up, and labelled during the day. The gentleman who superintends the management of this work for Mr. Tallerman is well versed in all the different processes of preservation, and is always happy to give all the information in his power concerning them to those really interested in the subject. In the centre of the Western Quadrant will be noticed a case containing samples of Tooth's (Sydney) Liebig's extract of meat, now used in almost all English households; and another of fluid meat, exhibited by Messrs. Darby and Gosden, of Leadenhall-street, which is, we believe, meat partially and artificially digested by pepsine; and, being thus "eating made easy," is recommended by many eminent medical men for invalids with weak digestion.

Condensed milk has of late become a very important article of preserved food, and is now largely manufactured for the English market by the English Condensed Milk Co., 96, Leadenhall-street, and by the Anglo-Swiss Co., both of whom exhibit their goods. Samples also are exhibited by Mr. J. Hooker, of West Horsley, Surrey. The difficulty of obtaining pure milk in London and other large towns, and even in country districts, has led to a large consumption of this article, which is obtained by evaporating the greater part of the water, which constitutes about 80 parts in 100 in natural milk, and by the addition of sugar, in order to preserve it. We have seen the process from beginning to end, as carried on at the English Company's works at Aylesbury, and more recently at their newly-erected manufactory at Middlewich, in Cheshire, which we visited a few weeks ago. The milk is received from the farmers early in the morning, and, being placed in large, open metal cylinders, is first subjected to a hot bath, after the manner of tins of meat in the preserving process, though not at so high a temperature. It is then emptied into large funnel-shaped vats, whence it is drawn up through a pipe in the centre into the condensing-pans. The sugar having been mixed with it, it remains in these pans, subject to a somewhat low heat, for two or three hours, while the evaporation of the water is taking place and the milk gradually condensing. When it has assumed the consistency of liquid honey, it is received again into the open cylinders, and is then subjected to a cold bath, after which it is run into the tins and hermetically sealed. The process, in one sense, is simple enough, but it requires the greatest nicety during the whole operation, and a most careful regulation of the temperature. The company, by a variety of tests, insures the delivery from the farmers of sound and genuine milk; and the article produced is, therefore, genuine milk, *minus* a large quantity of water, *plus* a little sugar. That it is pure milk, with a large proportion of water evaporated, has been proved by the most scientific analysts, the caseine, butturous, and other solid and nutritive substances remaining intact in their original form. This can be further demonstrated by adding to the condensed milk the equivalent of its original water, say three parts water to one of the condensed milk, and leaving it to stand in an ordinary milk-dish, when it will raise its cream in very nearly the usual proportion, though this action is somewhat impeded by the presence of the sugar. It will also churn into butter when raised to a temperature of about 60 degrees. Its excellence as an article of food is still more practically demonstrated by the fact that infants can, from their birth, be supported for many months upon it, without the addition of any other kind of food; and its uniformity gives it an advantage even over natural cow's milk. The products of the English and Anglo-Swiss companies are substantially the same, their analyses giving nearly the same result. A paper on the subject of condensed milk was recently read before the Society of Arts, by Mr. L. P. Merriam, the manager for this English Company, and reported, with the discussion which followed, in the Society's *Journal*. The English Company also exhibit their cocoa, chocolate, and coffee combined with the condensed milk, all of which articles have secured a large consumption, and are admitted to be most wholesome and pleasant beverages. The case in which these articles are exhibited is a handsome hexagonal structure, standing on the right-hand side of the Western Quadrant, after passing the entrance to the Albert Hall.

We have now enumerated the chief articles of preserved food shown in the Exhibition. If the names of any firms and companies which ought to have been mentioned, have been omitted, it must be attributed to inadvertence, and not to an intention to withhold their due from any. The public will remember that all who have exhibited have done so only with the sanction of the Food Committee, acting as the advisers of the Royal Commissioners; and thus, the mere fact of exhibiting is a testimony to some special and ascertained excellence in the goods of the exhibitors.

It is greatly to be regretted that, owing to difficulties with the refreshment contractors, no articles of food, with a few exceptions, can at present be tasted by visitors to the Exhibition. We will hope that, before it closes, some satisfactory arrangements may be made, whereby exhibitors may be allowed either to give away or sell their goods, for tasting in the buildings. Unlike almost all other objects of exhibition, food, especially in the form here displayed, does not appeal to the eye. For all that visitors can know, the piles of tin cases and jars may be only dummies. The Committee on Food are the only persons cognisant of their contents, and others must take them on trust. A Food Exhibition can only be really interesting when the public can taste samples of the exhibits. As wine has been deferred until next year for exhibition, when the Royal Commissioners will make arrangements, on a large scale, for the public to taste it, the contract with Messrs. Spiers and Pond coming to an end this year, we would endorse the suggestion that the whole subject of food should be re-opened on the same principle. Many firms have declined to exhibit food on the present occasion, simply because the public were to have no facilities for tasting. The only wonder is that the Food Section is as interesting as it is; and for this we have mainly to thank the Deputy-Commissioner, Mr. E. J. Craigie, through whose exertions, assisted by the Food Committee, the display has been got together, and to whom, as Secretary to the School of Cookery, the Exhibition is chiefly indebted for the organisation of one of its most interesting and justly popular departments.

Since the above remarks were in type the Russian annexe has been opened, and we find in it several interesting articles which come under the heading of Preserved Food. There are dry tablets of meat and game prepared by Wladislas Kleczkowski, the well-known provision merchant of Wologda, which, for the excellent flavour of the soup to be made from them, and for their cheapness, are likely to attract attention in the trade. Kittarg's packets of dried vegetables, composed chiefly of potatoes and mushrooms, are also very cheap, and most useful in the preparation of soups. Dried mushrooms on strings, after the fashion of American dried apples, strike us as a novel, as well as an acceptable article. The best range in price from 1s. 4d. per lb. upwards, while a kind which grows under the birch trees in forests can be sold as low as 4d. to 6d. Dried green peas are also to us a novel form of dried vegetables, and seem very cheap. Both these vegetables require to be soaked in water before using. The mushrooms can then be used in soups or stewed, or eaten, as is generally the case in Russia, with vinegar, before dinner, to give an appetite, as we (at least those of us who can afford them) eat oysters. A small fish, of the whitebait species, in a dried form, as also a coarser kind of fish, are exhibited; they may be used in soup, as in Russia, or simply warmed before the fire, when they make an excellent breakfast relish; and eaten cold they are very appetising. They remind us of the Newfoundland caplins in flavour, though much more delicate. Russia also sends us some specimens of cheese, very like the best Dutch product. Among other articles which are exhibited in this annexe, as "Substances used as Food," may be mentioned confectionery and a variety of cakes, as well as wines and liqueurs. Into them, however, we cannot now enter, as foreign to the present report. We would, however, suggest to those interested in wines to make acquaintance with the cheaper kinds grown in the Crimea. Altogether the samples of food shown in the Russian Annexe are well worth attention; and we may mention that the Russian Commissioner, M. Theodor de Lvoff, who is an excellent French scholar, is happy to give all required information concerning them.

In the Victorian Annexe there has also lately been displayed a variety of tinned meats and other preserved foods from Australia, including jams, cheese, hams and bacon, which are likely, eventually, to compete with similar articles produced in this country, or at least to supplement our home supplies. But the most important matter connected with the preservation of Australian meats is the experiment of preserving fresh uncooked meat in an ice-room, which seems to have been a complete success in the Victorian Exhibition at Melbourne, in 1872-73. Mr. G. Collins Levy, the commissioner for Victoria at the International Exhibition, has kindly communicated to us much interesting information on the subject, which is now fully explained in an able essay by Dr. John Bleasdale, who has taken up the subject, not only as an enthusiast but as a scientific and practical man. We do not now propose to enter into it, as a vessel is on her voyage to England with an ice-room fitted up on board, in accordance with Mr. Harrison's plans, and in charge of that gentleman. It contains 100 tons of meat, and there is every reason to believe that we shall in the autumn have delivered in London joints of beef and mutton as fresh as they were when placed in the ice-room, and which will keep as long before consumption, even longer, than ordinary butchers' meat.

The number of visitors admitted to the Exhibition on Thursday, July 10th, was as follows:—Season tickets, 133; on payment of 1s., 2,757; total, 2,890. On Friday, season tickets, 130; on payment of 1s., 2,822; total, 2,952. On Saturday, season tickets, 973; on payment of 1s., 3,983; total, 4,956.

The number of visitors admitted to the Exhibition during the week ending Saturday, July 12th, was as follows:—Season tickets, 1,736; on payment of 2s. 6d., 1,254; on payment of 1s., 14,881; total, 17,871.

The number admitted on Monday was, season tickets, 123; on payment of 1s., 2,699; total, 2,822. On Tuesday, season tickets, 129; on payment of 1s., 2,448; total, 2,577. On Wednesday, season tickets, 199; on payment of 2s. 6d., 945; total, 1,145.

EXHIBITIONS.

Vienna Exhibition.—The French Commission has at length issued its catalogue, printed at the Imperial Press of Vienna. That of the Fine Arts section contains 1,560 entries, of which 828 are of pictures and drawings.

Philadelphia Exhibition.—At Philadelphia, on Thursday, the 3rd inst., the President's proclamation, announcing that an International Exhibition would be held in that city in 1876, was publicly read. The President commends the Exhibition to all nations in the interests of peace, civilisation, and international friendship.

Victoria Exhibition.—The Government of Victoria has published, for circulation in the colonies and in Great Britain, an official record of the Exhibition of 1872, containing an introduction, reports, and recommendations of the experts, official awards of the commissioners, and essays and statistics on the social and economic resources of that colony.

Bradford Art Treasures and Industrial Exhibition.—This exhibition was opened on Wednesday last, July 16th, by the Mayor of Bradford, in the Theatre of the New Mechanics' Institute. The primary object of the exhibition is to effect the reduction of a debt of £5,000 upon the new building. The exhibition consists of a large collection of oil paintings, water-colour drawings, engravings, statuary, armour, machinery, &c.

The English engineers engaged on the Persian Railway project have completed the survey of the first fifty miles, viz., from Teheran to Kasvin, of the proposed line of railway from Teheran to Resht, on the Caspian. Part of them have left for Resht, to commence surveying thence towards Kasvin.

TESTIMONIAL TO MR. HENRY COLE, C.B.

On Friday last, July 11, a meeting was held at Willis's-rooms, for the purpose of promoting a testimonial to Mr. H. Cole on his retirement from connection with the Science and Art Department of the Privy Council, "in recognition of his useful, energetic, and varied labours." Amongst those present were the Marquis of Westminster (in the chair), Lord Granville, the Duke of Sutherland, Lord Houghton, Lord Cowley, the Duke of St. Albans, Lord Elcho, M.P., Sir Stafford Northcote, M.P.; Major Beaumont, M.P.; Sir John Pakington, M.P.; Lord Clarence Paget, Mr. E. Baines, M.P.; Sir Richard Wallace, M.P.; Sir Titus Salt, Mr. J. W. Henley, M.P.; Mr. Beresford Hope, M.P.; Lord Henry Lennox, M.P.; Mr. Mundella, M.P.; Sir Digby Wyatt, Sir Joseph Whitworth, Mr. J. E. Millais, Mr. H. Edwards, M.P.; Mr. D. Chadwick, M.P.; Mr. Bowring, M.P.; Sir Gilbert Scott, Mr. E. J. Reed, Mr. J. C. Macdonald, Mr. F. Leighton, Mr. P. Le Neve Foster, &c.

After some preliminary remarks by the Chairman, who dwelt on the ability and energy which Mr. Cole had devoted to the service of the country, Lord Houghton moved, and Lord Granville seconded the following resolution:—"That it is desirable, on the retirement of Mr. H. Cole, C.B., from the direction of the South Kensington Museum, to recognise in some permanent form his great services to the public." A committee was then appointed, and a subscription-list opened. Before the meeting adjourned a sum of upwards of £700 was collected.

THE SANDWICH ISLANDS.

A recent issue of the *Moniteur Belge* contains a report from M. Salvador Morhange, the Belgian Consul-General at San Francisco, which gives the following interesting particulars relating to the Sandwich Islands:—

The group, consisting of eleven islands, is 2,100 miles from San Francisco; 4,800 from Panama; 3,400 from Japan; and a somewhat greater distance from Australia.

In the largest island of the group, namely Hawaii, are the two celebrated living volcanoes of Mauna Loa and Kilauea, the former having an altitude of 13,763 English feet. The circumference of the crater measures about 18½ English miles, and the depth of the crater 781 feet. The crater of Kilauea, on the side of Mauna Loa, and at about 4,000 feet above the sea level, has a circumference of nearly nine miles, and a depth of 1,083 feet.

On the island of Maui is the largest crater which exists in the world; the volcano, however, has been extinct from time immemorial. The crater is situated on the top of Mount Haleakala, or house of the sun, more than 10,000 feet above the sea level; its circumference is estimated to exceed twenty miles, and the interior or funnel is no less than 2,500 feet deep. There is also another lofty mountain in the island of Hawaii, nearly 14,000 feet high, which, during the greater part of the year, is covered with snow, whence its name of Mauna Kea, or white mountain; other peaks rise to a considerable altitude.

With the exception of the large coral reefs, the whole formation of the group of islands is volcanic. In the high regions the soil consists of decomposed lava; upon the shores and in the valleys, of a mixture of alluvial earth, brought from the mountains by the rain, and of decomposed coral.

Speaking generally, the climate is mild and salubrious, the average mean temperature being 68° Fahr. During the night and in the early morning it is sometimes cool enough to require a light woollen vestment. In very hot weather the heat is nearly always tempered, during the greater part of the day, by the trade winds blowing from the north-east. These winds are most frequent in the island of Oahu, where the capital, Honolulu, is situated. There is no winter in these islands; the principal difference between the seasons is caused by the fall of the tropical rains, between the months of December and March. Southerly and other winds predominate during this period. Still, however much the climate may be esteemed for its salubrity, its effect upon foreigners not acclimatised to it is very debilitating, especially in summer; and persons, other than the natives, who have resided there many years, feel the want of a change, and are compelled to visit either the United States or Europe with the object of renewing their strength.

As regards the products of the soil, the bread-fruit tree, the sugar-cane, and a species of banana are considered to be indigenous. A large number of plants, interesting to the botanist, are to be found in the islands, but not so rich in variety, form, and colour as are met with in Australia and California. It is to the exotics from both hemispheres that the fields and gardens on the coast owe their beauty. The best vegetables are also those of foreign origin. Of alpine vegetation there is none in the islands; the highest mountains are almost entirely denuded of all trace of vegetation. At an elevation of 800 to 1,000 feet, the sides of the mountains are more or less wooded, according to the aspect and predominance of the wind; lower down, the trees and shrubs become stunted, and finish by disappearing altogether. In the valleys, which are well watered, the vegetation is luxuriant; foreign plants, however, are chiefly cultivated on the coast. There are no wild animals or venomous reptiles in the islands, consequently the explorer may fearlessly venture into the most remote recesses of the country. Of native quadrupeds only three have been discovered—namely, a dog, a rodent—between a mouse and a rat—and a kind of pig of small size, with a long head and short straight ears.

Birds are more numerous, but only in the interior. On the coast one seldom sees any but the owl, some species of water fowl, an indigenous goose, and wild duck. As a rule the Hawaiian birds are neither distinguished by beauty of song nor splendour of plumage. There are, however, a few exceptions, such as the *Drepanis pacifica*, whose feathers are of a bright violet blue, and the *Drepanis coccinea*, with yellow and scarlet feathers. In former times the feathers of these birds were solely employed for adorning the state helmets and mantles of the native chiefs. The Sandwich Islands are less rich in fish than the other Pacific groups. The best kinds were formerly monopolised by the chiefs, who had them preserved in numerous ponds, the inferior descriptions alone being allowed to the population, who had, and still have, a great predilection for certain kinds, which they eat raw.

The rapid advance in civilisation by the inhabitants of this small kingdom is very remarkable, more especially when contrasted with that of the inhabitants of many of the other Polynesian groups. Consul-General Wodehouse, in his report for 1872, states that the official census of 1866 puts the total population of the group at 62,959 souls, of whom 4,194 were foreigners—exclusive of Chinamen.

There are no mines or factories in the island. The cultivation of sugar continues to form the great staple of the country, the total export of which amounted in 1871 to 21,660,773lbs.

The total value of imports in 1871 was 1,625,884 dollars, and of exports 1,892,069 dollars, of which some 1,656,644 dollars represented domestic produce, including the produce of the Hawaiian whale fisheries. The total number of merchant vessels entered and cleared was 321, with a tonnage of 202,842 tons. The total British tonnage entered and cleared was 86 vessels, of 47,254 tons. The number of passengers arrived at the port of Honolulu during the year was 2,272, and the number departed 1,399; 934 passengers arrived in transit from Australia to California, and 527 from California to Australia. Honolulu boasts of a lighthouse, which can be seen from a distance of nine nautical miles; a steamer wharf of 600 feet in length, which is rapidly approaching completion, whilst it is stated that no port in the Pacific offers greater facilities for heaving down a large ship, as there is generally on hand an abundance of materials for the repair of damaged ships, plenty of good ships' carpenters, and a foundry capable of supplying all the iron-work which might be required by a steamer or sailing vessel, at moderate prices.

A new post-office was finished in 1871, and the corner stone for the new government offices and hall for the Legislative Assembly was laid in 1872. The erection of a new royal palace is also in contemplation; in fact, the Hawaiian kingdom appears to be running a race with the Japanese empire; and who can foretell the influence which the example of these two countries may have in the civilisation of the barbarous states and islands in and upon the shores of the North and South Pacific oceans.

THE INTERNATIONAL METRIC COMMISSION.

In the report by Mr. Chisholm, the Warden of the Standards, it is stated that the objects of the appointment of the International Metric Commission, at Paris, are wholly and exclusively of a scientific character. They consist of the construction and verification, with all the best appliances of modern science, of new international standards of the metre and kilogram; together with a series of authoritative copies of these standards, uniform in construction and identical in value, for the use of the several countries who have adopted or contemplate the adoption of the metric system; thus establishing it anew upon a scientific basis, and affording the means of making it, by the common accord of all the countries, a *de facto* system of international weights and measures. The proceedings were inaugurated and brought to completion in Paris, although they were for a time interrupted by the German war. The question of a permanent international metric establishment was raised by M. Hirsch, the delegate for Switzerland, and, after examination, was presented for the consideration of the Commission, and through the Commission for the consideration of the several governments interested. The proposals were to the effect that the International Metric Commission should become the central scientific organ of all metrological interests in countries where the metric systems are adopted, and should be composed of delegates from the governments of those countries, who should meet periodically to deliberate upon all questions of weights and measures which, from their nature, require an international solution. That a permanent body, consisting of five members, should be formed for the purpose of undertaking such researches and studies as might be requisite for the due development of the metric system, as well as the duties of solving all metrological questions of an international character. That an institution should be established for the execution of all the metrological operations which that Commission may direct in the interest of the metric system, particularly the comparisons and verifications of the international standards, in order to guarantee the international character and the independence of the institution. Its director and the personal establishment are to be nominated by the Commission, and its expenses to be defrayed by contributions from all the countries interested, in proportion to the number of inhabitants.

The members of the committee, representing countries other than France, were unanimously of opinion that, as the metric system originated in France, and as every effort had been made in France to make it an international system, it was obvious that the institution ought to be placed at Paris, on the condition that its international character should be guaranteed. The meeting of the Commission took place subsequently, on the 24th September, 1872, and was very fully attended. Meetings were held daily until the 12th October. The countries who took part were 29, and their representatives were 50 in number. The principle adopted for voting by nation was based on the proportion to total population, but no occasion occurred in which this mode of voting was actually called for during the session of the Commisson. Certain important questions were submitted, some of which admitted of immediate decision, and others of less import were referred to ten separate committees, each composed of ten members of the Commission, selected as being more particularly conversant with the several subjects, and the result of their decisions are given at length by Mr. Chisholm, in his report upon the subject to the Board of Trade.

COLONIAL PRODUCTS.

From the Annual Report of the Royal Gardens at Kew, for the past year, we (*Journal of Applied Science*) learn that the cultivation of tea in Ceylon is successfully established, and the quality produced satisfactory. The cinchona continues to flourish in the island, and the bark has been pronounced of the best quality. The director of the Botanic Garden there is actively promoting the cultivation of chocolate, for which the climate of the island is admirably suited. The yield of cinchona in the Indian plantations is already very large, and the bark has fetched good prices in the English market; the manufacture of quinine has been established in the Nilghiri plantations, and will shortly be commenced in the Sikkim Himalaya. The papers respecting the opium poppy disease in India have been transmitted to Kew from the local government to be reported on, as have those on the ravages on the vine pest, *Phylloxera vastatrix*, from various Continental States, by the Secretary of State for Foreign Affairs. This is a subject of very grave import, even to this country, the disease being reported as existing in various parts of England, and quite lately in the neighbourhood of London. Samples of excellent cigars have been sent from Jamaica by Sir J. P. Grant, which prove that this island ought to rival Cuba in respect to this produce. It cannnot be too often and too persistently repeated, that, notwithstanding the immense possessions of Great Britain in the East and West Indies, no tobacco of any consequence is imported from either country, except from the comparatively small Spanish territories of Manilla in the old World, and Havana in the New.

OBITUARY.

Mr. J. R. McClean, M.P.—The death of Mr. J. R. McClean took place on Sunday last, July 13. In 1844 he became engineer-in-chief of the Furness Railways, and he was from that time until he retired from the active exercise of his profession in 1868, intimately connected with the great enterprises of the Barrow district, including the now famous Barrow harbour, docks, and railways. In 1849, his plan for the purification of the Thames received high commendation from the Commission appointed to consider the subject. In 1851 Mr. McClean was called upon by the Emperor Napoleon to advise upon the practicability of introducing the English system of baths and washhouses into Paris. He subsequently carried out extensive works there at the sole expense of the Emperor Napoleon. Upon the death of Mr. James Walker, Mr. McClean was appointed Government engineer to the harbours of Dover, Alderney, and St. Catherine's, Jersey, as well as to the Plymouth Breakwater and the Shovel Rock Fort at Plymouth. In 1855 Mr. McClean formed one of the International Commission of engineers from England, France, Austria, Italy, Spain, and Holland, who were invited by the then Viceroy of Egypt to examine and report upon the works of the Suez Canal. In 1861 he was appointed one of the Royal Commissioners for examining and reporting upon the numerous plans submitted for embanking the river Thames. In 1862 and 1863 Mr. McClean acted on other Royal Commissions for the extension of the embankments of the Thames. In 1868 he entered Parliament as representative of East Staffordshire. He became a member of the Society in 1844.

GENERAL NOTES.

Royal Academy of Arts.—The election of a secretary to the Royal Academy, to succeed Mr. Knight, R.A., took place on the 10th inst. There were more than a hundred candidates, and the Royal Academicians elected Mr. Eaton. Mr. Charles Critchett, for thirteen years Assistant-Secretary of the Society of Arts, and now its Educational Officer, was second. The contest was very severe.

Production of Beer in Austria.—The total number of breweries in Austria, according to the latest returns, is 2,337, producing annually 1,066,480,896 litres of beer. The brewers in the kingdom of Hungary are 285 in number, and produce upwards of 70,000,000 litres yearly. The export of beer from the Austro-Hungarian Empire amounted to 5,000,000 litres, and the value of the beer imported to about 60,000 florins only.

Telegraphs in Switzerland.—The reduction in price of telegrams of 20 words, from one franc to 50 cents., in Switzerland, has been attended with most satisfactory results. In 1866, under the old tariff of one franc, the number of dispatches sent was 683,793; whilst last year, under the new, the number sent was 2,171,858.

Prizes for Turning.—The Company of Turners of London, in continuation of their action of former years, propose to give, in 1873, their silver medal and the freedom of the company and of the City of London to any one workman or apprentice in England who may send in the best specimens of hand turning for the year. The material to be used is varied in different years so as to include wood, ivory, metals, stone, spar, &c. There will be two competitions this year, one for turning in stone, spar, &c.; the other for turning in ivory. The qualities which will be chiefly considered in awarding the prize in stone are,—1. Beauty of original design in shape and colour. 2. Accuracy of copying. 3. Skill in overcoming difficulties in regard to the material. 4. Originality, novelty, or special skill in any other particular, as applied to this class of work. The qualities which will be considered in awarding the prizes for ivory will be the following:—1. Beauty of design, symmetry of shape, and general excellence of workmanship. 2. Exact copying, so that the two objects produced (such as two cups, vases, boxes, chessmen, or other article) may be facsimiles in every part. Carving is admissible, and if skilfully done, any additional effect produced by it will be considered; but it must be subsidiary to the turning. In addition to the prizes named, a bronze medal of the Company will be given to the competitor second in merit, and the company's certificate of merit to the third. The different objects must be delivered free at the Mansion House, London, during the week beginning Monday, Sept. 29th, and ending Friday, Oct. 3rd.

NOTICES.

SUBSCRIPTIONS.

The Midsummer subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

MEETINGS FOR THE ENSUING WEEK.

Fri......Quekett Club, 8. Annual Meeting.
Sat......Royal Botanic, 3¾.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

CHANNEL PASSAGE.

On Wednesday last the Council of the Society and the members of its Committee on the Channel Passage were invited by Sir E. Watkin, the Chairman, and the Board of Directors of the South-Eastern Railway Company, to Folkestone, to make an inspection of the Company's last new steamer, the *Albert Edward*, which has been fitted with deck-coverings fore and aft, and is in other respects superior to most of the vessels on the service. The following were enabled to be present:—Major-General F. Eardley-Wilmot, R.A., F.R.S. (Chairman of Council); Vice-Admiral Ommanney, C.B., F.R.S.; Messrs. E. Chadwick, C.B., Robert Rawlinson, C.B., Hyde Clarke, E. Brooke, Seymour Teulon, T. R. Tufnell, Capt. Scott, R.N., Captain Douglas Galton, C.B.; and P. Le Neve Foster, Secretary. There was a large company, including a large number of ladies. A short trip was made along the coast, and the whole of the arrangements of the vessel were thoroughly inspected. Plans for a new system of artificial ventilation, already in use in some of the Company's boats, and shortly to be fitted to the *Albert Edward*, were also examined and explained. The general opinion was that the vessel was decidedly of a higher class than any formerly employed, and that a very considerable advance had been made by the South-Eastern Railway Company. After this experimental trip, the visitors returned to shore and partook of a luncheon at the "Pavilion Hotel." In the speeches afterwards, it was stated that it had been found impracticable—with the existing harbours—to build larger vessels, but that the company had for some time been in communication with the French Government on the subject of enlarging the harbours across the Channel. When this was done, a larger and finer class of vessels would at once be put on the Channel service.

TECHNOLOGICAL EXAMINATIONS.

In addition to subscriptions already announced, the Council have to acknowledge the following contribution to the prize fund:—

Worshipful Company of Cordwainers, £10 10s.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The sixth lecture of the second course of Cantor Lectures for the Session, "On the Energies of the Imponderables, with especial reference to the Measurement and Utilisation of them," was delivered by the Rev. ARTHUR RIGG, M.A., on Monday evening, March 10th, 1873, as follows:—

LECTURE VI.

The Energy of Light, especially with reference to the Measurement and Utilisation of it.

The energy of light is all-pervading. Wherever life is, there this energy is. Darkness, or absence of light, is another name for death. That our knowledge of the mode in which this energy acts is "cabined, cribbed, confined," there can be no doubt. It has, however, an extended influence; indeed, there is reason to infer that it has an actual active kinetic power which may be described as enormous, even when separated from its usual allies, heat and actinism. The very small area of explored light-land only serves to assure us by its embarrassment of rich energies that in respect to light there are not only as great, but even greater developments to be made, than have yet taken place in any of the "imponderables."

The animal, vegetable, and mineral kingdoms; solid, liquid, and gaseous matter, each, in some form or other, admits of the energetic action of what passes under the general name of light. Such universal consent to the power of light, which recent science investigations seem now, for the first time in the history of the human race, to be making known, is rendering a spontaneous but somewhat unconscious and undesigned testimony to the truths of Scripture. In the first chapter of the book of Genesis, and at the third verse, we read that the very first act of creation is light—"Let there be light." It must be admitted as singular, very singular indeed, that that old book—the Bible—about which some men cavil, should have had written in it of events occurring, say, 6,000 years ago (six million years ago, if you please), that which science-investigation of the last 50 or 100 years has only made clear to all who read. Strange that this, "offspring of Heaven first born," without which no life can even now be sustained in healthy vigour, should have been formed in the fullness of energy before revelation asserts that life was. The strangeness ceases when the religious faith in inspiration enters.

Before this lecture is closed the conclusions and illustrations, if successful, will prove that, whilst this energy is less comprehended, and, if possible, more perplexingly mysterious than even the energy of affinity, it is nevertheless one whose presence is for vigorous action. Even the conducting power of bodies for electricity have within the last few months been shown to be so connected as to be influenced by light

It is not in my power to produce the experiment, but it may be stated that if a small bar of selenium—say two inches long, and one eighth of an inch diameter—have its ends electrically connected with such a galvanometer as you saw last week, then the speck moves as light shines upon or is excluded from the bar.

The sources of this energy are the sun, the stars, and meteors which, in some way unknown to us, setting aside the theory of luminous heat consequent upon atmospheric friction, are self-luminous.

There is no similar self-luminosity on earth. If it be wished to obtain light from other and accessible sources it is done by extraneous agencies. Heat caused either by affinity, electricity, or mechanical means, or by a concentration of the energies of some self-luminous source, is the way by which we usually produce light.

This process of production by concentration from self-luminous sources, although generally adopted, is very unpromising as a means for ascertaining the energies of such source-produced light. For this reason—as the light passes through or is reflected from the bodies employed in the concentrating operation, the extent or degree in which this energy may have been expended in chemical or physical work within or upon the concentrating body cannot be ascertained. Hence the remaining work—be it represented chemically or mechanically—is all that is left for investigation. It represents but the balance of the account. Now as a coin so small as one shilling may represent the balance of two accounts neither of which reaches one pound: so the same coin may represent a balance of accounts reaching many thousand pounds. Clearly, then, from this remaining work no inference can be drawn respecting the total of the energies involved in the production of such a balance.

The energy of light varies with the source from which it originates. In some respects, viz., as regards heat and light, properly so called, the energetic elements in what we call the electric light are more similar to those in the sun than any from other lights within our means of artificial production; in another respect, viz., chemism, or actinism, the energy of that from the combustion of magnesium is nearer to solar light than is the electric.

There are two lights which seem to have in themselves no traces of an energy producing effects on any of our appliances. They are the result of some unknown and as yet unappreciated energy. These are lights due to phosphorescence and fluorescence.

The decay of what was once possessed of the energy of vitality is a condition manifesting phosphorescence, a state in which light is without much (if any) heat. Whether the light on being given out is the result of some new operation of what was once called the vital principle, or whether it is a consequence of some elements of affinity approximating in character to those we call combustion, is an unsolved problem. Friction, also the passage from a formless state to the state of crystal, frequently causes a phosphorescent light to be emitted.

Phosphorescence is a name also given to a mode of obtaining light which seems to depend upon the property that certain bodies possess of rapidly concentrating within themselves the light they may receive from being exposed in the neighbourhood of a luminous body, and then emitting this absorbed light gradually. Probably the light stored up in a few seconds is not emitted in less than minutes.

Diamonds and other substances shine in the dark for a short time, after exposure to intense light. This shining of certain crystals, in the absence of light, probably led to the opinion that such crystals were living beings, petrified by light in the hands of men. Certain flowers, especially those with bright *yellow* petals, sometimes emit a sudden flashing light a little after sunset; also, some plants growing in mines emit light from their whole surface. Certain preparations continue to emit this light so intensely and continuously as to be used as night lights—not for illuminating rooms, but for such purposes as reading the hands of a watch.

There are in this box a series of tubes which, doubtless, appear to all of you, at the present time, perfectly white. If, however, we allow an intense light to shine upon them they are seen to possess a phosphorescence that will last for some time—from ten minutes to half-an-hour, as the case may be. This magnesium lamp shall be lighted, and the tubes exposed to its rays for a short time, and you will see, not only the simple phosphorescence, but different colours which the contents of each tube assume.

Fluoresence is a peculiar appearance consequent upon placing some substances in certain positions with respect to light. This may be illustrated by the action of light upon sulphate of quinine. In this bottle is what appears as pure colourless water; it is a very weak solution of sulphate of quinine. If looked at in the presence of light rich in actinic rays, a change in the appearance is observed. A piece of magnesium ribbon is now lighted. In certain angular positions a beautiful azure blue may be noticed; this blue is a consequence of those phenomena called fluorescent. These, phosphoresence and fluoresence, are two characteristics of the energy of light, of which all we know is that we can render no account of the causes of them, unless the theoretical explanation be accepted that the two may be classed as one—by regarding them as consequences of an alteration in certain wave lengths in portions of the entire beam of light. From the previous statements it may be inferred that the measurements of the energies of light are not yet accomplished; also, that two lights, which to the eyes do not differ much in intensity, or in what some might call power, yet may show very different energies. It must be borne in mind that here, as in electricity, intensity is not energy; there may be great intensity and little energy.

The great source of light is the sun, and whatever may be the speculations of science, either as to the cause of that light, or as to the mode in which it is propagated from the sun and received at the earth, they do not concern us at present. What we are concerned with is, how are the energies of the light thus received, and of such artificial lights as are utilised, to be measured?

A reference to the diagram of the spectrum may explain what is manifested by an analysis of solar light. Observe, there is shown in this spectrum heat, light, and actinism, or chemism, as it is sometimes called. The spectrum visible to us is the part thereon coloured, containing the usual prismatic colours, red, orange, yellow, green, blue, indigo, and violet; therefore, the light, properly so called, and which is utilised by human eyes for vision, extends from the letter A to the letter H and no further, and any energy consequent upon the state which occurs before the letter A, and any energy consequent upon the state beyond the letter H, is not the energy of light properly so called. Now, to our left of the letter A, extending over a space which bears a proportion to light, about half as long again as light, is a space containing the energy due to heat. To our right, beyond the letter H, extending to a distance longer than that of light, we have a space in which photographers and chemists delight. Chemists can get nothing out of this dark end to our left except heat, and chemists and photographers get nothing out of that dark end to our right except chemical action. The intensity of heat lies here, just before we reach light at all; and the intensity of chemical action lies there, just after we get beyond the light. No scientific investigation has yet detached the energy of light and its intensity from these two energies with which it is associated. At this line, marked D on the diagram, it will be noticed that those curves, indicating heat and actinism, die out. The one seems to be passing into the other. At D is what mathematicians might name a "cusp"—a zero on the scale similar to that zero in the arithmetical tables which may be said to mark the turn between counting by integers to the left, and by decimals to the right. At D is this dead blank for heat and actinism, and yet it is there the energy of light really lies. Before the end of the lecture something more should be said about the energy of light at this particular point. Amongst these three constitutents of a solar beam——heat, light, and actinism—there are several marked and extraordinary differences, yet we call them all "light." For instance, heat causes bodies to expand, but heat fails to make an impression upon the retina. Professor Tyndall, some years ago, put his eye into the focus of a heat beam where platinum was melted, and it produced no impression upon the eye. In his account of the experiment he says he did it, but he does not advise anybody else to do it—a piece of advice likely to be more generally accepted than advice usually is. This shows that heat fails to make an impression upon the retina. Heat also fails to produce any photographic result; heat can be conducted along metals, and heat can cause organic and inorganic bodies to expand.

Light, properly so called, possesses these qualities. It makes an impression upon the retina, it effects changes in organic bodies, and probably (in some way mysterious to us) in inorganic bodies also. Light does not possess these qualities—it cannot be conducted by metals, it cannot cause bodies to expand. Now, as to actinism or chemism, it possesses these qualities—it produces photographic results and chemical changes in organic as well as in inorganic bodies. It does not possess these qualities—it fails in making an impression on the retina, it cannot be conducted by metals, and it cannot cause bodies to expand. Hence there seem to be properties in each portion of the spectrum which do not exist in the other; therefore in the comprehensive term—light—there are three distinct elements, and it is really an error to write them under the one name light. Great would be the social misunderstandings if, because wheat, barley, and oats are all called corn, or grasses, these general terms were as constantly applied to them as the term light is to phenomena with which it is associated, but not connected.

There is also another form in which the energy of light is presented, *i.e.*, in its penetrative power.

For lamps and lighthouses this penetrative power is all important. Certain substances in combustion are possessed of this power in a much higher degree than other substances. It is not, however, only in the material burnt, but further in the mode of burning, that this penetrative power is manifested. The same substances under different conditions manifest very different energies in the emission of light to a distance.

Even the ordinary paraffin lamps—how very inferior in illuminating power some are to others. The utilisation of the energy in the one and only way in which it can be utilised without waste is well illustrated in the various constructions for the burning of different hydrocarbons, to which time forbids further reference. Many present are aware of the different schemes now before the public for obtaining both light and heat from the combustion of the hydrocarbons.

But it is not in liquids only that this difference exists. Even the same quantities of gas—*i.e.*, of a suitable gas—one containing such an element as carbon under different circumstances, yield lights of marvellously different penetrative power.

Here is a common gas burner; if a short tube having a few holes at the bottom be placed over it and the gas lighted at the top of the tube you have a light which has a certain non-penetrating power. It cannot penetrate far; it has a pale blue lambent flame. Now if the tube be taken off, and the gas lighted at the burner, you have the same quantity of material burning, but with a very different penetrating power. In this case it is evident that the penetrating power depends entirely on the mode in which the apparatus is arranged for combustion of the gas.

From the remarks made it may be inferred that science is yet incompetent to pronounce decidedly, 1st, what or which element or elements in the solar beam constitute light properly so called; 2nd, even if this be determined positively, yet science is still undecided by what rule, or weight, or measure, the energy of light is to be gauged.

Indeed, this remark may not be an exaggeration—in all probability no two persons see the same degree of light. It may be surmised that no two persons see any portion of this spectrum of the same colour, and, further, it is highly probable that there is no such thing as colour in nature at all. It is likely that colour is a pure impression produced upon the retina of each person's eye by the vibrations of the medium which strike upon it. Hence what we call red, orange, yellow, green, blue, indigo, and violet do not exist actually on the spectrum, but in the eye of the observer, and probably one person will see the red beginning here, and extending thus far, whilst others will see it beginning a little more to the left, and ending a little more to the right, or *vice versa.* Upon that point there is nothing really settled.

As to the first of the foregoing inferences the energy of light is said to be concentrated in the yellow portion of the visible spectrum. If the views of those whose pursuits are photographic are to be received, the perplexities of science are increased. The very name of their art—photography—indicates the writing of or by light alone.

The fact is that photography is not a process dependent upon light as light, but upon that portion of light which is possessed of certain peculiar, and hitherto unexplainable, influences of a chemical character. Photographic chemistry is as yet very partially understood—were it not that those who think they understand it might be offended—the truth would not be outraged by saying that photographic chemistry is not at all understood. And yet no process for estimating the energy of light, as light, has been suggested more hopeful for success than that dependent upon chemical changes; but these are not those chemical ones to which the photographer appeals. The fact is, that those changes appreciated by the photographer can be produced in inorganic compounds; what they are can be partially noted, they can be recorded, and that in terms which are but relative (not absolute), and which chemistry alone can measure, The day may not be distant when the energy of light, as light, will be duly and absolutely measured.

Judging from its place in the order of creation, previously named—judging from its influence over the whole world of animal and vegetable existences—judging from such facts as that when light is absent all animal and vegetable life lapses into a species of torpor, or sleep, and on the return of light nature awakes, and resumes its activity and strength, the conclusion is a very legitimate one, that in light—as light—there is great energy. Light opens the eyes, not of animals only, but even of flowers; hence one of our little English flowers is called "The day's eye." Those who can sleep through noise, and even through heat, are not insensible to the energy of even artificial sources of light playing, however gently, upon the closed eyelid. Medical men and nurses are well aware how essential light is for the regaining of health and strength by the sick or the infirm. Egypt and Madeira, as sanitaria or convalescent homes for our ailing brothers and sisters, may owe more of their influence to qualities or energies of light very different from those the photographer esteems than are usually allotted to them. And it may be permitted to add that marvellous testimony to some unknown element (be it figurative or be it real) which, whilst pervading all Scripture from Genesis to Revelation, assumes a most marked peculiarity in that expression of St. Paul (Eph. v. 14), "Awake thou that sleepest, and arise from the dead, and Christ shall give thee [marvellous gift] light"—not life, observe, but "light."*

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* This subject has been examined more in detail in "The Harmony of the Bible with Experimental Physical Science," published by Bell and Daldy, price 2s. 6d.

Sir H. Davy, in an article on the causes of the colours of organic beings, written about 1790, when Davy was only 19 years of age, writes—"Nature has catenated together organic beings, and made them mutually dependent on each other for their existence, and all dependent on light. A privation of light would be immediately destructive to organic existence; vegetation would cease; the supply of oxygen gas would be immediately cut off from animals; the lower strata of the atmosphere would become composed of carbonic acid; and perception and volition would exist no longer."* Although these views were expressed more than 80 years ago, very little progress has been made in the direction they indicate.

Such considerations as these suggest that he who would truly ascertain and measure the energy of light—that energy upon which all terrestrial life depends—must look to do so in its influence on organised beings; he must either separate the allied influences, or he must so separately estimate these that he can apply his estimate correcting a general result by a process of common occurrence—viz., the eliminating of all foreign or allied energies, and thus give to science the true energy of true light. He who, with knowledge and patient skill, enters upon this hitherto almost unexplored and yet noble field of investigation and research, will give to the age in which he lives, and transmit to future generations that which will indeed be a boon to all. Pending the coming of that time when some science investigator, possessed of sufficient knowledge, humility, originality, and skill, shall do for light what Newton, Atwood, and Kater have done for the measuring of the energy of gravity—what Mayer, Joule, and Thompson have done for that of heat—what Haughton has done for that of vitality, and what Siemens, Matthieson, Jenkins, and others have done for electricity—what Davy, Dalton, and others have very partially done for that of affinity, and what Bunsen and Roscoe have done for the chemical energy of light—but what no one has yet done for that of light—properly and exclusively so called—we must content ourselves with such modes of estimating this energy as are at present known and available.

This energy is supposed to be manifested in the promotion and facilitating of chemical affinities. These affinities (as doubtless some present remember) vary in their character as one or more of the "imponderables" are combined in their promotion. So much is this the case that chemical notation now adds, in reference to certain indicated changes, the words, by heat or electricity, as the case may be. There are, however, certain affinities called forth under the influences of light, which do not show themselves under any other conditions. As, for example, certain of the salts of silver (such as silver combined with chlorine, iodine, or bromine) change their colour and their character, the silver being set free from its combination as a black powder. There is also that power, which plants in the presence of sunlight possess, of changing the carbonic acid gas, which, if allowed to accumulate in the atmosphere, would soon render it unfit to be breathed, into its constituent elements, the plant retaining the carbon and ejecting the oxygen. Priestly, in 1790, that is, at the period when Davy wrote the article from which an extract has been read, a period when, for a short time, men's minds were being directed to this department of scientific research, was the first to show that plants kept the atmosphere pure and healthy, but he could not calculate. His was rather a qualitative, and not a quantitative result.

Changes in the colour of salts of silver, through some energy of light, have been observed since the middle of the 16th century. In 1777, Scheele suggested some explanations which, although very imperfect, are as yet the only recognised ones. In the early part of the present century experiments of a similar kind were made at the Royal Institution by Wedgwood and Davy.* The absence of any mode of fixing the impression caused the results to be very evanescent, but the localising of this peculiar property of light is clearly announced in these words:—"Red rays, or the common sunbeam, passed through red glass, have very little action; yellow and green are more efficacious, but blue and violet light produce the most decided effect."

The rapid development of the art of photography during the past twenty or thirty years has led enthusiasts in this branch to overlook the purely chemical character of their art, and to attribute the changes with which they deal to a manifestation of the energy of light. Hence scales have been devised which may enable photographers to adopt some kind of a standard. They are not, however, worthy of the name of scales of energy, as they depend upon the power of the eye to appreciate very slight differences in shade. A scale or measure, to be of general use, should be of such a character that a person in one part of the world writing to one in another might refer to some common standard.

There is, however, a process for obtaining a measurement of one element in the energy of light capable of greater accuracy of observation than the photographic one. This also is chemical.

In the lecture on the energy of affinity a brief time was devoted to the peculiar manifestation of affinities under the conditions of the nascent state.

It is apparently a deviation from this form of energy when the two well-known gases, chlorine and hydrogen, are produced and intimately mixed, either in their nascent state or afterwards, in the dark or in the presence of that portion of the solar beam we call red. Under these conditions no rapid union of the gases takes place. Permit the evolution or the mixing of the two gases to be in ordinary light, properly so-called, and an intimate union, or rather an actual chemical combination, is a consequence.

If these gases be separately produced and collected in a glass vessel in equal parts. the union and formation of a new chemical compound in this glass vessel follows from exposure to light. If the light, or rather that particular portion of the solar beam to which chemical action is generally attributed, be permitted to act upon the two mixed gases, then the union takes place at a rate determined by the energy of some one or more of these constituent elements of light on which the combination depends. Where in the solar beam these constituents are is a question easily solved.

Every ray, or every portion of a beam of light, is capable of producing union between hydrogen and chlorine; but the combination takes place at very different rates, according to the portion of the beam which acts upon the united gases. The actinic portion will act seven hundred times as rapidly as the heat portion. That is to say, a certain combination will take place under the influence of this portion in one minute, which it will take more than eleven hours to accomplish under the influence of the heat portion Therefore, by separating the ray of light, we can graduate the rate at which the combination occurs. Here are some glass bulbs, containing chlorine and hydrogen which have never yet been exposed to the light. If one of these be placed under this globe of red glass then the light that passes through it will be the portion of light corresponding to the heat end of the spectrum, and it will take hours to accomplish the perfect union of these two gases. If, however, one be placed under a globe of a blue colour, the light falling upon it will represent that belonging to the actinic portion of the spectrum, and the gases will unite (if the experiment be successful), and explode in about ten seconds.

Whilst recognising this test and measuring gauge of the chemical brightness of certain lights, it must be borne in mind that it is chemical action and not the energy of light, properly so called, that is measured. For instance, when the brightness of the sun's disc, as a case of light-brightness, is 520 times that of magnesium wire, the chemical brightness has been found to be not 40 times as great.

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*Davy's Works, Vol. II., page 106.

* *Journal of the Royal Institution* for 1802, p. 170.

Here are diagrams of two spectra, one of which is obtained from flint glass. Now, flint glass produces an effect which is considered to be due more to the physical property of density than to the elements of which it is chemically formed. Assume this diagram to be a faithful reproduction of the spectrum from flint glass. Now, however similar another glass may be in appearance, yet if it differ in density and constituent elements the distances between certain lines in the spectrum may in some portions be the same, but in others they will differ. If, therefore, light be estimated from the spectral appearance of it after it has passed through any substance, it is clearly subject to the influence of that substance. Again, on another diagram is a series of colours produced by a process called diffraction. This is the apparatus, and this is the mode of producing those colours. At the object-glass end of the telescope there are a number of very fine lines drawn, and if the telescope be directed to a very intense speck of light, such as the reflected sun from a small silvered globe or the bulb of a thermometer, coloured bands are seen, containing the same colours that the flint glass spectrum shows. But the colours seen under this diffraction arrangement are very different in quantity to those seen under any other arrangement. A diffraction experiment is easily made by each for himself. From that hook a bright reflecting silvered glass globe is suspended, and two or three smaller ones of the same kind. If anyone is tired of listening, and feels disposed to go to sleep, they can perform this experiment very easily. Just close your eyes and allow the eyelash to interfere with that speck of light reflected from the globe, and you will probably see colours radiating on both sides. Those are colours due to diffraction, and there are modes by which they can be made to appear much wider apart than by the one now described. Taking the diffraction spectrum, we find that these distances, from D to E, say of the yellow portion of the spectrum, are not of the same length as the corresponding portion in the flint glass spectrum, and the same with the other portions, so that the proportions are quite altered. This is called the "irrationality" of the spectrum. Line D there becomes the middle of the spectrum instead of being, as it is here, very near to one end. The consequence is, when we talk of there being no heat in this portion of the spectrum, we have really and truly distributed the heat which ought to be condensed in F, G, over that large space, and therefore it shows on a fixed area much less heat than it would do not so distributed. If, now, these apparently unequal halves of the spectrum be examined for heat, it will be found that collecting them into two separate foci, the heat in the one focus is equal to that in the other. Clearly, had these portions been examined over equal areas the heats would not have been equal. Therefore the notion generally entertained of heat being confined solely to one end of the spectrum is not strictly true. That diffraction spectrum explains it, and there are other matters bearing upon it which, if time permit, shall be referred to presently.

That kinetic energy, of a character as important as any found in the other imponderables, exists in light, may be inferred from the fact that if light be extinguished by falling upon such a surface as lamp-black the stoppage of the ray—the consequent absorption of it—produces heat. The motion of the light has been converted into a motion called heat. If, however, the light be stopped by some of the salts of silver, then this motion is converted into chemical changes. The heat and the change are consequences of an energy in light. Nor is it only when influencing different substances that light effects different results. Take, for example, carbon, and note how varied is its behaviour towards light and electricity. When in the form of a diamond, then carbon transmits light and stops electricity; but when in the form of coke, into which the diamond is transformed by heat, then carbon transmits electricity, but stops light. No cause has yet been assigned to that which seems almost universally the case, viz., transparent bodies stop electricity—carbon, the metals and opaque bodies, stop light.

It is a popular opinion that sunlight or sun-brightness extinguishes household fires. May not this be from some hitherto undiscovered energy of solar light, for it is not the heat of the solar beam which thus causes the carbonaceous fuel in our grates to become dim? If the energy of light is to be studied and its value to be estimated and brought within our powers of utilisation, it must be done through agencies widely different from those hitherto named. Looking at the order of creation, and watching the behaviour both of the animal and vegetable kingdoms, it seems that through them must be had our knowledge. Allusion has been already made to these. It may be well to investigate more closely the relation of the energy of light to them. No mode of measuring the energy of light in relation to animal life has been suggested, and yet its energy in this respect is more strikingly extraordinary than that of the other imponderables. Take one illustration only. When you knock at the door of a friend's bedroom and receive no answer, how loud, and louder still, becomes the rap ere he awakes. How often are stories told at the breakfast-table of night noises unheard and unheeded by those asleep. Let but a beam of sunlight, or even candle-light, shine on the closed eyelid, and by some mysterious energy on the well-covered retina the sleeper awakes.

The worlds of animal and vegetable life awake and work mainly in consequence of some such hitherto unmeasured energy of light as that now alluded to.

Turn to vegetable life. With respect to this, Professor Helmholtz remarks:—"Take a seed, then look at the tree, and consider from what source has been derived all the material of the tree. Burn the seed, burn the tree, whence comes the different amounts of heat? Chemistry tells us that the heat is produced from carbon, oxygen, and hydrogen; these are derived from carbonic acid and water. Plants cannot obtain these except under the influence of solar light." *

After plants have utilised the light it is not useable again for the same purpose. Take two screens of dark paper, such as these, with holes in them—say half an inch in diameter—one hole covered with letter paper, the other covered with a green leaf, put pieces of photographic paper behind them, and expose to day-light or magnesium light. Beneath the letter paper is a dark spot—an image of the hole—beneath the leaf is no discolouration. The leaf has utilised the light, the letter-paper has not. The energy of that which passes through the leaf is spent, of that passing through the paper is not spent.

Although in plants a variety of operations take place, which must in some way unknown to us store up a large amount of energy, and although there is to all practical purposes no heat developed, yet we know well that there are thus stored up chemical tensions which give out their true physical value in heat and mechanical work, as the tissues of the plants are destroyed by a process of animal or other combustion. We are as yet quite at a loss to know how the plants do this, or by what elements in light, properly so called, it can be so completely and perfectly done.

Sir John F. W. Herschel, in a paper in the *Philosophical Transactions* for 1842, gives a most interesting account of an extended series of experiments on the action of the solar spectrum on vegetable colours. He operated upon the juices of the leaves, and also upon some of the resinous compounds of plants, and his conclusions have since been confirmed, viz., the action of the solar spectrum is confined to the visible region of it. The chemical or actinic rays act with chief energy upon silver or inorganic compounds, but are, for the most part, powerless upon vegetable colours; so also are the heat rays, or those below the extreme red. Thus Sir J. Herschel, in 1842, separated by a very broad line the luminous portion of the solar beam from the other parts of it. That the energy of the luminous portion of the solar beam is requisite ere plants can exercise their vital functions is well known to all who have made any of the experiments which show the extent to which, under the influence of that energy, plants can effect chemical changes. These changes take place most abundantly in the yellow, or in what our eyes would call the brightest portion of the spectrum.

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* Helmholtz, *Medical Times*, 30th April, 1864, p. 473.

The energy of this luminous portion may be gathered from experiments made during the last few years by an American. Flowering plants were placed in different colours of the spectrum, and it was soon observed that their action upon carbonic acid gas depended upon the colour of the spectrum. He took a flower, and under the action of a red ray he did not get one cubic inch of gas off, but only 0.33 of an inch. As soon as he submitted that same plant to the orange ray, he got 20 cubic inches, and from the yellow he got 36 inches. But when the same plant was put under green, blue, indigo, or violet, he could not get the plants to act at all in the purification of carbonic acid gas, thereby showing pretty clearly the energy of light in the luminous portion of the spectrum as regards growing plants.

The decomposition, then, of the carbonic acid is effected chiefly by the energy resident in what may be called the yellow rays. It is a somewhat noteworthy coincidence, that the eye generally fixes upon the yellow portion of the spectrum as that possessed of the greatest brilliancy; it is also noteworthy that the spectroscope reveals *that* in the atmosphere (viz., sodium) which, on being burnt, always produces a yellow band. It is, to say the least, curious that we cannot get heat by combustion in the air without the production of this yellow light.

It seems, then, that plants and human eyes are most sensitive to the same portion of the solar beam, and this portion is in light properly so called. May it not be that yellow light is most acceptable to the plant, and most impressive upon us, because carbon is in both cases involved—the retina of the eye being a carbonaceous compound. Had the retina been a salt of silver, then the greatest brilliancy would perhaps have seemed to be in the blue rays.

This identity in composition between the plant and that part of the animal on which light exercises its chief energy, suggests that in the influence of light on plants (whatever that may be) must be sought the data from which to deduce a mechanical rather than a chemical measure of the energy of true light.

The contrast of this energy in its effect upon the metal salts and plants is especially marked as regards time. On the metal salts it may be said to be instantaneous, but on the gums and resins of plants exposure for days and months to clear sunshine, is needed to produce any marked action. A patient watching and building up on such scant data as may hitherto have accumulated, will, some day, produce the dynamical equivalent of light.

There is one experiment here which will probably bear out what has been said. You are probably aware that plants, by receiving light, manufacture what we name colour. They manufacture the green material out of which the leaves and the general character of the plant is formed, and that green material is called "chlorophyll." This vesssel consists of two beakers with the bottoms cut off, one about an inch and a-half larger than the other. The glass cylinders then left are fixed with marine glue in a wooden ring. The space between them is filled with a solution of chlorophyll, obtained by steeping for forty-eight hours common parsley in any cheap spirit, such as methylated alcohol, and then filtering. It therefore contains the green colouring matter of leaves. This green colouring matter has been made almost exclusively by the yellow portion of light, and not at all by the chemical portion, and, with a view to show this, we must refer to the spectroscope view, namely, that chlorophyll being really manufactured by yellow light, is practically saturated with yellow, and can take up no more. Thus, if a vessel containing a saturated solution of salt had a piece of salt dropped into it, that piece would not dissolve. If, now, there be placed inside this chlorophyll solution anything that produces these other coloured rays, we shall probably find that, whilst sensitive to the one colour, the solution will not be to the other. Here is some lithium, which shall be placed on a little piece of platinum wire and burnt, so causing a beautiful red flame. On putting the flame within the hollow cylinder containing the chlorophyll, you will see the yellow beam alone can pass through the green solution. The green solution having been made with that yellow beam is thoroughly saturated with it and can take up no more, but it can take up the other coloured rays, and therefore they do not pass through. In that portion of the flame rising above the green solution you see the red-coloured flame. Thus, the yellow colour is consequent upon the saturated solution of chlorophyll, and therefore nothing but yellow can come through. The absorption of this yellow portion of the solar spectrum, by the vital energy of the plant and utilising the same in its composition, might have been inferentially suspected from the fact that leaves become yellow in the autumn, thus restoring in their death what, for want of a better term, we must call "the colour" they had absorbed in their life. The yellow colouring matter of the autumnal leaf is called "xanthophyll." Probably, as "chlorophyll" and "xanthophyll" are more examined and known, so the energy of light may be more appreciated and measured.

This examination of light, properly so called, has led to another contribution towards an estimate of the energy. That plants grown in the dark are drawn to any crevice through which light enters has long been known. But it has not been so often observed that young plants bend the stems to the indigo portion of the spectrum, *i.e.*, if grown in red, or yellow, or green, they bend in one direction, but if in the violet, then in another direction. They recover the vertical position in darkness. May it not be that the energy in the indigo of the sky produces the vertical character of stem?

Thus light proper produces motion, and so assimilates itself to heat and electricity. The complementary colours of red and green (see the chromatic circle of Newton on diagram) are those which represent the relation of colour between the animal and vegetable kingdom. Plants reject green and absorb its complementary (red). The blood of animals is red, therefore animals should have green supplied in the fields and in our furniture.

That this energy of light is utilised in vegetation, and that practically we recognise it, may be noted in the ingenious modes by which in our small gardens we try to imitate nature. The nailing of branches on walls—an advance on this in espaliers on lattice woodwork, and the still more recent practice of cutting out the inner branches of orchard apple trees; also training others to hang in umbrella fashion, or the splaying of gooseberry bushes as funnels, all these are devices to permit of the more universal exercise of this unmeasured energy of light.

Light influences the colour of animals and the plumage of birds in tropical climates. In the arctic regions polar bears are white, like vegetables grown out of the influence of light—arctic foxes are white in winter and brown in summer. Fishes inhabiting deep water chiefly are grey, or brown, or black; those living near the surface are of rich and various colours.

That the measurement of the energy of true light should be by an appeal to its influence on organised matter, and not on inorganic, is a testimony borne by all observations, and even suggested by the records of Creation, the earth having been prepared by the creation of light for animal and vegetable life even before they were formed upon it. This measurement has not yet been made.

ANNUAL INTERNATIONAL EXHIBITIONS.

The Council, having been informed that her Majesty's Commissioners do not intend to publish Reports on the different departments of the Exhibition of the present year, and looking to the great importance to Arts, Manufactures, and Commerce that these annual displays should not pass away without some record, have decided to undertake that duty, and for this purpose have engaged the services of gentlemen specially skilled in the subjects of the several sections, to prepare such Reports for publication in the Society's *Journal*. The Council, however, desire it to be understood that, in publishing these reports, they do not necessarily adopt all the views expressed in them, which must be taken as those of the writers only.

The following report is the sixth that has been issued. The remainder will appear as soon as they are complete.

REPORT ON CARRIAGES.

CLASS XI.

By George N. Hooper.

The Carriage Department of the London International Exhibition of 1873 is of a somewhat more comprehensive character than that of any previous exhibition, and differs from all of them in several important features.

The mode of conducting it, and the inducements held out to exhibitors, are different to those where British carriages have hitherto been shown.

In former exhibitions there has been the attraction of prize medals and commendations, each having a recognised value, and there has also been a jury to examine the products and reward the exhibitors who have sent the most worthy specimens. In connection with this exhibition there are no prizes and no jurors. However, to prevent the display becoming that of a mere bazaar, H.M. Commissioners appointed a committee to organise the exhibition, and reject such carriages as were not likely to be creditable. This examination took place on the 9th of April, and, considering that the great body of exhibitors had done their best, and the mortification that would be felt by those whose goods were returned to them on account of not reaching a high standard of excellence, the committee have liberally passed over some that a more rigid scrutiny would have excluded.

Hitherto, the great inducement to exhibitors has been an enhanced reputation, by the award of a medal or commendation, and this is especially the case with foreign exhibitors, who make but a very small contribution of carriages, partly owing to the absence of prizes, and partly owing to the counter-attractions of the Great Exhibition held in Vienna this year.

Considering the lessened attractions, it is somewhat surprising that so many British exhibitors have sent carriages; that is probably caused by their desire to maintain worthily the reputation of an important British industry, and partly to the large amount of space that her Majesty's Commissioners were able to place at their disposal this year. The French Annexe was very unexpectedly available for British goods, the French Government having determined to concentrate their efforts at Vienna, rather than diffuse them by putting in an appearance in London and Vienna in the same year. It thus became available for a large display of carriages; but if events had not so happened, the space for carriages would have been small indeed, compared to what it now is.

When the Committee for Carriages met, it was resolved to apply to the Coach and Coach Harness Makers' Company of London to assist in rendering the carriage department as complete possible. The Company appointed a Committee, which afterwards acted with the one nominated by H.M. Commissioners, having the Duke of Beaufort as its chairman.

The Company voted a sum of £50 towards meeting the expenses necessary to carry out the proposals of the Committee; this has been supplemented by a guarantee fund, supported by many of the carriage exhibitors.

The demands for space having exceeded that at the disposal of the Committee, additional accommodation has been provided by glazing the arcades, giving thereby the means of exhibiting cabs, carts, waggons, and light country vehicles, and reducing the number of carriages by making a charge of £10 per carriage to all exhibitors who had applied for more space than two carriages would occupy, and were willing to pay for it. It was also considered by the Committee that it would be more satisfactory to exhibitors to leave the placing of carriages entirely in the hands of H.M. Commissioners and their officials; and they have carried out an intricate and difficult matter with considerable success, as there is a certain air of unity in the arrangement that has been wanting in all former displays of carriages, where they have been grouped geographically. It is one of the advantages that should result from annual exhibitions on a moderate scale, that every department should be as complete and well regulated as possible, in the main features as well as in the details that tend to render it not only interesting but useful; and in these respects the present display is eminently so beyond former ones. Specimens of coach-building of olden times are contributed by Her Majesty, who lends her State carriage, representing the state; that of the Speaker, representing Parliament; and that of the Lord Mayor, representing the ancient Corporation of the City of London.

With these are sedan chairs used by former Duchesses of Northumberland, and various litters, &c., from India, Japan, &c., as also an Australian barouche, lent by his Royal Highness the Duke of Edinburgh; and a town chariot built about 40 years ago for the late Earl of Onslow.

In connection with the State carriages shown, there is a good collection of photographs of the State and other carriages of Germany, Austria, Spain, Saxony, Denmark, &c., as well as of private carriages made in the United States, Hungary, &c.

The photographs of some of the foreign State carriages are remarkable for the beauty and variety of some of the decorations, and are well worthy of careful examination by carriage draughtsmen, carvers, and decorators.

A contribution to the department will probably not receive so much attention as it deserves; not on account of any high excellence, but as the result of a City company endeavouring to bring itself into harmony with the wants of the present age. It consists of a series of working drawings of carriages, to the scale of one inch to the foot, sent in competition for prizes offered by the company, the details of which, with the judges' report to the Company, will be found in the appendix.

This is the second year the Company has awarded prizes through judges appointed from their own body, but it has for many years offered its medals to candidates passing good examinations held by the Society of Arts and Science and Art Department in Freehand Drawing and Practical Mechanics. It now further seeks to encourage the scheme of Technological Examinations proposed by the Society of Arts, and has recently made a grant of ten guineas towards assisting its development.

A short time ago, when his Royal Highness the Duke of Edinburgh took up the freedom and livery of the Company, and was elected a member of the Court of Assistants he said that he felt greatly interested in developing the plans proposed by the late Prince Consort, for advancing technical education in the country, as a means of enabling its manufacturers to render their products more artistic and beautiful, and also to enable them to simplify their methods and get the best results from a thorough knowledge of the laws that should guide their operations.

However, some of the City Companies are so fettered and controlled by their charters and bye-laws, and by the objects for which they were founded being now accomplished by other means, that they require more freedom of action to develope their great opportunities of usefulness, just as greater freedom seems to be considered necessary by the municipalities throughout the country, whose representatives met the Lord Mayor of London very recently, with a view to its attainment.

As a means of comparing the British export of carriages with that of foreign countries, Her Majesty's Commissioners, at the request of the Carriage Committee, have procured from the Board of Trade statistics of the export and import of carriages, which show that the export trade of France and Austria now greatly exceeds that of Great Britain.

Her Majesty's Commissioners show an album containing a large collection of prints and illustrations of carriages of former times; it is, probably, unique, and very interesting from the information it contains of the progress and changes in the art of carriage-building.

The Postmaster-General shows a model of a mail-coach, such as carried the letters of a former generation, on all the great roads throughout the country.

Several coachbuilders also show drawings of carriages such as were made before railroads became general.

It is much to be regretted that the Coachmakers' Company has not been able to make any contributions to illustrate the carriage manufacture during the two hundred years of its existence, the Court having evidently overlooked, during these years, the importance of collecting and preserving drawings, models, and information in connection with the manufacture it represents. However, now that it has commenced the formation of a library of reference, it is to be hoped that every exertion will be used to collect such drawings, books, and illustrations as exist, and render the collection a useful and interesting one.

The literature of carriage-building does not receive so much attention in England as in several other countries. In France a magazine is published every two months; and, in the United States, there are two periodicals dealing specially with carriage-building. These are well supported, and have a large circulation; in them are discussed an infinity of matters connected with the manufacture of carriages; and illustrations of new designs, and methods of construction, appear constantly.

In the United States one of these periodicals greatly facilitated the formation, last year, of an American Carriage Builders' National Association, with a view to the improvement of the manufacture of carriages in the States. It seems to take for its model the Institute of Civil Engineers, in London; proposes to discuss and record improvements of all kinds in connection with carriages, and to bring together, to a conference, each year, the whole of the American coach builders, in order to throw their influence into the regulation of taxation, customs duties, &c. The conditions under which the Americans carry on the carriage manufacture differ from those of Great Britain. Up to the time of their war, carriages were untaxed, and their use became much more general than in England; and their trade is now protected by a duty of 30 per cent. on foreign carriages imported.

Up to a recent time foreign carriages were prohibited entry into France, except as the property of persons using them. By the Cobden Treaty of 1860, the duty was fixed at 10 per cent.; it is now said to be intended to raise it to 20 per cent. For many years foreign carriages have been admitted into this country free of duty; and, although Englishmen may, in principle, prefer free trade, many think it should not only be free to the foreigner, but to the English, as, although the example has been set for many years, at present no country reciprocates British liberality, and wherever British carriages are sent a duty is levied on them. As regards taxation, it is not levied equally in Great Britain, for, while carriages are untaxed in Ireland, they must pay a yearly duty in England, Scotland, and Wales.

The time is approaching when the taxes on locomotion should receive more attention than hitherto; for, although those on private carriages have nominally been simplified and reduced, the mode of their collection under recent regulations has been rendered troublesome and vexatious.

When such taxes were first imposed, those who travelled most were the noble and rich, who kept handsome and expensive family carriages for town use, and well-appointed carriages, specially made for travelling. The poorer classes travelled on foot or horseback, or in the stage-coaches that were then in their infancy. Travelling was then a luxury for the well-to-do; and to those who were poor it was a hardship, accompanied with trouble and risk.

Under the present carriage taxes, the handsome dress coach pays no more than the doctors' brougham or the farmer's phaeton, and the tax is heaviest in proportion to those who can least afford to pay it. Formerly, the ostensible owner and person who used the carriage paid the tax with his other assessed taxes on horses, men-servants, heraldry, &c., and only one payment was necessary. However, a system has become very general with persons of fixed incomes of hiring their carriages for a term of years for an annual payment (the coachbuilders undertaking the repairs). Under the new regulations all the coachbuilders are held liable for the taxes on such carriages, and have to pay the tax for them in advance at the commencement of each year, collecting the duty as they can from each individual hirer, without the rights or privileges of the recognised collector of taxes. The hirer has, therefore, first to pay his licence duties to the government on his horses, men-servants, heraldry, &c., and then to the coachmaker's collector for his carriage, making a double collection necessary. Such a mode of levying taxes frequently causes trouble and irritation, while it offers no single advantage to the government.

Having thus glanced at the conditions under which the present carriage exhibition has been formed, its position as regards foreign trade, and the taxation to which the finished product is subjected, it becomes necessary to examine the collection more in detail.

The first thing that strikes one is the small number of foreign carriages. At each of the large international exhibitions held in London and Paris, foreign carriages have been shown in considerable numbers. In the present Exhibition there are 210 British and 10 foreign, entirely from France. When we know the proportionate numbers at the Exhibition in Vienna we shall probably find that the attraction there has overcome that of London.

A peculiarity of most foreign carriages is the difference of the track of the front and hind wheels; this is caused by the continual striving of foreign builders to shorten to the utmost the distance between the front and hind wheels; they effect their object partly by complicated arrangements of the fore carriage, aided by a shortening of the front axle several inches. In England we submit to a longer space between the front and hind wheels with these advantages, the hind wheels following in the two tracks marked or cut by the front wheels have that portion of the road rolled for them, whereas in the foreign plan each of the front and hind wheels has to roll a track of its own, thereby increasing the draft for the horses.

Besides this, the driver of an English carriage can rely on his hind wheels passing where his front wheels have cleared; not so the driver of a foreign carriage with short front axles, for his front wheels may have passed without collision or accident, but he can hardly ever be sure of his hind wheels being safe unless he has a tolerably clear space on each side.

Among the French carriages is a drag, or four-horse coach, for private use; Messrs. Belvalette, of Boulogne and Paris, have so closely copied the lines and style of London, that at a distance it would be difficult to believe it was a foreign production; however, the reputation of London for such carriages is well supported by Messrs. Peters and Messrs. Hooper, whose carriages of this type are already well known to persons who take any interest in four-in-hand matters. There have of late years been a variety of improvements in details, in order to meet the wants and convenience of persons who use such carriages, more especially as to the stowing of luncheons, ladder, table, &c., but the main features remain such as had been proved most useful for mail and stage coaches used regularly for passenger traffic, just before railways superseded their use for that purpose.

The next carriages to be noticed are the little one-horse phaetons, now become so general, and known as Victoria and Vienna phaetons—the former having curved lines, and the latter straight lines and sharp angles. They have come into use since 1869, in which year the Prince of Wales, on his visit to Paris, had one sent over for the Princess's use. Though so well known and in such general use in Paris, it is currently believed that the late Mr. David Davies, of London, was the original builder of such carriages about forty years ago; he merely adopted the body of the cabriolet, furnished it with a driving-seat in front, and mounted it on four wheels instead of two; be this as it may, they had been made in England for many years, but waited a good introduction; this was effected by his Royal Highness, at a time when their convenience and utility were at once appreciated, and they have been the means of giving much employment since he gave the stamp of fashion that such carriages had long waited for. Their name, given by our French neighbours, savours of the "entente cordiale," as they would hardly adopt the name of our sovereign unless it found favour among them, and its use by the Prince of Wales is a coincidence as to name and nationality that is a fitting sequel.

It may be interesting to some persons to know that another carriage—the waggonette—which has enjoyed great popularity for many years, was introduced by the late Prince Consort, in the year 1845.

There are two well-appointed Victorias from France, and several also from London; they are not so numerous, however, as one might expect, considering the approval they command.

The landaus shown number thirty-three, and are mostly smaller and lighter than those shown in London in 1862 and Paris in 1867; with very few exceptions, they have the improved heads, which fall in a single line, without breaks on the pointed parts, as formerly. In addition to this improvement, twenty-one of them have the further improvement of a balancing action to the head.

Notwithstanding all the improvements made in recent years in these carriages, as regards lightness, style, fall of head, there yet remained the difficulty of raising the head quickly in case of rain. The first step to obviate this was an invention by Morgan, that was worked by a screw on the driver's seat acting on a series of cranks, pinions, and levers; but, although highly ingenious, it was very complicated, and liable to be thrown out of action on uneven ground, or by any conditions preventing its free action. Another invention, by Martin, acted by a metallic rope passing over or under a series of wheels and levers.

An advance towards a simpler method was that of Rock, whose plan was to raise the head by the action of steel plate springs fixed under the wooden elbows. By this plan, a great deal of the space of the sitting room in the carriage was lost by the thickness of the timber both of the pillars and doors.

Other improvements by Morgan, McKenzie, Aldebert, Coward, Lenny, Harrison, Burt, Shanks, and Stokes, consist in applying a spiral steel spring in various ways behind the upright pillars; that of Morgan is worked with concealed joints; the others mostly have the ordinary outside joints, to keep the doorway square and true for the action of the glasses.

There are now eleven patents for effecting this object. They are mostly set in action by a joint of the pillow-top, having a lever-arm in connection with the spiral spring. For their successful application, the bodies must be made with nearly flat elbows, and the heads must fall much flatter than formerly, otherwise there is a possibility of the head rising when in use.

It is evident that the time is approaching when all landaus will be fitted with a balancing mechanism of some kind, as the convenience of being able to open and close such carriages quickly is beyond all doubt.

It may be said that the outside of an omnibus is not the place for ladies. However the difficulty of getting to the outside seats is such that few ladies would formerly make the trial. This difficulty has now been removed by a simple arrangement in the omnibus, for private use, shown by Messrs. Fuller and Simpson, of Leamington. It consists in making a trap-door opening in the front of the body and back of the boot, provided with convenient carpeted steps, communicating with a large door. Though requiring a little care, to prevent a hat or bonnet being crushed, it is a very simple contrivance.

Taking the carriages as a whole, those exhibibitors seem, as usual, to have succeeded best who have sent such as they are in the habit of building, and have had time and opportunity to render perfect and really fit for use; there are some rather glaring examples of the opposite plan; however, exhibitors have, in such an assemblage of carriages, opportunities of learning their weak points and avoiding them in future.

There are this year a large number of carriage drawings shown by professional carriage draftsmen. Hatch and Cooper show a very considerable advance in the art, and, were it not for some extravagances and exaggerations of designs that most carriage-draftsmen occasionally run into, if they are not also coach-builders, would be highly commendable. But it is where designs for State carriages are attempted that the weakness is apparent, both as to the design and decoration It is in this direction that a careful study of the photographs of old foreign state carriages will aid the English designer; for, although the construction is antiquated, and no longer suitable, some of the decorations have much beauty, and are well and skilfully applied. It is to be hoped that these works will be carefully preserved and rendered accessible after the close of this Exhibition.

No foreign countries exhibit carriage-drawings; a large number of such coloured side-views as are shown are sent from England to to foreign countries, as London still sets the fashion for carriages more than any other capital, coach-builders from being annually visited by many parts of the world.

It is much to be regretted that no carriage-drawings are sent from France, where a system of carriage-designing, little known at present in England, is being established, and is exerting considerable influence on carriage-building all over the continent of Europe.

English carriage-drawings are mostly made to satisfy the eye, and to show to intending purchasers the type or style of the carriages that are or can be built, whereas the French plan aims, by accurate, full-size drawings, or drawings to scale, to place every part in its proper position and every detail correctly, so that the master or workman may be sure of the result being satisfactory when completed. The want of such training is apparent in the designs now shown for State carriages, not that such vehicles are much wanted in England, but they are much used in some foreign countries, and the demand is now almost entirely supplied by France and the continent of Europe.

With great reduction of the weight of carriages, there has arisen a rage for straight lines and angles, and, although some builders have combined them with much skill, others have fallen into extravagancies and absurdities that carry their own condemnation, both as to the design of the bodies and weakness of form in the iron-work.

Another defect, that seems still on the increase, is that of so cutting and shaping away the woodwork of the under-carriage that there is no strength left, and this deficiency is made up in a complicated set of iron plates and stays that would allow the wood itself to break on the first real trial of strength—when some deep rut or projecting stone has to be passed over. In fact, such work is made more to please the eye than for real service on the road.

Two carriages are shown by Messrs. Laurie and Marner of London, and one by Messrs. McNaught and Smith, of Worcester, in which Sir J. Whitworth's steel is used instead of iron. Although the metal is, in a high degree pure and dense, its use is at present experimental for carriages, and time is required to ascertain if it fulfils in all respects the conditions necessary for such work.

The present Exhibition shows a tendency towards still further reducing the weight of carriages. It is probable that this will be checked as tramways become more generally used in towns and cities. It is frequently difficult, when private carriages get on the line of trams, to get them off, and this difficulty is much increased with light carriages, by reason of the wheels falling into the iron grooves; and it often happens that either the wheels and under-carriage become seriously strained in freeing themselves, and this will cause the cost of repairing such carriages to become gradually more expensive, and produce increasing annoyance and inconvenience to their owners.

The accessory or supplementary trades connected with the manufacture of carriages are better represented than at any former carriage exhibition, notwithstanding many important omissions. Among those unrepresented are axles, springs, cloth, morocco, leather, colours, &c.

American hickory wheels are shown by Mr. James, the Newhaven Wheel Company, U.S.A.; those of Mr. McKinlay, St. Catharine's, Ontario, Canada, have not yet arrived.

They are excellent examples of accurate workmanship, such as has not yet been attained in this country, for the want of the such appliances as are in ordinary use in America.

Mr. Hopton, of London, shows a well-made London wheel.

Of late years a considerable trade has sprung up in the importation to this country of light American wheels; the freight of made-up wheels, however, adding much to the cost, has induced the manufacturers there to send over prepared spokes, turned and morticed stocks, and bent rims, thus effecting a considerable saving in freight on finished wheels or timber in its rough state. It is probable that the waste wood serves to raise steam for the machinery that prepares the finished article, and thus helps to pay for its conversion.

In carriage laces and silks the French and Germans have been gradually advancing in quality beyond the English; the French and German war having for a time stopped the regular supply, induced Messrs. Fry, of Dublin, to endeavour to equal the foreign products; this they have attained with considerable success, and the results of their enterprise are shown in the south-east carriage gallery. The adoption of improved machinery has enabled them to do with great facility that which was most difficult and tedious in the old looms.

On some of the carriage panels will be found some well-executed heraldry. This is an art which had fallen into much neglect, but a revival has taken place latterly. The monogram has taken the place of the widow's formal but orthodox heraldic lozenge; besides being much used in making an effective group with the coronet or crest of noblemen and gentlemen. Several novelties, in the manner of arranging these matters, are shown on carriages in the Exhibition.

It was rumoured that the Clothworkers' Company of London had intended offering medals for carriage cloths, to be shown in the Carriage Exhibition of London; but delays intervened, and there is no special separate show of cloths for the purpose.

It is hoped that the valuable medals the Company offer for competition at the Vienna Exhibition this year, will be of advantage to British manufacturers, as foreign nations have recently been making great strides in the manufacture of cloth. It is, besides, an excellent support to other Companies that are endeavouring, with great hindrances and impediments, to bring their funds into use for the advantage of the manufactures they were specially formed to foster, uphold, and improve.

There is a small contribution of carriage glasses, from the eminent firm of Chance, of Birmingham. Although the consumption of plate glass for carriages is not so large as for buildings, mirrors, &c., there is still a considerable demand to be supplied; and its proper manufacture has, of late years, been neglected. The glass now usually supplied is too thin, and has a tendency to cause vibration and rattle; if very thick it becomes too heavy for a lady to lift when in a carriage; it is, besides, wanting in purity and whiteness, not being so good in colour as French glass, and, being soft, it has a tendency to become scratched in such service as carriages must undergo.

Among the late foreign arrivals is a case of carvings by M. Boire, of Paris. Although they evinced much skill in designs and manipulation, but few of the specimens are suited for carriage finish or decoration, being too intricate and delicate for such rough usage as even dress carriages must be fitted to endure. However, they show a much greater facility for design than is usual among English coach-carvers, and are well worthy of notice. The carved fittings for interiors of carriages are prettily executed, and are better adapted for the end in view than the carvings prepared for the external parts.

Some cases of metal chasing for carriages are shown by Mr. Boyden and Mr. Hughes.

It is to be regretted that no specimens of French metal chasing are shown in this department, as the art has attained a high degree of perfection in Paris, and enables the coach builders of that capital to execute orders for dress, and state carriages for Egypt, Turkey, South America, Mexico, and other countries, with comparative ease. There is an amount of intelligence, capacity, and enterprise for such work among our French friends, that seems wanting in London; or, if it exists, it is singularly backward in rendering itself available.

The beautiful invention of Messrs. Cristofle, of Paris, whereby artistic models are reproduced in metal, at a moderate cost, is singularly applicable to such work. A thin hollow deposit of copper is made; this is partially filled with brass in a fluid state, and when cool the object is as strong, and, at the same time, as chaste and delicate as the original model. An electro-deposit of silver or gold renders the object fit for the decoration of such highly decorated carriages as many orientals will only buy or use.

Mr. G. E. Holmes shows an interesting collection of the various woods used in the manufacture of carriages in England; it would be interesting to bring together similar collections of the woods used in other countries for the same purpose.

Mr. C. Holmes shows leather and other work used in carriage-building, machine sewn. There have been difficulties in the application of sewing machines to such purposes, and the present examples show that they are in a fair way of being overcome. The same exhibitor shows portions of carriages, in wood and iron, partially prepared by machinery; the latter may give useful hints to coachsmiths and ironmongers who prepare large quantities of such articles for coachbuilders' use, and might enable them to reduce the cost of production, notwithstanding the increased cost of iron and fuel.

For many years the late firm of Raworth produced in Sheffield large quantities of excellent carriage-axles forged by machinery; and it is surprising that the process has not been more generally adopted, as experience had long since proved how sound and good the forgings by such means can be made.

A new and inexpensive process of coating steel and iron goods with nickel has no representative in the Exhibition. Polished pole-hooks, chains, driving-bar-ends, bits, stirrups, spurs, &c., when treated by this process, can be kept clean and in good condition with one-tenth of the labour necessary when such articles are used as at present, when a very short exposure to water or damp air produces oxidation.

A good collection of carriage-lamps is shown by Mr. Moore. There has been much change in form of late years, and large, strong, well-made lamps are required for the four-horse coaches so much used by country gentlemen; they are fitted with argand burners, requiring great care in manufacture, powerful, well-adjusted reflectors, and, from the great heat of the flame, require special precautions to prevent the top of the lamp being fused when in use.

Mr. Wallis shows a model of an omnibus with improved ventilating roof. On this plan, with some modifications, all the best London omnibuses are now built; and the public owe a debt of gratitude to the inventor for showing how fresh air can be introduced into such carriages without producing unnecessary drafts.

Mr. Boswell shows a model of an omnibus hung on two very high central wheels, supplemented by four smaller wheels at the corners, the axles of which, being connected by cross chains, lock the four end wheels simultaneously, and enable the vehicle to turn on little more than the ground it covers.

Among the small vehicles in the east arcade are invalid chairs, by Ward and Alderman; perambulators by Ward and Johnson; and some very light bicycles by Keen, and Smith and Stanley.

Mr. W. Cook shows a carriage-wheel with steel tension rods and elastic tyre, said to have been used three months on a physician's brougham; it shows little sign of wear, and if it fulfils all the conditions of a good wooden wheel, and is also noiseless and elastic, it will solve a difficult problem.

There are 5 carriages from Scotland, and 2 from Ireland.

A glance at the table of statistics shows that there are in the present Exhibition, 185 private carriages, 16 public carriages, 8 old carriages on loan, and 11 wagons and carts, making a total of 220 vehicles. Of the private carriages, 10 are foreign, all being from Paris; 84 from London, and 91 from the provinces; the exhibitors of such carriages being 4 foreign, 46 London, and 48 provincial—total, 98.

Of the drags, 2 are of London, and 1 of Paris.

Of the landaus, 20 are of London, 12 from the provinces, and 1 from Paris.

Of the broughams, 27 are of London, 16 from the provinces, and 2 from Paris.

Of the Victoria phaetons, 13 are of London, 18 from the provinces, and 1 from Paris.

Of the other phaetons, 13 are of London, 18 from the provinces, and 1 from Paris.

Of wagonettes, 2 are of London, 9 from the provinces.

Of dog-carts, 1 is of London, and 23 from the provinces.

Of public carriages, 7 are of London, and 3 provincial.

Of the 33 landaus shown, 21 are fitted with balanced heads, on various ingenious plans, and of varying degrees of merit, most of them patented.

Of the 9 carriages hung on C-springs with iron perch, 5 are of London, 2 provincial, and 2 from Paris.

London, like most other capital cities, is the principal seat of the carriage manufacture of the country it is in; and on the present occasion, partly on account of the Exhibition being conveniently placed for its manufactures, and partly to keep its productions before the public, is well represented; indeed it contributes nearly as many carriages as come from all other places jointly, and nearly all the most celebrated builders send specimens of their manufacture. The provinces are also well represented by nearly all the best-known builders. The carriages of France are few in number, and although there are contributions from the house of Belvallette Freres, that has won so many medals at Industrial Exhibitions, in contrast with the best London carriages there is still a wide interval.

Nearly all the contributions show change, but not all in the best direction; many of the provincial carriages show points of great excellence, adapting them to country work and conveniences as regards easy draft, facility of access and capacity without great weight.

Reverting, however, to the London carriages, it may be safely said that the best of them will safely bear comparison with and surpass those from any other place in the world, whether as regards style, design, general arrangement, durability, or high finish. There is a *distingué* look about them, that is only approached by some of the best Paris ones, and in those cases only where the London models have been most closely copied.

To the Society of Arts is due the credit of collecting the cabs now exhibited in competition for the money prizes offered by the Society. Under the present system people ride in cabs as cheaply as can reasonably be expected, but the Society seems to aim at a better service, not only in consideration of reduced taxation, but to meet public requirements.

The cabs now in use, whether on two or four wheels, do good service; the former in taking people rapidly from place to place, and the latter in carrying the utmost number of passengers, with luggage, to or from railway stations, with a single horse. But as for a little enjoyment in leisure hours, no provision is at present conveniently available for those of moderate means who cannot afford to keep their own carriages. Every one does not want to be constantly whisked about in a vehicle that is inaccessible to most people beyond middle age, or to have their teeth shaken out in the cramped and unsightly and uncomfortable four-wheeler. Some comfortable and appropriate carriages, readily available, even at a slightly increased rate of charge, would be a great convenience to many residents, as well as to strangers.

A great change has been accomplished in the other class of public vehicles plying for hire in London. Most omnibuses have improved roofs, by which a current of fresh air circulates in the vehicles, rendering them not only more wholesome, but available to persons who formerly were unable to use them on account of the foul air certain to accumulate in such vehicles when carrying passengers.

A new feature in locomotion is the equipment of four-horse coaches, now leaving London daily. These have mostly been put on the road by various noblemen and gentlemen who have, as a general rule, not looked upon the enterprise in a commercial light, or as a source of profit.

It is very desirable to encourage the visits of the most intelligent artisans to such periodical Exhibitions as are now being held annually. Without previous arrangements, it is but too easy for them to dissipate their attention, and learn very little. In order to obviate this, and to render their visits not only interesting, but of real service to them in their daily occupations, it has been found that if a few experts in a trade make themselves thoroughly acquainted with the contents of their department as to new inventions, improved processes, highly skilled workmanship, new materials, &c., they are in a position to point out to strangers and workmen who have not had the time or opportunity to study the class as a whole, the objects most worthy of notice. Her Majesty's Commissioners have taken steps to afford this aid in the Carriage Department, by naming an expert who is willing to offer his services where they may be required.

APPENDIX.

Public Carriages.

	French.	London.	Provincial.	Total.
Hansom cabs	..	4	7	11
Four-wheel cabs	..	3	2	5
	..	7	9	16

Private Carriages.

	French.	London.	Provincial.	Total.
Coaches	1	..	..	1
Drags	1	2	..	3
Barouches	..	6	6	12
Landaus	1	20	12	33
Landaulettes	..	3	..	3
Broughams	2	27	16	45
Victorias	4	8	2	14
Phaetons	1	13	18	32
Omnibuses	..	..	2	2
Waggonettes	..	2	9	11
Breaks	..	1	..	1
Gigs	..	..	2	2
Dog-carts	..	1	23	24
Hansom cabs	..	1	1	2
	10	84	91	185

C Spring Carriages (included among Private Carriages).

	French.	London.	Provincial.	Total.
Barouches	..	2	..	2
Landaus	..	2	1	3
Broughams	1	1	1	3
Coach	1	..	..	1
	2	5	2	9

Old Loan Carriages.

	French.	London.	Provincial.	Total.
State coaches	..	4	..	4
Neapolitan carriole	..	..	..	1
Chariot	..	1	..	1
Flemish carriage	..	..	..	1
Barouche	(1 From Australia)			1
	—	—	—	8
Waggons and cart	—	5	6	11

Gross total 220

Summary.

Total number of	Private carriages	185
,, ,,	Public ,, ...	16
,, ,,	Old loan ,, ...	8
Total		209
Waggons and carts		11
Gross total		220

No public omnibus; 1 brougham and 1 landau from Ireland; 1 gig, 2 dog-carts, and 1 park phaeton from Scotland.

Exhibitors.

London	46
Provinces	48
France	4
Total	98

Total Value of Carriages Imported and Exported into and from Various Countries.

COUNTRIES.	Years.	IMPORTS. For Home Consumption.	EXPORTS. Domestic Produce.
		£	£
FRANCE. Carriages	1869	10,418	139,327
	1870	10,003	76,324
	1871	40,646	100,153
BELGIUM. Carriages, carts, and waggons, and parts thereof	1869	6,227	26,685
	1870	4.889	46,112
	1871	5,365	54 985
HOLLAND. Carriages	1869	10.373	8,818
	1870	13,119	5,542
	1871	10,404	8,314
SPAIN. Carriages (exclusive of carts and waggons)	1866	10,200	Not distinguished.
	1867	16,100	
	1868	10,900	
AUSTRIA. Carriages (exclusive of carts and waggons)	1868	1,930*	91,730*
	1869	2,450	100,770
	1870	2,700	150,240
UNITED STATES. Carriages	1869	Not distinguished	83,191
	1870		92,694
	1871		57,273
UNITED KINGDOM. Carriages of all sorts, except railway carriages	1868	...	53,605
	1869	...	59,228
	1870	...	57,657

* The figures for Austria are for the total imports and exports.

Report of the Judges of the Coachmakers' Company on the Drawings sent in Competition for their Prize Medals and Certificates.[*]

The judges appointed by the court of the worshipful Company of Coachmakers and Coachharness Makers of London, to examine the drawings of carriages and parts of carriages sent in competition the medals, money prizes, and certificates, &c., &c., offered by the Company, have to report as follows:—

The drawings sent in were far more numerous than last year, there being 27 competitors and 62 drawings.

Some of the competitors were excluded, by reason of their drawings not being made in accordance with the conditions published by the Company.

However, most of them seem to have fairly understood what was required by the Company, and it is hoped that by taking advantage of the means of exhibiting the best drawings at the Carriage Exhibition, held this year at South Kensington, the prizes offered annually by the Company will become better known and more keenly competed for, and each year show a higher average of skill in drawing.

In considering the drawings sent in, there seems to be a very general want of knowledge in free-hand drawing, as a preliminary training before special carriage drawing; the consequence is a poorness of design, that better training would prevent.

There is also an evident want of general knowledge of carriage construction as a whole among the competitors. Each competitor seemed to have a fair knowledge of his own department, but when he tried to combine the work of other departments with his own, the result in many cases is unsatisfactory. A good training in the technology of carriage building, as proposed by the Society of Arts, will tend greatly to strengthen future competitors in the means of producing satisfactory results.

The judges have not considered the work of any competitor of sufficient merit to justify them in recommending the court to confer the freedom of the Company this year. They, however, recommend that, considering the great increase of competitors, the company should increase the number of medals and money prizes to be awarded in future years by the judges, and continue to offer the freedom to such candidate as shows a high degree of merit, especially as the freedom seems to be considered a distinction eagerly sought after.

After a careful examination of the drawings sent in for competition, the judges award as follows, viz.:—

1st Prize (the Company's silver medal, £3, and certificate) to Mr. George Fleming Budd (the winner of the first prize last year), coachbody maker, of No. 3, Cumberland-street, Tything, Worcester, for a set of three drawings, as follows:—1st. An elliptic spring barouche, with working section. 2nd. A "C" and underspring brougham, with working sections. And 3rd. An elliptic spring landau, with working sections.

2nd prize (the Company's silver medal, £2, and certificate) to Mr. James Brown, foreman, 18, Kingsmead-street, Bath, for a set of two drawings, as follows:—1st. A mechanical drawing of a landau, to open and shut from the driver's seat, with sections thereof; and 2nd. A design for a T cart.

3rd prize (the Company's bronze medal and certificate, with £1 added by the right worshipful the master) to Mr. George Edward Holmes, foreman, London-road, Derby, for a drawing of an elliptic spring barouche, showing the front side and back elevations, with working sections, and two views of a self-acting folding step.

In addition to the above prizes, the judges award the certificate of the company to each of the following, viz.:—To Mr. Benjamin Laws, foreman, 413, Liverpool-road, Islington, for four drawings, viz.:—1st. An imperial phæton, showing front, back, and side views. 2nd. A single brougham, showing the same views. 3rd. A "C" and underspring barouche, with like views, and under-carriage; and 4th. Drawings of springs and axles.

To Mr. John P. Lake, foreman, 1, Philip-street, Westminster, for the drawing of a dress coach, with working sections.

Herbert M. Holmes, Master.
Jno. Holland, Upper Warden.
George N. Hooper, Renter Warden.
Jos. Peters, Past Master.
W. T. Thorn, Past Master.
Jno. F. Woodall, Past Master.

Description of Her Majesty's State Coach.

Finished in the year 1761, the most superb carriage ever built, designed by Sir William Chambers, and executed under his directions. The paintings executed by Cipriani.

The front panel, Britannia seated on a throne, holding in her hand a staff of Liberty, attended by Religion, Justice, Wisdom, Valour, Fortitude, Commerce, Plenty, and Victory, presenting her with a garland of laurel; in the back-ground, a view of St. Paul's and the river Thames.

The right door, Industry and Ingenuity, giving a cornucopia to the Genius of England.

The panels on each side of right door, History, recording the reports of Fame and Peace, burning the implements of war.

The back panel, Neptune and Amphitrite issuing from their palace in a triumphant car, drawn by sea horses, attended by the Winds, Rivers, Tritons, Naiäds, &c., bringing the tribute of the world to the British shore.

Upper part of back panel is the royal arms, beautifully ornamented with the Order of St. George, the rose, shamrock, and thistle entwined.

The left door, Mars, Minerva, and Mercury, supporting the imperial crown of Great Britain.

The panels on each side of left door, the Liberal Arts and Science protected.

The front and four quarter-panels over the paintings are plate glass.

The whole of the carriage and body is richly ornamented with laurel and carved work, beautifully gilt. The length, 24 feet; width, 8 feet 3 inches; height, 12 feet; length of pole, 12 feet 4 inches; weight, 4 tons. The carriage and body of the coach is composed as follows:—Of four large Tritons, who support the body by four braces, covered with red morocco leather, and ornamented with gilt buckles. The two figures placed in front of the carriage bear the driver, and are represented in the action of drawing by cables extending round their shoulders, and the cranes and sounding shells to announce the approach of the monarch of the Ocean; and those at the back carry the imperial fasces, topped with tridents. The driver's foot-board is a large scallop shell, ornamented with bunches of reeds and other marine plants. The pole represents a bundle of lances; the splinter bar is composed of a rich moulding, issuing from beneath a voluted shell, and each end terminating in the head of a dolphin; and the wheels are imitated from those of the ancient triumphal chariot. The body of the coach is composed of eight palm trees, which, branching out at the top, sustain the roof; and four angular trees are loaded with trophies allusive to the victories obtained by Great Britain, during the late glorious war, supported by four lion's heads. On the centre of the roof stand three boys, representing the genii of England, Scotland, and Ireland, supporting the imperial crown of Great Britain, and holding in their hands the sceptre, sword of State, and ensigns of knighthood; their bodies are adorned with festoons of laurel, which fall from thence towards the four corners.

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[*] Referred to at page 706.

The inside of the body is lined with rich scarlet embossed velvet, superbly laced and embroidered with gold, as follows. In the centre of the roof is the star, encircled by the collar of the Order of the Garter, and surmounted by the imperial crown of Great Britain; pendant, the George and dragon; in the corners, the rose, shamrock, and thistle entwined. The hind lounge is ornamented with the badge of the Order of St. Michael and St. George; and on the front the badge of the Guelph and Bath, ornamented with the rose, shamrock, and thistle. The hind seat-fall has the badge of St. Andrew, and on the front the badge of St. Patrick, adorned with the rose, shamrock, thistle, and oak leaf. The hammer-cloth, of the same costly materials. The harness, for eight horses, is made of red morocco leather, and decorated with blue ribbons, the Royal arms, and other ornaments, richly gilt; and it is used when Her Majesty goes in state, drawn by eight cream-coloured horses, and is kept in the Royal Mews, Pimlico.

The Lord Mayor's State Coach.

This coach was built in the year 1757. An entry in the *British Chronicle* of Wednesday, the 9th November, 1757, states that Sir Charles Asgil, Knt., attended by the aldermen, sheriffs, and other officers of the City, went in the new state coach, drawn by "six fine roan horses, to the Three Cranes, and being attended by several of the companies' barges, went from thence to Westminster, where he was sworn into the high office of Lord Mayor of this City, before the barons of the Exchequer, &c." It would appear probable, therefore, that this was the first occasion of its public use by the Lord Mayor.

In 1777 extensive repairs and adornments were made to the coach by a Mr. Jacob.

On the 27th September, 1778, a report was presented to the Court of Common Council, in which it is stated, "That the present state coach was built in 1757, by subscription of £60 each from the several aldermen then under the chair, and the aldermen entered into an agreement that every gentleman thereafter elected alderman should on his admission subscribe £60 towards the expense of building the coach, and when elected mayor £100, which £100 was to be allowed him for ornamenting and beautifying the same."

At the same time the then proprietors of the coach, having relinquished their rights therein to the Corporation, the Common Council directed that measures should be taken for its due preservation, and it has since that time been kept in repair by the General Purposes Committee.

By whom the coach was built or the carvings executed cannot now with any certainty be ascertained. The panels are said by some to have been painted by Cipriani, and the heraldic devices have been attributed to Catton, one of the foundation members of the Royal Academy, who was also coach-painter to King George III. The statement of Smith, in "Nollekens and his Times," that after the present royal state coach was built, in 1762, the old one was purchased by the City of London, and the panels repainted by Dance, appears from the entries before given to be without foundation.

The under-carriage, which is richly carved and gilt, has in front a pair of marine figures supporting the seat of the driver, in front of which projects a large scallop shell, forming the footboard.

Above the hind axletree is an open gilt framework, to which the braces supporting the coach are attached; the ends of the framework are ornamented with two griffins, and in the centre is the shield of the City arms, supported by figures of Commerce and Plenty.

The perch, which is painted Indian red and picked out with gold, is double, and terminates in dolphins' heads.

The four wheels, which resemble those of ancient triumphal chariots, are carved and painted red, and partly gilded, having massive gilt bosses covering the wheel-boxes.

The body of the coach is not supported by springs, but suspended upon four thick black leather braces, fastened with large gilt brass buckles of spirited design, each bearing the City arms.

The framework of the carriage is also finely carved and gilt throughout.

The roof is painted red and ornamented with eight gilt vases. The centre was formerly occupied by a group of four boys supporting baskets of fruit and flowers, the truncated base of which still remains, and is covered with the City arms, from which ornamental gilt scroll-work trails over the remainder of the roof.

The upper intervals of the body, except at the back, are filled with plate-glass; above each door is a Phrygian cap, with wings, surrounded with scroll-work; and between the upper and lower panels a Roman trophy, of helmet, spears, and flags. At the lower angles of the body are dwarf figures, emblematic of the four quarters of the globe. The smaller enrichments about the panels, as shells and flowers, are also admirably carved and grouped. Over the back panel are a serpent and dove, typical of Wisdom and Innocence.

The lower panels, which are admirably painted, are as follows:—

The front panel—Faith, Hope, and Charity; Faith beside a sacrificial altar, supporting Charity, Hope pointing to St. Paul's Cathedral.

Lower back panel—The Genius of the City, seated, Riches and Plenty pouring money and fruits into her lap; a large ship in the background, and bales of merchandise in front.

Upper back panel—The Genius of the City, attended by Neptune, receiving the representatives of Trade and Commerce from all the quarters of the globe; the shaft and capital of the monument in the background.

Right side door—The Genius of the City throned, having in her hands the sword and sceptre; Fame presenting to her a Lord Mayor, over whose shoulder she holds a wreath. On the left of the picture, on a table, are grouped the sword, mace, and cap of Maintenance, the spire of old St. Paul's in the background. In the small panel beneath are the staff of Mercury, and a cornucopia emblematical of Peace and Plenty.

Side panels.—The left represents Truth with her mirror, and the right Temperance holding the bridle.

Left side door.—The Genius of the City standing with her right hand on the civic shield. Mars, the especial deity of citizens, pointing with his spear to a scroll held by Truth, bearing the inscription, "Henri Fitzalwin, 1189" (the first mayor); the tower of London, with some shipping in the background. In the small panel beneath is the City state sword and scales of Justice.

Side panels.—The left panel depicts Justice with her sword and scales, and the right Fortitude.

In shields at the lower angles of each door, and of the front and back panels, are emblazoned the arms of the Lord Mayor for the time being and those of the City of London.

The coach was entirely re-gilded in November, 1868. and the paintings carefully cleaned in 1869, when numerous coats of varnish, which previously obscured them, were removed, and the coach was re-lined, and a new hammer-cloth supplied.

Irish Lord Chancellor's carriage (catalogue number 3,979). Date 1780. Panels decorated with allegoric paintings by W. Hamilton, R.A.

Neapolitan carriole (catalogue number 3,979). Date early 18th century.

Flemish carriage (catalogue number 3,979). Date 1,750.

Swiss sledge (catalogue number 3,980). 17th or 18th century. Made of lime wood.

English sledge (catalogue number 3,980). 17th or 18th century.

Japanese sedan chair. 19th century.

TECHNICAL EDUCATION.

His Royal Highness the Prince of Wales held a conference on Monday morning last, at Marlborough-house, of representatives of the principal City companies, with the view of discussing how technical education might be promoted by those companies acting in concert with the International Exhibitions. The conference was attended by the Right Hon. the Lord Mayor, the Earl of Carnarvon (chairman of the Board of Management of the Commissioners), Sir William Anderson, K.C.B., and by the following representatives of companies:—Mr. L. A. Outhwaite (Blacksmiths), Mr. John Addison (Clockmakers), Mr. J. Bazley White (Clothworkers), Mr. G. N. Hooper (Coach and Harness Makers), Mr. Henry Capel (Coopers), Mr. John Loat and Mr. E. Burkitt (Curriers), Mr. S. C. C. Fish (Drapers), Mr. H. W. Jewesbury (Dyers), Mr. James Spicer (Fishmongers), Mr. T. Mowlem Burt (Glass Sellers), Mr. H. W. Johnson (Gold and Silver Wire Drawers), Alderman Stone (Haberdashers), Mr. H. A. Smith (Ironmongers), Mr. Jas. Winter, jun. (Joiners), Mr. J. Russell Freeman (Masons), Mr. M. D. Longden (Mercers), Mr. Charles Gordon (Merchant Taylors), Mr. S. M. Hubert (Plasterers), Mr. H. Harris (Saddlers), Mr. J. G. Nichols and Mr. J. V. Shaw (Stationers), Mr. G. Offer (Tin Plate Workers), Mr J. E. Saunders (Wheelwrights), Mr. A. Gillett (Woolmen). Mr. Henry Cole, C.B., and Major-General Scott also attended the conference.

The Lord Mayor having introduced the several representatives to his Royal Highness,

The Prince of Wales said the interest which the City Companies felt in the subject which had called them together was shown by the number of the gentlemen whom they had deputed to represent them, and such a meeting proved to him that the object was already half attained. His Royal Highness stated that he had learnt that some of the Companies intended to send to the present Exhibition scholars attached to the schools under their care, and he trusted the other Companies would follow their example, and thus co-operate with the Commissioners in their great task of promoting the study of science and art as allied to productive industry.

Lord Carnarvon said it was to aid in the work of allying science and art with productive industry that the scheme of the Annual International Exhibitions at South Kensington had been started, and, great as had been the difficulties in the way of an Exhibition to be held every year, he was sanguine of its ultimate success. He thought that bodies of such influence and wealth as the City Companies could give the Commissioners much assistance. The promotion of technical education through the Exhibitions was in the interest of all of them. His lordship entered into details of the scheme of Exhibitions, and pointed out that every branch of industry had a year allotted to it for its representation, three or four branches being included in each year's Exhibition. Lord Carnarvon acknowledged the great interest which the City companies had always taken in the work of public education, as manifested by the numerous schools under their management. He recommended that, as a present step, the schools themselves should be sent to the Exhibition, or certain scholars should be selected, who should attend the daily lectures which the Commissioners had arranged to be given in the presence of objects themselves. He also suggested that the City companies might place tickets of admission at the disposal of the London School Board, who might select scholars to receive them as prizes. He concluded by saying that if Great Britain intended to keep the prominent industrial position she had acquired amongst all nations, she must devote her whole energy to the advancement of the people in the arts and sciences applied to industry.

The Lord Mayor acknowledged the accuracy of Lord Carnarvon's statement, that the City Companies had already done much to promote the cause of technical instruction. Some—for instance the Clothworkers and Coachmakers—had made grants of prizes for the most meritorious productions of workmen engaged in various branches of trade. Others had introduced scholarships in science and art, whilst the Stationers had instituted a highly successful series of lectures. These had been the efforts of single companies, but much more important results could be obtained by union, and especially by a union promoted by his Royal Highness. His lordship thought the idea of connecting the City Companies in promoting the objects of the Exhibition Commissioners was well worthy of the attention of the City Companies, and that they ought to respond readily to the Commissioners' proposals. He concluded by proposing the following resolution:—"That this meeting cordially sympathises with the objects for which it has been called, and as far as lies in its power, promises the best support and co-operation of the City Companies." His lordship added that at this period of the year it might be difficult to get some of the Companies to make grants of money, or to otherwise move in the matter; and he suggested that it would be advisable that a precise explanation of the action which it was wished that the Companies should take should be communicated to them, in order that there might be unity of action.

Alderman Stone seconded the resolution. He thought that those Companies which had no special trade of their own to support ought to be the foremost in supporting schemes for the benefit of the public at large; and, speaking for his own Company (Haberdashers), he thought he could promise support.

Mr. Cole, C.B., explained that the Commissioners had determined that, during the months of August, September, and October, schools should be admitted to the Exhibition by ticket, at three-pence each scholar, and that, during the month of August at least, frequent lectures each day would be given on the various subjects and processes exhibited. He suggested that the City Companies, in addition to sending their own schools to attend these lectures, might purchase tickets, and place them at the disposal of the London School Board, to enable them to award them as prizes. Such tickets might also be distributed among other public schools.

The resolution was carried unanimously.

His Royal Highness said that he felt sure that, after the discussion they had had, the gentlemen present must be convinced of the importance of the question which had called them together. He suggested that they should endeavour to interest the Companies they severally represented in the matter, and should let the Board of management of her Majesty's Commissioners know the decision which each Company arrived at.

The Lord Mayor expressed his acknowledgments to his Royal Highness for having called the Conference together, and the gentlemen present then retired.

The Company of Coach-makers and Coach-harness Makers have offered the three following prizes, £3 and their certificate, £2 and their certificate, £1 and their certificate, to foremen, clerks, workmen, and apprentices in the coachbuilding trade in the United Kingdom for the best reports on the present international exhibition of carriages at South Kensington. The reports, with a private mark, are to be sent to the Company's Hall, Noble-street, Falcon-square, E.C., on or before the 30th October next, accompanied with a letter bearing the same private mark. Such letter to contain the name, address, age, and position of person sending in such report. The reports will be adjudicated upon by the standing committee of the company.

The number of visitors admitted to the Exhibition on Thursday, July 17th, was as follows:—Season tickets, 156; on payment of 1s., 2,887; total, 3,043. On Friday, season tickets, 156; on payment of 1s., 2,286; total, 2,442. On Saturday, season tickets, 867; on payment of 1s., 3,685; total, 4,552.

The number of visitors admitted to the Exhibition during the week ending Saturday, July 12th, was as follows:—Season tickets, 1,630; on payment of 2s. 6d., 945; on payment of 1s., 14,005; total, 16,580.

The number admitted on Monday was, season tickets, 120; on payment of 1s., 1,982; total, 2,102. On Tuesday, season tickets, 141; on payment of 1s., 2,697; total, 2,838. On Wednesday, season tickets, 137; on payment of 2s. 6d., 635; total, 772.

EXHIBITIONS.

Vienna Exhibition.—Cheap excursions are now starting every Saturday from London, *viâ* Antwerp, to Vienna and back. Fore cabin and third-class rail, £4 6s. 6d.; fore cabin and second-class rail, £5 12s. 6d.; best cabin and second-class rail, £6. All tickets available for one month. For tickets and further information, apply to Charles Atkins, 1 Water-lane, Great Tower-street, London.—In the supplementary estimates for the year, presented to Parliament this week, appears a sum of £14,000 as an additional grant for the purposes of the Exhibtion. This second grant is more than double the amount, £6,000, previously voted.—*Nature* says:—"Les Richesses Naturelles du Globe à l'Exposition Universelle de Vienne," by M. Bernardin, is the title of a short pamphlet called forth by the Vienna Exhibition, the author's object being to show that most of the industrial materials obtained from the animal, vegetable, and mineral kingdoms within the last 40 years have been lighted upon by chance, and that if competent men were to make a thorough investigation of the subject, Nature might be made to contribute to industry a vastly greater amount of material than she at present does.—The Board of Directors of the Vienna Corn Exchange have resolved that an international corn and seed market shall be held at Vienna on the 5th and 6th of August, 1873, which, taking place during the Universal Exhibition, will offer an opportunity to agriculturists and dealers in agricultural produce to hold a general meeting in Vienna.

OBITUARY.

Lord Westbury.—By the death of Lord Westbury the Society has lost a distinguished member. There is no necessity to repeat in these columns any account of a life, the history of which has already been given with sufficient fulness by the daily press. It may be enough to mention that, since he became a member of the Society in 1853, Lord Westbury often contributed valuable assistance to many of the objects the Society has in view. In 1861 he was elected a Vice-President of the Society; but it was in connection with the Fine Arts Copyright Act of 1862 that he rendered most especial service. It is not too much to say that, without his co-operation, first as Attorney General, and afterwards as Lord Chancellor, this Bill could not—at all events, at that time—have been passed. The value of the privileges thus obtained for artists of every sort needs no comment. It was indeed an anomaly in our legal system that for so long a time the producer of a work of art should not have had equal privileges with the author of a work of literature. That so important a boon was conferred upon the world of art though the agency of the Society, must ever be a source of gratification to its members, and it should not be forgotten that amongst those who laboured for so desirable an end, a foremost place must be assigned to the late Lord Chancellor.

Sir David Salomons.—The death of Sir David Salomons took place on Friday, the 18th inst. The deceased was in his seventy-sixth year, having been born in 1797. In 1835 he was elected a Sheriff of London; in 1847 he became an alderman, and in 1855 he attained the Lord Mayoralty. He had previously sat for a short time in parliament as member for Greenwich. In 1859 he regained his old seat, and retained it up to the time of his death. The baronetcy was conferred upon him in October, 1869. Sir David became a member of the Society in 1849.

NOTICES.

SUBSCRIPTIONS.

The Midsummer subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

THE LIBRARY.

The following works have been presented to the Library:—

The Edinburgh University Calendar, 1873-74. Presented by the University.

The Twentieth Report of the Science and Art Department of the Committee of Council on Education. Presented by the Department.

The Charter, Bye-laws, and List of Members of the Institution of Civil Engineers. Presented by the Institution.

Heavy Rifled Ordnance. Speech of Mr. Hick, M.P., in the House of Commons, on the 23rd of June, 1873. Presented by Mr. Bashley Britten.

A seam of coal has (says the *Liverpool Daily Post*) just been discovered at Saughall Massie, Cheshire, and operations are about to be commenced for the sinking of shafts. Fresh coal-fields have also, it is said, been discovered near the River Dee.

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FRIDAY, AUGUST 1, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

GENERAL EXAMINATIONS.

The Programme for next year is in preparation, and will shortly be published. The subjects will remain the same as at the last Examination.

With reference to the suggestions made at the Conference, the Council have decided as follows:—

1. They do not see sufficient reason for restoring the subject of Latin.

2. The rule which prevents a candidate who has once obtained a first-class certificate in a subject from being again examined in that subject with a view to gaining a prize, has, in accordance with the wish expressed at the Conference, been rescinded. In future, therefore, a candidate who has obtained a first-class certificate in a subject may be again examined in that subject, but not more than one first-class certificate in any subject will be counted for the Prince Consort's prize, and no candidate will be entitled to take a prize of the same grade twice in any subject.

TECHNOLOGICAL EXAMINATIONS.

The subjects in which examinations were held this year, namely, Cotton Manufacture, Paper Manufacture, Silk Manufacture, Steel Manufacture, and Carriage-building, will be retained in the Examinations of next year, with the addition of Cloth Manufacture, Glass-making, Pottery and Porcelain, and the Manufacture of Gas.

The Programme is in preparation, and will be published as soon as possible.

SIR JOSEPH WHITWORTH'S PRIZES FOR THRIFT ESSAYS.

Sir Joseph Whitworth has offered prizes of the value of one hundred pounds, to be awarded by the Society of Arts, for the best Essays on the "Advantages that would be likely to arise if railway companies and limited companies generally were each to establish a savings-bank for the working classes in their employ." With this offer he has transmitted the following observations:—

1. Is not a good rate of interest, with perfect security, more likely to promote the habit of saving than any other plan that can be devised?

2. Sir Joseph Whitworth suggests that the interest to be paid on the deposits should be the same as the dividend, with a guarantee that it shall not be less than 4 per cent.

3. By paying the same rate of interest as the dividend earned, there is a bond of union established between labour and capital.

4. An Act of Parliament might make the deposits of the industrial classes the first charge on the estate.

5. The proprietor of a private establishment, whose profits are not made known, might undertake to pay, say 7 or 8 per cent. when the profits reached that amount or more, the proprietor giving an undertaking to pay not less than 4 per cent.

6. In the case of Agriculture, each county might have its savings-bank for the savings of both men and women in the said county, and the interest to be paid might be 6 or 7 per cent.

7. To do this there might be a rate collected along with the poor-rate, to be called the interest or industrial rate.

8. As this rate increased, no doubt the poor-rate would diminish, and if the habit of saving became general among the labouring classes, there would probably be great gain to the property-owning classes, considering the great variety of ways in which they have now to contribute for the support of the unfortunate who now make no provision for themselves.

9. In order to realise what might be the probable saving to those who encourage the savings-banks thus suggested, Sir Joseph Whitworth points to the list of charities, also institutions, such as infirmaries, hospitals, union-houses, prisons, police, &c., &c.

10. In any establishment, if only one-third of those employed deposited savings, they would have immense influence over the other two-thirds of their fellow-workmen.

11. Men who spend all their earnings are generally reckless, and become the dupes of agitators; but the man who has put by some of his earnings will be likely to exercise forethought, and will not be led away by others.

12. In South Wales is it likely there would have been the late turn-out, if the different establishments had each had such a savings-bank as that proposed?

13. In the case of a man or woman falling into distress from causes beyond their control, what better proof could be given that they were deserving of sympathy and assistance from their friends, than the fact that they had put by savings at a time when they were able to do so? The rule of action should be to do as little as possible for those who do as little as possible for themselves.

14. Some of the points to be considered by the essayists will be the amount to which the savings shall be limited, and when the depositor wishes to withdraw the whole or any part of the sum deposited, what notice shall be given.

15. The co-operative system is no doubt effecting much good, but if the system here sketched

out were adopted, the greatest good, in the shortest time possible, might be effected.

To the above observations Sir Joseph Whitworth has added the following:—

I think it will be admitted as desirable that one-third of the period of man's existence should, if possible, be spent free from the necessity of labour and toil.

The middle period of life is, therefore, the time when man's energies should be put forth, and the greatest amount of work should be done that strict obedience to the laws of health will permit. The experience of industrious men goes to prove that the most pleasurable existence is insured by following this course.

It is therefore wrong, in every sense, for the Amalgamated Engineers and other Trades Unions to combine and endeavour to compel young and middle-aged men, in the prime of life, to limit and reduce their hours of labour to the extent now being attempted, and thus prevent them from saving so much, and laying it by for that period of life when man's energies begin to fail, when work becomes irksome, and when rest is necessary in order to pass a comfortable existence. May not the case between the industrious working man who saves part of his earnings, and the man who is reckless and will not save part of his earnings, be fairly stated thus:—

That the man who does not save when he is in health and strength, robs the man who does save, because the law compels him to support those who have not saved, and to bury them when dead?

The principal subjects which the essayists should consider are the preceding.

After commending these observations of the enlightened and liberal donor to the consideration of the competing essayists, the Council, however, would further call their attention to the liability to frauds of various kinds to which such a system may be subject, such as, for instance, that of colourable investments being made by parties investing, in their own names, moneys not bonâ fide their own; and would impress upon the competitors the importance of suggesting the best means of preventing such abuses.

There will be two prizes, £70 for the best, and £30 for the second best essays. The judges reserve the right of withholding the prizes altogether, or awarding lesser sums.

The following are the conditions to be observed:

1. The essays must be sent to the House of the Society of Arts, Adelphi, London, addressed to the Secretary, on or before 1st December, 1873.

2. They must be delivered either in print or in manuscript. If in manuscript, they should be written distinctly on foolscap paper, on one side of the paper only. Every paragraph must be numbered.

3. They must be sent in sealed, with only a motto or cypher; and a separate letter, also sealed, with the motto or cypher marked outside, must accompany the essay, giving the name and address of the writer.

4. Brevity will be considered as a merit.

5. They may have been published anonymously before being sent in.

6. The Society is to have the right of publishing the two prize essays in its *Journal*.

7. The award of the judges will be final.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The last lecture of the second course of Cantor Lectures for the Session, "On the Energies of the Imponderables, with especial reference to the Measurement and Utilisation of them," was delivered by the Rev. Arthur Rigg, M.A., on Monday evening, March 17th, 1873, as follows:—

Lecture VII.

On the Energy of Heat, with especial reference to the Measurement and Utilisation of it.

The energy of heat has, in one form or other, attracted more notice than that of any of the other imponderables with which this course of Cantor Lectures has to deal. Various explanations of the cause of heat being possessed of energy have been given, but it was not until the closing years of the last century that views on this question were first enunciated, which have since borne such good fruit. Count Rumford, in 1798, by an experiment in the boring of cannon in the arsenal at Munich, and Sir Humphrey Davy, in 1799, by the liquefaction of two pieces of ice by the friction of each on the other, laid the foundation of that explanation which has been so successfully generalised, and which even now is hopefully pursued

The first question that presents itself to us is, "What is heat?" And in order to present the modes suggested for measuring it which are diagramically expressed on the wall, it will be needful to make some preliminary statements. In the general table of energies the sources of heat are represented as the sun and fuel. That term fuel might with very good reason have been omitted, for the one source of heat is the sun; fuel is a secondary source, having its primary in the sun. Heat obtained from the sun, and the circumstances under which it is obtained, are foreign to the subject of this lecture. Heat obtained from fuel, and also from the sun, is kinetic, or capable of producing motion when it is radiant, or passing from place to place; and it is potential, or stored up, when it is absorbed. Now it was absorbed in those primeval times when there was an immense mass of vegetation on the face of the globe; that vegetation absorbed the heat. In these primeval forests it has been preserved, and in such fuel as coal it is restored. In being so restored or returned, that is given back to the earth which was absorbed perhaps before the creation of man. These buried forests are now a-glow with light, and heat, and vigour—unmistakable types of resurrection from a grave. Let us turn to that received from the sun, and refer to the diagram of the spectrum which many of you saw last week, and consider how that diagram aids in illustrating the question of heat. On Monday last an endeavour was made to explain how it was related to the phenomena and energies of light, and incidentally to the phenomena and energies of chemical affinity. One portion is related to the energy of light, properly so-called; another portion is related to the energy of affinity, properly so-called; and in this portion, which is perfectly obscure, and which escaped notice until recent years,—in this which is invisible to the human eye, although it may be visible to the eyes of other animals, lies that which we call solar heat. You observe that to the spectators' left-hand of the portion marked with the usual prismatic colours, there is a shade of red extended to a length equal at least to that marked with such decided colouring. It is not far from the truth to say that in this lies all the heat from which we obtain our stock of motion. It may be desirable to explain how we know that the heat lies there, and why the diagram is there drawn, and extending to such a distance from the visible portion of the spectrum, and that in such portion lies the greatest amount of heat. It is done in this way. We take a little instrument called a line thermopile, composed of a number of strips of metal laid edge to edge, and soldered at the alternate ends. The two metals are usually antimony and bismuth. The pile is in the form of a straight line, because it is to be used for determining the heat at a particular portion or line across the spectrum.

Thermometers for heat purposes may be said to be useless, and, perhaps, before going further, it may be well to state why they are so. A thermometer is an instrument which, by the expansion of a fluid, as air, or a liquid, as alcohol, mercury, &c., or by any other means, tells us the difference in temperature between two bodies. If a thermometer be placed in water, it would tell us how much the temperature of the water is above the freezing point, or how much below the boiling point. But freezing and boiling points are neither of them standard points. There is heat far below the freezing point, and there is heat still higher than the boiling point; and indeed there is no approachable zero from which to commence the graduations of a thermometer. We want, too, another thing, not relative heat, but absolute heat. Another means for obtaining records of heat is by the use of the thermopile and a galvanometer. This galvanometer is connected with the thermopile, and the speck upon the screen is that to which we have to look. If two short thin wires, one silver and the other copper, be taken, one wire attached to one end of that round the galvanometer, and the other to the other end, questions in relation to heat and electrical phenomena in connection with it may be made clear. If the free ends of the silver and copper wire be placed in contact and held between a finger and thumb, or placed near a lamp-flame, the speck immediately moves, and travels over a large space. No thermometer is so delicate or sensitive to heat as this combination of instruments. The heat which in a thermometer would be employed in expanding the liquid, is in this case converted into an electrical current which affects the galvanometer. Heat in the one case is measured by the expansion of a liquid, in the other by being converted into electricity, and the electricity is measured, as explained in a previous lecture, by the galvanometer. The speck is now steady, but on taking hold of the junction of the wires the speck moves in consequence of the simple touch of a finger. If the junction be once waved near the flame of a lamp, the speck moves directly—evidently there is a real and measurable energy in the heat which has passed. It should be remembered that this galvanometer requires quantity of electricity, and not what is called intensity. That motion, therefore, by being properly measured, enables us to get, inferentially, at the quantity of heat. The measurement of heat by differences of temperature is called "Thermometry." The measuring of an absolute quantity of heat is called "calorimetry."

These metals thus indicating heat by the conversion of it into electricity are applied here in a line, and if this apparatus is placed in front of a real spectrum, of which that on the wall is a pictorial diagram, and moved gradually along by means of a fine-threaded screw, the line thermopile passes into successive portions of the spectrum, and according to the amount of heat in each portion, so the galvanometer deviates. If, therefore, the galvanometer at one portion is sent further aside than at another, we know it is owing to a larger quantity of heat being converted into electricity. Such an arrangement was carried out, and the largest amount of heat was found to be where that high mountain is marked on the drawing. This much must at present suffice for showing how to determine and measure the quantity of heat.

Now let the consideration be how this heat is converted into motion. Motion, we know, produces heat, but here the converse question is presented—heat producing motion. If we can show that heat produces motion, and if we know that motion produces heat, those two are mutually interchangeable. That no motion can take place without the development or absorption of heat may be made manifest by an experiment. Here is a thermopile, rather more delicate than the one hitherto used. Here is an air-pump, connected with which are two copper vessels separable by a tap. If, now, the air be exhausted from one of these vessels, the one nearest to the air-pump, it then becomes empty, and if the thermopile be caused to touch the other vessel, or to touch this one, which is empty, and the speck of the galvanometer is stationary; then, when the tap that separates the two is opened, air rushes from one into the other, and the galvanometer speck indicates a change in the heat relationships of the two vessels. These changing heat relationships result whenever action takes place. If a thermopile having a larger surface, intended for the purpose of investigating very delicate changes of temperature, be attached to a condenser which serves to increase the surface and so to magnify the result, it would be found that by merely touching one portion the speck of the galvanometer moves. Now, if a fan be caused to act in front of and upon the thermopile, the impression would be that we should withdraw heat. The withdrawal of heat may be produced by the blast of air, but this air striking on the thermopile causes the spot of the galvanometer to move in the direction indicating an increase of heat. The question is, whence comes that increase of heat? The answer is, that heat comes from my arm, and is produced by muscular energy being converted into mechanical power, which is then transformed to heat, which is changed into electricity. In this case the energy passes direct from my arm through the fan, and propels a current of air against the thermopile. If, however, the draught of air upon the thermopile, instead of being direct from my hand had been treated in this way—If a close vessel had been taken, and by means of a condensing syringe, air had been forced into it, and allowed to remain for a few minutes, and then jetted against the theremopile in the same way as the air from the fan, we should find, after the first impact of air, that cold, and not heat, had been produced. Therefore the one blast blows hot, and the other blast blows cold. Thus, Æsop's fable of the man and the satyr appears to be realised. Much confusion has arisen from the use of the word cold, as though it was something distinct from heat. "Cold" is only a condensation of the phrase, "decrease of heat." Conflicting views would sometimes be harmonised were this word disused, and the word "heat" employed with a proper prefix.

There is a very good reason to be given for these results. The case of a blast producing decrease of heat may be illustrated thus:—In this iron bottle there is some condensed carbonic acid gas, which is under a pressure of about 700 lbs. on the square-inch. Now, it might be expected that as the blast from the fan produced heat, so the blast from this bottle of condensed gas would also. A jet of this condensed gas is now directed to the thermopile; the reflected light of the galvanometer by its motion indicates that the current has produced cold. It certainly appears remarkable that in the case of one blast heat is manifested, and in the other cold is produced. The explanation is this:—In neither case can the air be put into motion, except by the expenditure of heat. In the case of a fan the heat is at once expended in causing a blast of air, but in the other case the heat is expended in the previous act of condensation. When this condensing syringe has been used for two or three strokes, the cylinder of the syringe has become hot. The process of heat radiation is continuous. As soon as that bottle was filled, the heat accumulated in the work of condensation began to radiate. In other words, the muscular energy, which condensed the gas into the bottle, was dissipated in the form of heat. The contents of the bottle require an expenditure of that, which may be represented by, as much heat to get out of the bottle, as they required to put them in; therefore this heat must be drawn from some source or other, and the first supplies are drawn from the contents of that which was in the bottle. The paradoxical and apparently contradictory phenomena are, however, reconcilable in a most instructive manner. In the case of the fan the blast carries the muscular energy converted into heat direct to the thermopile. In the case of the bottle this heat has been dissipated by radiation.

Let us now consider and describe how Mr. Joule obtained that which has become the basis of our calculations, and the arithmetical measurement of heat, namely, 772 foot-pounds as the mechanical equivalent of the amount of heat required to raise one lb. of water through one degree Fahrenheit, or 1,390 foot-pounds for raising the same quantity of water through one degree Centigrade.

His experiments extended over about seven years, and the first apparatus used was the one shown in this diagram. There is a small vertical shaft capable of being rapidly turned by a handle; across or through the shaft is a short glass tube, in which were introduced a number of bars of wrought iron. These were covered with oiled paper, so separating them electrically one from the other. The bundle was wrapped round with copper wire, and then inserted into the glass tube, which was closed at one end with a cork, and capable of being closed at the other. That glass tube was coated with tin-foil, so that in fact the tube was very like what is called a Leyden jar. It had an electrical coating inside and out, the only peculiarity being that a slit was cut along the coating on the outside of the vessel to prevent electrical induction. The tin-foil was then covered by strips of wood parallel to the tube, and bound all over with silk. The ends were corked, and also covered with oiled silk, so as to close it thoroughly. From the inside of the tube two wires passed down and dipped into two mercury cups, which were connected with a galvanometer, so that currents of electricity, if any were produced in the interior metal bars, would be manifested by the galvanometer. On each side of this short glass tube were fixed two arms of wrought-iron, bent in the form of a horse-shoe, and as nearly in contact with the ends of the glass as possible. This wrought-iron horse-shoe had a coil of copper wire round it, and by the usual means it could be converted into an electro-magnet. A certain weight of water was put into the short glass tube along with the bars, and having rotated the instrument for a quarter of an hour, the temperature of the water when examined was found to be hotter than before. The galvanometer being observed it was known what electricity had passed, and this combined with the change that had taken place in the temperature of the water after fifteen minutes' rotation of the shaft, at the rate of six hundred rotations per minute, sufficed for determining the amount of electricity converted into heat. Thus, approximate data were obtained on which to found other experiments. Such experiments were made and re-made, they failed, and were again renewed; and to note how Mr. Joule overcame one difficulty after another until he succeeded furnishes a beautiful example of perseverance. Sometimes where he expected to find a substance had gained heat, he found, on the contrary, it had lost. Such anomalies, however, were afterwards completely accounted for.

Research in science claims the exercise of much ingenuity under unexpected and baffling conditions. The perplexity just described became an element in success. Mr. Joule availed himself of the process of "interpolation," and so adopted what proved of great assistance in future experiments. What has been described was the earlier of many processes. Next, he found it needful to measure the energy exerted upon the handles, because if in this vessel a quantity of heat had been generated which produced an observed increase of temperature in the water, it was desirable to know what was the value of the mechanical energy which had caused that heat to be so generated. If motion be given by the hand only, there is no means of measuring that value. The earlier object was to see if heat could be obtained; then the next object was to measure the heat obtained, and also to measure the mechanical energy by which it had been obtained. The apparatus now assumed this form. He gave up the electrical process, and began to take a vessel, similar to the one shown in this diagram, which had brass plates in it, and brass bars fixed to the inside of the vessel, and running across, so that paddles could rotate between the bars. The vessel was filled with water, and therefore when the paddles rotated, the fixed bars stopped the whirl of the water, and heat was developed. The sea, as those who are accustomed to bathe know very well, is warmer on a windy day than on a calm day, simply because the motion of the water caused by the wind is converted into that motion of the molecules of the water which we call heat. So in the experiments with this apparatus, the motion of the water in the vessel is converted into the motion called heat. Of course all possible means were adopted to prevent heat passing by radiation from the exterior of the vessel. Hence the vessel was enclosed in another, and that again in another. The contrivances for ascertaining a measure of the mechanical effort made to keep the paddles rotating at a uniform rate were very simple.

The little vertical shaft on which the paddles were fixed was prolonged upwards, being divided across and reconnected in line by a piece of vulcanite, which, in common phraseology, would be called a non-conductor of heat. Wound round the upper part of this shaft were two cords, the ends of which passed over two pulleys on opposite sides. To these cords were fixed weights, by the descent of which motion could be given to the paddles. The cords were two in number, and on opposite sides, in order to obviate as far as possible the heating effect of rubbing friction on the shaft journals. With this apparatus, and others constructed upon similar principles, a series of experiments enabled him to arrive at certain definite conclusions.

In a research of this kind, made with apparatus contrived as new thoughts and new experiments suggested, it was not to be expected that the tabulated results should speak with one consenting voice. They did, however, seem to proclaim this—that the mechanical equivalent of heat competent to give an increase of temperature of 1° Fahrenheit to 1 lb. of water was between 500 and 800 foot-pounds. Detecting and eliminating those elements which seemed to affect the accuracy of the result, he was enabled at last to come to this conclusion, that 772 lbs. was the exact number which was the mechanical measure, or, as it is commonly called, the mechanical equivalent of heat. That means this—he found how much a known quantity of water was raised in temperature by a recorded mechanical exertion, and he deduced the measure of that exertion needful to raise 1 lb. of water 1° on Fahrenheit's thermometer. Thus he found that that heat, applied to raise weights, would lift 772 lbs. through one foot; that is, if you had

772 lbs. weights here, and lifted them a foot high, it would be the same thing exactly as applying the same force to 1 lb. of water, and raising the temperature 1° Fahrenheit.

There is a table written out mathematically, by means of which the 772 lbs. are deduced. Mr. Joule having made these experiments, others followed, and we have a table showing the means used, air, friction, steam, Daniell's battery, electro-magnetism, &c.; also the names of the experimentalists, and the mechanical equivalent of heat, as determined by them. Although the results differ from Mr. Joule's 772 lbs., yet his figures are now generally adopted.

MECHANICAL EQUIVALENT OF HEAT BY DIFFERENT METHODS.

Means used.	Experimentalist.	Ft. lbs. per 1 deg. F.
Air	Regnault	776·47
Friction	Joule	774·73
Steam	Hirn	752·78
Electrical Induction	Joule	823·86
Daniell's Battery	Weber	765·54
Electro-Magnetism	Favre	807·46
Current in Wire	Quintus-Icilius	729·08

The title of this lecture includes the words measurement and utilisation. The utilisation of heat is so important a commercial as well as scientific question, that there are one or two matters bearing upon it which may be worth present attention and much future thought from all. That we do not obtain in a steam-engine more than a quarter of the heat we expend in the furnace is now generally recognised. There is a table here, based upon Mr. Joule's calculations, which gives the number of horse-power—a technical term, meaning 33,000 units of work, which could be obtained by utilising the heat required for passing nine pounds of ice through its physical and chemical changes. If we have 9 lbs. weight of ice, and attempt to melt and convert them into liquid, a certain amount of heat is absorbed, or rendered "latent," as it is called. At any rate, there is a quantity of heat that does not show itself upon the thermometer. Then, after it is converted to water, if we gradually raise the temperature to 212°, there is another large quantity of heat rendered "latent" in the conversion of this water into vapour; and if we then convert that vapour which comes from the water into its elemental gases, viz., oxygen and hydrogen, another large quantity of heat is absorbed or rendered "latent." Now, take that process backwards; assume we can take this 9 lbs. of oxygen and hydrogen and reconvert them back again into ice, and that it was in our power to use the heat which had been given off, then we get the quantity shown in the table. If we burn a quantity of hydrogen in oxygen it is converted into water; if one part of hydrogen and eight parts of oxygen are combined by an electric spark or other means, and converted into water at 212°, a number of units of heat equal to 1,451 horse-power are obtained. If, then, we pass it still further into the form of water at 32° we should obtain 38 horse-power more; and if we then pass it from the form of water into the form of ice, we should obtain 30 horse-power. Therefore, if in obtaining 9 lbs. of ice from its primeval elements, viz., 1 lb. of hydrogen and 8 lbs. of oxygen, we could utilise as a mechanical agent all the heat set free, then from the data given we see that there would be obtained 1,519 horse-power of work. But we cannot obtain this. What becomes of the heat, where it goes, and why we cannot contrive to utilise it, are inquiries which yet perplex scientific students. Various surmises have been made, but none of them have been accepted, except as the vague guesses of an unsolved riddle, the best of which are taken, though there remains a lurking feeling that none of them are right.

The following is a copy of the table to which allusion has been made in the previous paragraph:—

MECHANICAL VALUE OF HEAT, DEVELOPED AS NINE LBS. OF WATER PASS FROM THE GASEOUS TO THE SOLID STATE.

		Units of Work.		Horse Power.
1 lb. of hydrogen and 8 lbs. of oxygen to water at 212°	develope	34,462 × 1,390 (C.)	or	1,451
Water from 212° to water at 32°	develope	180 × 9 × 772 (F.)	or	38
Water from 32° to ice	develope	143 × 9 × 772 (F.)	or	30
Total horse power developed				1,519

There is another table bearing on this question, viz., the advantage of using steam at a higher pressure than what is called low-pressure steam. If we take water at 33°, that is just above the temperature of ice, and that be warmed until it attains the temperature 213°, it would occupy a bulk 1,669 times as large as it was in the form of water. There is a relation between the pressures and temperatures which must be maintained, in order to preserve the whole of the water in the form of steam. These relations are expressed in the first two columns in the following table. The third column expresses the resulting volume of steam. The fourth column is the product of the pressure and the volume, and, therefore, represents the mechanical value of our unit of water. How much and at what rate this value or power increases with an increase of heat and a correspondent increase of pressure may be known by considering the figures in this fourth column. These figures represent the advantage of using steam at high pressures, and, therefore, high temperatures:—

STEAM FROM WATER.

Pressures.	Temperatures.	Volumes.	Pressure multiplied by volume.
lbs.	Deg. Fah.		
15	39	1	
15	213	1,669	25,035
25	240	1,042	26,050
35	260	765	26,775
45	275	608	27,360
55	288	506	27,830
65	299	434	28,210
75	308	381	28,575
85	317	340	28,900
95	325	307	29,165

The reason why we cannot work steam at some of these very high temperatures is this, that when we superheat it, we thereby prevent any of it being converted into vapour, and if it is not so converted into vapour we have no means of lubricating the faces of our slide valves, and the consequence is, the metals being heated, they soften, then scratch and tear each other's faces, and the engine is soon destroyed. As soon as we can get slide valves made of some material which will bear this higher temperature without abrasion or scratching, then, probably, we shall be able to work super-heated steam economically.

The amount of steam converted into visible vapour, and cause of excessive loss of power in ordinary steam-engines may be made clear in this way. There is in the receiver of the air-pump a piece of sponge with a little water on it; if a portion of the air saturated with vapour be pumped out, a small portion of the water is converted into vapour, which you see deposited in a film on the glass. This is caused by the air being rarefied and becoming colder, therefore not competent to hold in solution as much vapour as it had previously done. Now, what takes place in this receiver is taking place in hundreds of steam-engine cylinders, and wasting pounds and pounds of fuel. As soon as the steam enters the cylinder it fills it, or rather it fills the part of the cylinder below the piston. Arrangements are usually made that a portion of the stroke may be accomplished by the expansive action of the steam. Now, as soon as the opportunity for expansion is presented, there is at once this deposit of moisture, and the deposit is indicative of a sacrifice of heat.

Now, this action of heat is not confined to liquids, it also extends to solids. Here is a piece of unannealed glass. Those present who have to deal with steam-engines, know that it very often happens from some apparently unaccountable cause, that what are called the water-gauges of the boilers are broken. These breakages are in consequence of the glass tubes being unannealed; and if you are aware of the process by which tubes are made, you will see at once they cannot, without some special arrangements, be annealed. They are made by taking a solid ball of glass out of the pot; this is then blown into a globe; then a second man puts a pipe with a molten nodule of glass upon it on that part of the globe which is opposite to the pipe by which it was blown. The men run asunder, and so the globe is lengthened out into a tube and laid along the floor. This long pipe is then cut into gauge-tube lengths, and generally so sold. If one of these tubes be cleaned with an iron wire, having a piece of cotton wool wrapped round it, the wire being pushed up and down as is usually done, and the clean tube be restored to the boiler, it may, in two or three days or weeks, fall to pieces without any one being to blame, except those who put the wire through the tube. Here is a piece of glass very thick and strong, and in all respects very good glass, but unannealed. It is really a simple piece taken out of the melting-pot as a sample, to guide the manufacturer respecting the quality and colour of the articles that may be made from it. Now, in all probability, if this piece of quartz, less than the size of an ordinary pea, be allowed to drop gently into the sample flask, this strong flask (the glass is nearly one-half of an inch in thickness) may fall into pieces. There! You see the bottom has immediately dropped out, notwithstanding the thickness, and if it were left here all night it might crumble into half-a-dozen pieces before the morning. On one occasion I cleaned out a glass tube, about three feet long, connected with an air-pump, and in a thoughtless moment took a wire, attached some cotton wool to it, and drew it through the tube. In about half an hour there was a slight click—in a few minutes another click. On looking at the tube it was seen to be cracked. The slight but instructive noises continued, click after click, and crack after crack, and in the morning the tube was separated into many hundred pieces, though no one touched it. Workmen and servants are often blamed for the breakage of glass, which breakage arises from such a cause as this.

What are called Prince Rupert's drops are obtained by allowing molten glass to fall into water, and so falling the drops are suddenly cooled on the outside, and the consequence is that the molten glass in the interior is firmly bound beyond its power of resistance, even though it has a large amount of heat in it. If it had been free, the molecules of glass would have crystallised and arranged themselves according to the law which governs them; but being bound by the external film they cannot so arrange themselves. The heat contained in them cannot do the works of crystallisation it was competent to do—it has become stored up or potential. Therefore, as soon as ever the equilibrium of the shell of the bulb is destroyed this heat gives out its work. In the interior of this bulb there is a large amount of potential energy; and if the equilibrium be destroyed by cracking off the end, in the same way as it was destroyed in the other case by dropping a little bit of quartz into the thick glass, we shall find it will manifest itself, and very possibly will break the glass bottle in which the Rupert's drop is placed.

We will now pass on to a series of experiments, the object of which is to show the effect of heat in relation to solids and liquids, and converting them into vapour. Mr. Wills, to whom we were indebted for assistance on the evening of the lecture on the energy of affinity, has kindly undertaken to exhibit some striking and instructive experiments. In this iron bottle there is condensed carbonic acid gas, which under ordinary circumstances is a gas, but when it is brought under a pressure of 700 lbs. to the square inch it becomes a liquid. To reconvert it from liquid into gas requires a large amount of heat. The consequence is, one part takes heat from the other, whilst a portion of it is sent forward in the form of vapour at the expense of the heat of the remainder. That remainder, therefore, becomes colder and colder, and appears in the form of ice and snow, as you see on turning the tap, and letting it escape into the room. The white substance which now is falling in the atmosphere of the room is carbonic acid snow. There is an apparatus for enabling the vapour to pass round and round in a copper vessel, and then escape at the handles; in so doing it absorbs a large quantity of heat, and therefore that which remains in the vessel freezes. We shall collect in this way a large amount of snow, which can afterwards be used for other purposes. Nearly a pound weight of this carbonic snow is now deposited in the copper vessel, and so cold is it, that, on wrapping a piece of wet flannel round the vessel, it freezes immediately. This snow can be held lightly in the hand without inconvenience, but if pressed a blister will at once be raised. Mr. Wills has taken a small portion upon his tongue, and breathing out the vapour as it melts, a candle is immediately extinguished. In the same way some of it may be put in a beaker, and the gas collected as the snow melts, when it will be found that a light cannot live in it. Again, here is a bottle of water, by putting some carbonic snow into it, and corking it up, we immediately get excellent soda-water. By pouring some ether upon it, the degree of cold is greatly increased by the rapid evaporation, so that the vessel becomes frozen to the stool upon which it stands, and a pound or two of mercury will soon be frozen into a solid body. Its temperature is about 130° below the freezing point. On placing the frozen mercury at the top of a tall jar of water, beautiful icicles are immediately formed in consequence of the intense cold.

Before closing, attention may be directed to the sources whence our supplies of heat are derived. The classification of these, and the character of the heat derived from them, may be studied in the tabular form.

SOURCES.

A	Inherent Affinities.
B	Solar Radiation.
C	Earth's Rotation.
D	Earth's Internal Heat.

STORES.

POTENTIAL.	WHENCE DERIVED.
Fuel	B and A.
Food	B.
Reservoir Water	B.
Tidal Water	C.

KINETIC.	WHENCE DERIVED.
Winds	B.
Ocean Currents	B.
Hot Springs	D.
Volcanoes	D.

There is one other matter to which the subject of last week's lecture bears a very extraordinary relation. Science investigations have established that a process of what is called dissipation of energy is going on.

In the lecture on the energy of light, attention was directed to a remarkable testimony which, through modern science views, is thus given to Scripture. Let me add a few words on an equally remarkable one in reference to the energy of heat. In the case of light, page 699, reference was to the beginning of the Bible; in this case of heat it is to the end of it. St. John (Rev. vii., 16), speaking of the new heavens, writes, "neither shall the sun light on them, nor any heat." How singularly in accord with this is the declaration (Rev. xxi., 1), "There shall be no more sea, neither shall they thirst any more." Clearly, if the heat be not, there can be no water nor sea. Now, science testifies to the dissipation of heat, and thus unconsciously testifies to a gradual progress to that state which prophecy so plainly declares.

In closing this course of Cantor lectures on the energies of the imponderables, the thought re-presents itself, which was not an unfrequent visitor in the preparation of them, and which gained utterance in the first lecture in these words:—"It may be said, and with some show of reason, when the comprehensive title of these lectures is considered, a little well or completely done is better than much ill or very partially done. As a principle in education this is a truism. These Cantor lectures are not to be scholastic lessons; they may teach, but the primary object of them is rather to be suggestive of thought, to give food for reflection, material for development, to arouse inquiry, to provoke investigation, to leave, in fact, an unsatisfied impression that there is more than the lecturer has expressed, and that there is much for hearers and readers to consider. Such an unsatisfied feeling in relation to the energies named and the measurement and utilisation of them it is the object of this course to create. If this result be attained, then, in those future years when by individual labour light shines where darkness now overspreads, there will be cause for thanks where perhaps, when these lectures end, an unsatisfied longing may alone be found."

Experience in the delivery confirmed the anticipation in my mind, and probably to your minds has suggested the question, why was so much undertaken with so little time in which to do it? Let the answer now given satisfy those who were not present on the first occasion, that however imprudent or unwise the judgment may have been, there, nevertheless, were method and object in it.

Probably the illustrative apparatus and diagrams which the room contained, but of which no use was made, may have assured some how much remains to give the zest of freshness to an extended research. Should any pursue this course they will find an interest at every turn which probably other pursuits cannot supply—an enjoyment with no after-reproaches, a provocation to cheerful thought and pleasant meditations, for:—

> "To him, who in the love of nature holds
> Communion with her visible forms,
> She speaks a various language."

They will further find an employment for leisure hours which soothes care by for a while removing it. They will find their eyes opened to sights of beauty and brightness to which the eyes of many are closed; they will be induced to permit their children, and their children's children, to acquire along with other knowledge that which surpasses both in interest and in educative power the writings of men in other days. Solomon and Pope, in this matter, have each given advice—one encouraging, the other discouraging, those studies these Cantor lectures suggest. Solomon wrote, more than two thousand years ago:—

> "I was King, and gave my heart to seek and search out by wisdom concerning all things that are done under heaven."

He illustrates this and shows his knowledge of physical science by writing in the same chapter (Eccles. iv., 6-7) the following, which are clearly suggestive of what we call trade-winds, evaporation, condensation, &c., &c.:—

> "The wind goeth toward the south, and turneth about unto the north; it whirleth about continually, and the wind returneth again according to his circuits. All the rivers run into the sea, yet the sea is not full; unto the place from whence the rivers come, thither they return again."

Pope wrote, more than one hundred years ago:—

> "Know, then, thyself—presume not God to scan—
> The proper study of mankind is man."

To follow Solomon is to find peace and pleasure; to follow Pope is to find contentions and wars. Cunning craft and over-reaching are not in those pursuits with which we have been dealing, for you may rely upon it that—

> "Nature never did betray the heart that loved her.
> 'Tis her privilege through all the years of this our life
> To lead from joy to joy."

At the conclusion of the lecture a cordial vote of thanks was passed to the Rev. Arthur Rigg, on the motion of Mr. Davenport, in acknowledgment of the great pains, time, and talent he had devoted to the subjects.

ANNUAL INTERNATIONAL EXHIBITIONS.

The Council, having been informed that her Majesty's Commissioners do not intend to publish Reports on the different departments of the Exhibition of the present year, and looking to the great importance to Arts, Manufactures, and Commerce that these annual displays should not pass away without some record, have decided to undertake that duty, and for this purpose have engaged the services of gentlemen specially skilled in the subjects of the several sections, to prepare such Reports for publication in the Society's *Journal*. The Council, however, desire it to be understood that, in publishing these reports, they do not necessarily adopt all the views expressed in them, which must be taken as those of the writers only.

The following report is the seventh that has been issued. The remainder will appear as soon as they are complete.

REPORT ON THE "SWORDS AND MILITARY ARMS OF STEEL."

By Colonel Owen, R.A.

Although there is but a small display of swords and steel weapons exhibited this year, those to be found in the East Crush Rooms of the Albert Hall are well worth examination, for they not only include some excellent specimens of swords, foils, lances, and small arms, but a number of others to illustrate the different stages in the manufacture of the arms. The rooms, which are high and well lighted, are very suitable for such an exhibition, as there is ample space for the arrangement of the different cases containing the articles, in such a manner as to allow of everything being clearly seen.

It will not be necessary to go into the manufacture of steel, or the history of swords or other arms, which have been so frequently described;

and the limits of this paper will not allow of more than a brief description of the objects exhibited, and of a few remarks to call attention to the chief points deserving of notice in connection with them.

The Eastern swords, of which few are exhibited, being intended for cutting, and seldom used for guarding, have generally a blade much curved, and a small hilt; but the swords used in Europe, of which there are many specimens, are employed for so many different purposes—for thrusting and guarding, as well as for cutting—that the quality of the metal and the form of the blade must combine such various conditions as will ensure a generally efficient and trustworthy weapon. The properties especially required in the metal of the blade are, tenacity, elasticity, and hardness; but, besides these, lightness, within certain limits, is of great advantage, as the force of the blow depends upon the *vis viva*, or *energy*, to use a term applicable to projectiles, and is therefore proportional to the weight into the velocity squared; lightness is also requisite when a sword has to be quickly recovered, in order to guard with it.

There are several points in respect to the form of the blade which require some explanation. For thrusting, the blade should be straight, as in a rapier; but for a sword which is also intended to cut, the blade must have a curve, so as to give greater width and depth of incision. The centres of gravity and percussion must be properly adjusted, so that the sword may balance well, and may be used with effect, but without jar to the hand. To determine the proper angle of the cutting edge is a matter of some difficulty, as the substances to be cut into or through are of such different kinds, hard, soft, brittle, or tough; two angles are, however, given on each side of the blade, one termed the angle of resistance, of 40 degrees, the other, at the extreme edge, called the entering angle, of 90 degrees. Then, in order to give stiffness, the blade has one, and in some cases two or more grooves, which also serve to lighten it. On this point, which is not generally well understood, Mr. J. Latham, in a paper read at the Royal United Service Institution remarked:—"There is no possible use of a sword in cutting, thrusting, or guarding, in which too great flexibility would not be a disadvantage. It is a singular illustration of the little attention paid to this subject in England, that this very defect, flexibility, is frequently assumed as the criterion or test of a good blade. The blade which springs the most easily is called the best, whereas nothing is easier, by making the blade thin enough, and useless enough, than to produce a sword which shall bend twice round the hilt and go into a hat-box, or clasp hilt to point, and form a waist-belt, both of which wonderful swords I have myself made. The error arises from confounding flexibility of the blade with the elasticity of the steel; the latter is necessary, the former useless and always injurious. But, to resume. A blade which has been ground thin to lighten it, will frequently be too flexible and whippy. In this case, by putting a groove on each side, we not only make it still lighter, but we also make it stiffer; for if we apply any force to bend a grooved blade sidewise, we meet with the greatest amount of resistance which any mechanical force can supply. We are, in fact, bending an arch inwards upon its crown, and of course the deeper the arch the greater the resistance, which explains why the narrow groove is preferable to the broader groove of the same depth."

In a large case (No. 3,792) is a collection of specimens exhibited by Wilkinson and Son, to illustrate the different stages in the manufacture of the sword blade. The chief of these are the following:—A sword mould, giving the metal for two blades, as received from the steel makers. The mould broken across the middle, to show the fracture of the metal, and hence its quality. The tang ready for welding to the blade; the tang, or projection at the bottom of the blade, by means of which it is fitted into the hilt, is made of wrought-iron, as being less liable to snap off from a blow than steel. The mould drawn out, grooved, and the tang welded on. The blade grooved and pointed, and the final forging, which requires 25 separate heats. Several blades, showing the effects of different methods of tempering; one tempered at 40 deg., the maximum density of water; another at 60 deg., the usual temperature; a third tempered in air; a fourth in oil, at a temperature of 550 to 580 deg., a process which greatly increases the toughness of the steel, but does not give sufficient hardness for swords; a fifth in wood (oak and beech sawdust), a method of tempering frequently employed for coach-springs. A blade ground ready for proof, and tested by acid for greys or marks in the steel. A blade polished, embossed, and etched; and another blade, which, instead of being polished with emery on a revolving drum, has been burnished with steel, an old method, giving a very hard surface, but necessarily a tedious operation.

In this case are also shown a number of specimens to show the different kinds of blades used; such as those of a rapier, claymore, early English backsword, and two Indian blades—one of a cimetar with two grooves, and the other not grooved, but having great thickness. There are also a couple of practice swords.

On the side wall near the case containing the blades just described, and bearing the same number, 3,792—that of Wilkinson and Son—are shown the different operations in the manufacture of the hilt and scabbard, both made from sheets of rolled cast-steel. A number of different hilts, and some scabbards may be seen on the finished swords. The chief conditions required in a hilt are, protection to the hand, strength to stand a heavy blow without fracture, firm hold without cramping the hand, and good balance, so that the blade may not be liable to turn over.

Below the operations on the hilt and scabbard are some very curious examples of fracture in sword-blades which have failed in proof (No. 3,792, Wilkinson and Son). These show that the fracture, which occurs from vibration, and is usually at some little distance from the point struck, follows the line of least resistance offered by the varying qualities of different parts of the blade. It may be well to say here a few words on the proof of swords. The proof to which a sword is generally subjected is, to strike each side flat on a table, then the back and edge on a block of wood, and, finally, to bend the blade each way until the length is shortened by some inches. As, however, the striking proof is open to the objection that the force exerted by different men, or even by the same man, is liable to variation, the late Mr. H. Wilkinson invented a sword *eprouvette,* which is capable of exerting a force similar to, but much greater than, that of the human hand, and can be adjusted to any kind of sword.

Another test to which swords or daggers have been subjected, and are now by some makers (Wilkinson, for instance) is the Toledo proof, which consists in forcing the blade by a blow through a metal plate; an example is shown by Wilkinson and Son in the case of finished swords--the blade of a dagger with a curiously carved ivory handle, piercing a piece of iron plate and a large silver coin.

The swords, including dirks, rapiers, and foils exhibited, will now be noticed, and also a few lances, not in the order of the numbers, but as they will be found in proceeding through the rooms from west to east.

Wilkinson and Son, No. 3,792, have sent a large number of swords. The regulation swords for officers of the different services, Infantry, Cavalry, Artillery, and Engineers; a Highland claymore, a general's and an admiral's sword, rapiers, fencing-foils, and dirks. Besides these, two beautiful specimens of cut-steel work, made up of an immense number of separate small pieces secured together, in the hilts of a court sword, and of a rapier. A sword with a chased steel hilt, cut out of solid cast-steel; and two Eastern cimetars, one with hilt and scabbard, chased and parcel-gilt, the other having a black Khorassan damasked blade, with the Royal arms engraved on it. The custom of wearing swords, except on State occasions, having been abandoned by nearly all but officers of the military or naval services, the demand for them is small to what it was when swords were generally worn and frequently used in duelling. The possession of a trusty weapon was then of great importance, and the skill and time spent in artistic design and workmanship were also appreciated and duly rewarded. The cut-steel work mentioned above, and other specimens of it shown by Mole and Sons, are, therefore, of interest as the evidence of an art now seldom practised.

No. 3,714.—Two short swords made by the hill tribes of India, and two Indian daggers, are exhibited by Mrs. Byrne.

No. 3,766.—Mr. C. Reeves, of Birmingham, has sent a number of swords, foils, and halbert heads. One of the swords has a well-executed chased steel hilt, but it appears rather small to afford a good hold.

No. 3,748.—The swords exhibited by Mole and Sons, of Birmingham, have been designed for presentation to officers of the regular or volunteer services, to generals, and Indian princes, and most are of elaborate patterns. An artillery officer's sword has an engraved scabbard, somewhat rough in execution, but a handsome chased steel hilt, nickel-plated; a general's sword, silver mounted; the mounts of others are silver gilt, and that of a volunteer officer's sword is parcel gilt. Two Court swords have elegant cut-steel hilts, and one is nickel-plated. Besides the swords are fencing foils, and Highland dirk, nickel-plated; halberts of ornamental designs, silver and parcel gilt; service and practice lances, and boarding pikes with nickel-plated mounts and shafts of ash, for which bamboo has, however, been substituted in the lances of the British cavalry. The object of the nickel-plating is to prevent corrosion; the surface thus obtained is very similar in appearance to steel; it will wear a long time, and preserve its brightness if cleaned occasionally with leather.

No. 3,765.—The Royal Commissioners have sent some Chinese swords, of rude design and workmanship; an officer's sword; soldiers' swords, both single and double, in rough leather scabbards; and an executioner's sword. The prices which are attached are such as would be asked in this country rather for knives than swords; thus, the soldier's sword costs but 5s., and the executioner's, which is the most expensive, only 12s. 9¼d.

No. 3,738.—The Husquarna Small Arms Manufacturing Company, Jonkoping, Sweden, sends a damasked sword blade.

No. 3,739.—Three Japanese swords, which

are to be found, not in the Crush Room, but on the wall to the right of the entrance to the School of Cookery, in the East Gallery. These swords have wide blades, with thick backs, ground down to an edge like a razor; one blade has a simple design cut in it, two have grooves, but the third has no groove. They have rough, unpainted wooden hilts, without any guard, and plain wooden scabbards.

No. 3,788.—The War Department exhibit a couple of the service lances, with bamboo shafts, made at the Enfield Small Arms Factory; the male bamboo, of which the shafts are made, is solid, and is obtained from India; it is lighter than ash.

Before proceeding to note the small arms exhibited, it may be as well to say a few words on the damask pattern, or watering, to be observed on some blades. The damask is obtained by subjecting the blade to the action of acids. Dr. Percy, in his "Metallurgy of Iron and Steel," thus explains the cause of the irregular action of the acid, which produces the effect:—"The damasked portion is due to the difference in colouration resulting from the action of acids on iron and steel, the surface of the former being left with a metallic tissue, and that of the latter being left coated with a black, firmly-adherent carbonaceous residue. By suitably piling together bars of steel and iron, welding them, and then drawing them out under the hammer, or otherwise, patterns of various kinds may be produced, just as is done in the case of glass by heating together variously coloured pieces of glass, and drawing them out into rods." Gun-barrels are damascened on the same principle. It is evident from the above explanation that a blade of steel only will not exhibit a damask pattern, and that those blades which can be damasked are, from the presence of a proportion of wrought iron, softer than steel blades.

Only a few small-arms are shown, and these, although some of the best of their kind, present no novelty. The War Department, No. 3,788, has sent a Martini-Henry rifle, with a number of specimens of the various stages of manufacture as carried on at the Small Arms Factory at Enfield. A large number of separate pieces illustrate the numerous operations through which the different parts of the breech arrangement pass. A rough steel barrel, cast, drawn out, and bored at Mr. Mark Firth's works, Sheffield; a finished barrel, a section of the barrel to show the rifling, and a rifle with stock complete, make up the collection.

In the case containing the sword blades in various states, as before described, are 49 stages in the manufacture of the bayonet (No. 3,770), exhibited by the Royal United Service Institution; the service bayonets are made by machinery at Enfield.

The Husquarna Small Arms Manufacturing Company, Jonkoping, Sweden (No. 3,738), exhibit several guns and rifles with steel barrels and locks; they are central-fire breech-loading arms, with a compact and light breech arrangement. The metal of which they are made—Swedish cast-steel and Bessemer steel—is said to be of excellent quality, equal to that produced by the best works in Sweden. These guns and rifles can be made at a very low price, labour at the Husquarna works being very cheap, and there being a fine waterfall, 80ft. high, which gives motion to the machinery. A number of specimens of the lock in various stages of manufacture are also exhibited by the Husquarna Company.

Wilkinson and Son, in the case containing sword-blades, No. 3,792, has one pair of gun-barrels without and another pair with the breech-loading apparatus, all made of Whitworth steel; and in the case of swords No. 3,792 a double-barrelled gun complete, with Wilkinson's patent central fire breech action and barrels, also of Whitworth steel. This metal, when cast, is subjected to very powerful hydraulic pressure, in order to condense the steel, get rid of any air cavities, and obtain perfect uniformity and soundness in the casting. A nine-pounder cannon, made of this compressed steel and exhibited last year, was tried at Southport in October, 1872, and stood without injury the heavy strains caused by large charges of two and a half pounds.

The War Department exhibit a number of heads of shrapnel shell, as made in the Royal Laboratory, Woolwich, of the following calibres;—9, 16, 25, 40, and 64 or 80 pounder; 7, 8, 9, 10, 11, and 12 inch; also a 10 inch head, in various stages of manufacture. These heads are made of Atlas metal, which is a mild Bessemer steel. A head is made from a disc, which is stamped in dies of various sizes, until brought to the proper ogival shape. It is attached to the cast-iron shell by means of rivets.

No. 3,770 is a curious combination of pick, spade, axe, and mantlet, presented to the late Sir John Burgoyne by A. S. Harrison, captain in the First London Engineer volunteers, and sent from the Royal United Service Institution. It is doubtless intended for a sapper.

In the West Gallery (letter L. on the plan in the official catalogue) Vickers, Sons, and Co., of Sheffield, exhibit a very long steel block, intended for the lining of a heavy built-up piece of ordnance; also various small test pieces, with the tensile strength and the limit of elasticity and elongation marked on them. Such blocks for the inner tubes of ordnance are made by melting the steel in crucibles, which are emptied into an iron mould. The ingot is allowed to cool gradually, and is then heated in a Siemens furnace, and very gradually drawn out under a steam hammer. The steel blocks for the service ordnance are roughly bored and tempered in oil, which renders the metal both harder and tougher.

The War Department exhibit a pair of trunnion blocks, No. 3,788, for a 35-ton gun, made in the Royal Carriage Department, Woolwich.

REPORT ON RAW SILK.

By B. Francis Cobb.

Among the novelties exhibited at the Exhibition, few are more interesting than the rearing the silkworm by the open-air process of M. Alfred Roland, of Orbe, Switzerland; and the reeling the silk from the cocoons, as exhibited by Messrs. Jouffray of Vienne, Isère, France.

The rearing silkworms in this country is not new, and as recently as 1870 the process was shown at the South Kensington Museum; but the present exhibit has the novelty of rearing in the open air, and exposing the worm to all the variations of climate without protection beyond a roof, for the rearing for cocoons; while for "graine," the worms are allowed to remain on the trees, pass through the stages of worm, chrysalis, and moth, and lay their eggs upon the tree itself, where they remain through the winter exposed to frost or ice. In a paper read at the Society of Arts on the 23rd of April last, this method was fully explained, and in the discussion which followed, the opinion was expressed that not only might this method be available for raising "graine" in this country, but that it would be of great service for the production of cocoons in the colonies.

M. Roland, when in London recently, seemed to entertain no doubt but that his worms would outlive the evil effects of the east wind then blowing, and in fact expressed himself quite satisfied as regards our climate, notwithstanding its sudden changes; but an unexpected enemy appeared in the shape of the London "blacks," which the east wind showered upon his little mulberry trees, set like a miniature plantation by the side of the magnanerie, and caused no slight apprehension as to the result such unexpected doses of carbon might produce upon the worms. Certainly, this was an element which had not entered into M. Roland's calculations when he consented to exhibit his process in London.

In the magnanerie the worms are now spinning their cocoons, and the fact that up to the present not a single death has occurred speaks volumes for the open-air process, for during part of the time there has been great difficulty in the supply of leaves for food.

That this process is a complete success can no longer be doubted, and the certificate of Messrs. Gaydou and Co., of Turin, read at the Society of Arts on the occasion alluded to, places the matter beyond doubt. They certify—

"The educations made this year, 1872, with grain produced by the open-air system of M. Alfred Roland, of Orbe, Canton de Vaud, Switzerland, have given on an average 40 kilogrammes of cocoons for 30 grammes of grain; that is to say, 1 oz. troy weight produced 107 lb. troy. The yellow cocoons of M. Roland yield one kilogramme of *grège* silk per 12 kilogrammes of cocoons. About 160 cocoons go to make up the kilogramme (2·2 lb. avoir.). This race does not contain more than 8 per cent. of double cocoons.—(Signed)

"A. GAYDOU AND CO.

"Turin, Sept. 12, 1872."

From the rearing the cocoon to the reeling the silk from the cocoon is the natural step, and this art is shown by Jouffray's machine, 3,682, West Galleries, room 17, ground floor, part of which is for reeling and the other part for re-reeling. In both these processes the reel is here turned by steam-power, but this is not a necessity, and the reels might be just as easily and well turned by hand; in fact, the China crop for the past season, just estimated at 7,150,000 lbs, has been all reeled by hand. This silk reeling is an exhibition which no one should pass without examination. It is an industry which we have not in this country, and it is somewhat to our discredit that silk is the only manufacture in Great Britain in which we do not commence with the raw material. The raw material of silk is the cocoon, such as one sees reeled at this exhibit, besides the specimens in rooms 14 and 15, class 8, division 2. It has been stated seriously that English women could not acquire the peculiar knack necessary to reel silk well, which is equivalent to saying that English women cannot do that which French, Italian, Chinese, Japanese, and the women of many other parts of the world can do without difficulty. Of course it is nonsense; but it is a fixed idea in many of the silk manufacturing districts, and the more this process is seen and talked about, the sooner the old pre-conceived prejudices must give way. The great skill required is to keep the thread the same size, so that a given number of yards may at any time weigh the same; for instance, supposing the reeler starts with four cocoons, towards the end it would require six cocoons to maintain the size, the thread of the cocoon becoming more and more attenuated as it approaches the chrysalis, until it finally breaks, and what is left, technically called "skin," is treated as other waste silk, and carded.

The woman reeling at Messrs. Jouffray's machine is evidently an expert, as the beauty of the raw silk she produces proves; but there is no mystery to be discovered, and the use of the second basin, which sorely puzzles some curious spectators, is to contain cold water to cool the reeler's fingers in. The heat of the water in which the cocoons are placed to dissolve the natural gum varies, with the description of cocoon used, from 160° to 200° Fah., and this is a thing that requires care and a little discrimination to regulate. In this case the heat is supplied by steam, which can easily be regulated, but in China and Japan a charcoal fire under the basins supplies the heat, and the specimens of Japanese reeling machines, immediately opposite Messrs. Jouffray's machine, show how simple the process is in that country.

In Milan the complicated machines of the Chevalier Albert Keller not only reel, but put a twist into the thread by one process, making what are called "singles;" and the silk, in consequence of this improved machinery, has a high repute. It seems strange that the silk trade of this country never yet adopted the most approved method, and improved the mechanical appliances for reeling silk.

The work is especially adapted for women and girls, and is an industry which might be developed in this country to the benefit of all classes; and by Keller's process the same high-class skill is not required as in the swift reeling now exhibited, the motion of Keller's machines being slow.

In rooms 14, 15, No. 3,611, is a case of English silk, grown and reeled in this country from seed. Specimens of the cocoons are shown in the "bush" where the worm spun them. The moths, eggs, cocoons reeled, refuse, thrown, and manufactured silk exhibited in this case are all English, and exhibited by the grower, Capt. Mason, of Yateley, who has for the last few years experimentalised upon the rearing of silk in this country. The reelers have been brought from the village, and one boy, who has attained the art of reeling, Capt. Mason speaks very highly of. The specimens of raw silk in this case will bear comparison with many high class silks, although they have been grown and reeled in England.

In case 3,638 are beautiful specimens of Broussa silk, and the cocoons from which the silk was made. The exhibition of the cocoons with the raw silk makes this case extremely interesting, and the different races—yellow Italians, Japans, pure whites, and sulphur-coloured cocoons—with the high quality of the silk obtained from some of the white and yellow cocoons, place this silk in a good position among its competitors. It is worthy of note that but a few years since the silk produced from this district was inferior. They are all exhibited by the Turkish government.

In case 3,612 China races are exhibited by Messrs. Matheson and Co.—Tsatlas, from Nanzing and Hoochow; Taysaams, from Ka-shung and Woo-sei, with China throwns. These are beautiful silks, and it must be acknowledged that when China sends forth her choice samples they are very hard to beat. The specimens of yellow silk from Shantung are interesting, as being only recently received from there, the north of China not being considered formerly a silk-producing country.

Messrs. Matheson and Co. also exhibit very beautiful specimens of Japan raws; with each specimen the price is given, both in dollars and sterling. Of these the Jo-sheiu and Sinchieu are very fine, and show what can be turned out by the primitive reeling machines of these people by care and extra labour.

The specimen of green silk of the Yama-mai is exceedingly interesting, as showing a very difficult reeling successfully overcome, and producing a very valuable silk from an oak-feeder. The history of this silk is modern. About 40 years ago the inhabitants of 16 villages formed themselves into an association to cultivate the Yama-mai, and this culture has gradually increased until the number of cocoons sold annually exceeds two millions. Mr. Consul Adams at the time of his visit to the district found the value of this silk to be 800 to 840 riyos, which is about the value attached to this specimen—viz., 27s. 6d. per lb. The imperial robes of Japan are said now to be made of this silk. The worm feeds on different descriptions of oak, but that best suited is *Quercus serrata.*

The Japanese Government also exhibit raw silks, some of which show the re-reeling, being on the reel of four bamboos. These specimens are very fine, and it is to be regretted that a full translation of the names of the different districts was not given, but very few being the wiser for the Japanese characters on the labels.

No. 3,582, by Messrs. E. Hall and Son, is worthy of attention, as enabling the observer to make useful comparisons. Here we find Japan, Indian, Italian, Turkish, and colonial cocoons; China raws in the gum, and the same dyed; Tsatlee trains, and the same dyed; India and China sewing silks, in the gum, and the same after boiling; Japans and Cantons, in trains, and the same boiled; and a skein of Szecumen yellow silk, worth comparing with the Shangtung silk exhibited by Messrs. Matheson and Co. before alluded to.

Nos. 3,551, 3,631, 3,626, are fine specimens of European silk, showing the weights in diniers.

Indian raw silks are not so well represented as they might easily have been. In Messrs. Matheson's case, 2,612, are Madras cocoons of the usual unsatisfactory nature, and the Surdahs, made from similar cocoons, show what a beautiful silk can be made with so inferior a raw material. It is provoking to find, with such labour and appliances, that the specimens sent home from time to time from the Nielgherries, in the South; Poonah and other places in the Bombay district, and Kangra, on the Sub-Himalayan slopes, cannot be multiplied and substituted for the inferior raws of Bengal. But a few years ago a race of worms was found at Kangra almost wild, and without a history, with all the superiority, both of size and quality, of the old Tuscan races.

The tussahs of India are more interesting, seeing that fashion has at last deigned to patronise this description of silk. In case 3,567 we have specimens of a rough tussah-looking silk, and 3,612 shows the Indian tussahs as reeled upon a woman's knee, which cannot be unreeled in this country from their conical shape. The Chinese tussah, in the same case, is a useful description. The waste silks in this case are also worth attention, as they are now being utilised in this country to an extent never before equalled, and have become of considerable importance.

The uses of this waste, after being cleaned, carded, and boiled, is shown by the machine exhibited by Messrs. Greenwood and Battley (3,685), and the produce of the manufacture, by Messrs. Baker, Tucker, and Co. (3,553), and Messrs. J. and T. Brocklehurst (3,559). Its manufacture forms a new and most important feature in the silk manufacturing of this country.

In 3,551 is a specimen of raw silk grown and reeled in Egypt, by Maxwell Anketell, Esq., a gentleman who has just been laying out large plantations for the Khedive, and introducing silk-reeling into that country. This is from Italian seed, and classed with Italian raws.

Messrs. Hands and Co., in 3,583, show raw silks in the gum and boiled off, also silks in the various stages of dyeing; and their case is worth attention from the pleasing arrangement of colours as well as the more useful information to be gained.

No. 3,574 is a well-exhibited collection, showing the cocoons, reeled silk, and waste. As might be expected of an exhibit from Alais, the raw silk is not only very beautiful, but the quality superb. The reproductions of Japanese cocoons point to its origin, and Messrs. Gascuil and Tronchias have, by a judicious arrangement, made an interesting exhibit.

Dr. Campbell, in 3,563, shows the silk obtained from the worm feeding on the castor-oil plant in Assam and Darjeeling, and it is a matter of regret that where this "endi" comes from the mulberry is not cultivated, for wherever it has been planted to protect young tea, it grows luxuriantly.

Perhaps the most extraordinary exhibit in the way of raw silk is the black dyed, which shows a very peculiar property in silk, viz., the power to retain certain drugs and chemicals in a quantity not only to replace the natural gum removed, but to increase the size of the thread to, in some cases, six times its natural size. In the natural state, silk contains almost 25 per cent. of gummy matter, which is extracted in the process of dyeing soft silk, and the original 16 ozs. is reduced to 12 ozs. Such silk is bright, soft, and lustrous, will take the most beautiful dyes, and is employed in the production of the most costly goods. Specimens of such have already been noticed in case 3,583 and others. But if, instead of a reduction in the size of the thread, it can be enlarged to a considerable extent, it is obvious that the manufacturer dealing with a thread which covers three or four times the space the natural thread would do, can produce a manufactured article at such a price as to leave competitors no choice but to discover the secret or be out of the market. Thus the present cheap black ribbons of Coventry could not possibly be produced at the price were not the silk thread made artificially to cover four times the space of the natural thread.

The extent to which silk will take up such weighting is most extraordinary, and is admirably illustrated by Messrs. Dickins and Co., Middleton (3,569), some of their dyed silks showing an increased weight exceeding 600 per cent. For some time the secret was confined to Lyons, but Messrs. Dickins and Co. appear to have gone beyond even the skill of the Lyonese, for while at Lyons a pound of silk is returned weighing about 90 to 94 ozs., Messrs. Dickins return it to the manufacture weighing 120 ozs.

In the Queensland Annexe are specimens of Japanese and Indian cocoons. It is to be regretted that these last are in the colony at all. The Japanese reproductions are very good. The reeled silk from that country is only worthy of notice for the purpose of intimating to the colonists that the reeling of silk is an art of itself, subject to certain trade rules, and that specimens like that from Queensland, although reeled silk, are not raw silk, and have little or no value.

The raw silk grown and reeled by Dr. Hiddingh at the Cape is extremely encouraging, and the beautiful sashes made from this silk, and exhibited by the Society of Arts (3 634), show what magnificent fabrics can be produced from it. The Society is thus encouraging a new industry which bids fair to become, in the immediate future, a prolific and powerful source of silk supply.

From Australia are very good specimens of cocoons. No. 129 of the Australian catalogue is an exhibit of cocoons raised on the Murray river, by Mrs. Bladen Neill, from an acclimatised race introduced a few years since into Australia by

Mr. C. Brady. These worms appear by the change of climate to have been enabled to shake off the disease which has made the race now nearly extinct in Europe. Mr. Thorne also shows cocoons of a very high class from seed selected and sent him from this country. The yellow, sharp-pointed cocoons also exhibited will doubtless give place now to the better varieties introduced by Mrs. Neill and others mentioned.

In conclusion, it must be admitted that the exhibition of raw silk—with the exception of the magnanerie and reeling—has not been made so instructive as it might easily have been. One sees a skein of China silk, but beyond the fact that it is better than the ordinary run, we learn nothing; could we at the same time learn the district where the worm was reared, the description of mulberry, any peculiar marking of the worms, specimen of cocoons, number of cocoons required to produce a pound weight of silk, report upon the "workability" of that silk, and any other remarks—if we could collate a number of such, much very useful information might be collected from which every silk-producing country might benefit.

The number of visitors admitted to the Exhibition on Thursday, July 24th, was as follows:—Season tickets, 115; on payment of 1s., 2,662; total, 2,777. On Friday, season tickets, 97; on payment of 1s., 1,901; total, 1,998. On Saturday, season tickets, 178; on payment of 1s., 2,482; total, 2,660.

The number of visitors admitted to the Exhibition during the week ending Saturday, July 26th, was as follows:—Season tickets, 788; on payment of 2s. 6d., 635; on payment of 1s., 11,724; total, 13,147.

The number admitted on Monday, July 28, was, season tickets, 143; on payment of 1s., 2,043; total, 2,186. On Tuesday, season tickets, 156; on payment of 1s., 2,330; total, 2,486. On Wednesday, season tickets, 129; on payment of 2s. 6d., 714; total, 843.

Her Majesty's Commissioners have decided that the collections of works of deceased British artists, to be formed in connection with the London International Exhibition of next year, shall consist of works by the following artists:—

Painters in oil.—John Constable, R.A., died 1837; Augustus Egg, R.A., died 1863; David Roberts, R.A., died 1864; David Wilkie, R.A., died 1841.

Painters in water colours.—J. Coney, died 1833; J. S. Cotman, died 1842; F. Mackenzie, died 1854; S. Prout, died 1852; A. Pugin, died 1832; J. M. W. Turner, R.A. (architecture only), died 1851; C. Wild, died 1835.

Owners of pictures painted by these artists are invited to intimate their willingness to lend them to Her Majesty's Commissioners.

Sir Charles Wheatstone has been elected Foreign Associate for the French Academy of Sciences, to fill the vacancy occasioned by the death of Baron Liebig.

In the kingdom of Italy there are 116 mines in operation, about one quarter of the whole number in the country—45 are iron, 34 copper, 13 argentiferous lead, 14 auriferous pyrites; the other are, 10 zinc, mercury, nickel, and manganese.

A telegraph line has been opened from Calcutta to Native Burmah.

ON THE PRODUCTION OF SILKWORM GRAIN BY THE CELLULAR SYSTEM.

Since the appearance of the silkworm disease, great difficulty has been experienced by the silkworm educator in procuring sound and healthy grain, and European cultivators have been driven to draw their supply of eggs from Japan and other eastern countries which are supposed to have been unaffected by this terrible scourge. The existence in the silkworm of vibiro life, or the so-called *corpuscles* of cornalia, seems to be the direct cause of several of the diseases to which this useful insect is subject, and germs of contagion being in this manner handed down from generation to generation, the silk trade has been, since the appearance of the pebrine, gattine, passis, &c., threatened with complete annihilation.

In the microscope a powerful means is brought to bear for detecting traces of this epidemic in the silkworm, and as he is enabled by its aid to separate the good from the bad, the sericulturist is to a great extent certain of the results of his crop, which otherwise would be a matter of mere chance.

Experience has shown that the yellow variety has a greater tendency to be affected by disease than the original Japanese silkworm, and also that the reproductions of the latter are hardier than those of the other kind, so that if more than 6 per cent. of the corpuscular infection be found in the grains of the yellow variety and Japanese reproductions, very much must be rejected as unfit for education. On the other hand, the original Japanese will give a tolerable return even with 8 to 10 per cent. of infection, but with 12 per cent. there is no prospect of their being worth rearing. Before undertaking the education of the silkworm, the grain should be examined with the microscope, to ascertain that it contains no greater per-centage of infection than that just stated.

The production of silkworm grain by the cellular system is now practised on a large scale in Italy, and more especially in Lombardy, where it has given most brilliant proofs of success. This system is extremely simple, consisting solely in the use of the microscope for the examination of the moths after they have deposited their eggs, and in the rejection of the grain should they not be found free from infection and containing germs of disease in their blood, or with dark spots on their wings and bodies, a distinguishing sign of this disorder. The establishment of societies for the production of silkworm grain on this system, similar to those already existing in Lombardy, the Friuli, Tuscany, the Tyrol, and Gonzaga, cannot be too strongly advocated, and their direction should be confided to competent persons.

A knowledge of the use of the microscope is indispensable to the sericulturist, who will find in it both profit and satisfaction.

The silkworms that pass through the various phases of their life and complete their metamorphosis with the greatest degree of regularity, the foremost in commencing to spin, and those that have shown no trace of disease, and whose cocoon is well-shaped and does not yield rapidly to the touch, may, without hesitation, be pronounced to be the healthiest. The first cocoon spun is probably that which will produce the best grain.

The cocoons should be firm at the ends, as also in the middle, and should be selected from the best formed ones, but not from the largest or smallest; they should be slightly curved inwards towards the centre, the silk should be of fine texture and of uniform and natural colour, and on shaking the cocoon gently a slight rattle should be heard, indicating that the chrysalis is perfect and free from the cocoon.

From five to six hectogrammes of cocoons are sufficient for the production of one ounce (30 grammes) of grain.

For the production of grain care should be taken to exclude—

1. The cocoons of silkworms that have given signs of "pebrine," or "gattine."

2. Those affected with "passis" in a larger proportion than 3 per cent.

3. Those that have not accomplished their metamorphoses with regularity.

Having selected a batch of cocoons, an examination of the chrysalis must be next made. For this purpose take 100 cocoons and cut them open with a pair of scissors to see whether they present any black spots. Bellotti and Cornalia are of opinion that these marks are a sure sign and have direct connection with the disease called "flaccidness" or "passis," and that grain produced from these cocoons will to a certainty be affected by this dreadful malady.

Take another sample and place them in a warm room, or, better still, in an Orlandi's incubator for the purpose of hastening the coming out of the moths. The temperature in the incubator should be maintained at 26° Ream. (90° Fah.). The remainder of the batch of cocoons is to be placed in a well-ventilated room, where the temperature does not exceed 18° Ream. (71° Fah.). In this manner the moths in the sample will come out two or three days before those of the remainder of the batch, and there will be still time to utilise their silk by suffocating the cocoons, in case a sufficient degree of health has not been found in the sample, which is the case if more than 40 out of the 100 are affected with corpuscles, vibrios, or germs of fermentation.

The examination of the moth is now made in several ways. One plan consists in crushing the moth in a glass or porcelain mortar, with 15 to 20 drops of distilled water. It is, however, inconvenient and tedious, as great care must be taken to clean everything used during this operation at each separate examination. Mummified moths may be treated in the same manner. A drop of blood may be taken from live moths by pricking them with a needle in the abdomen, and transferring it to the object glass of a microscope. Another and more expeditious plan is to cut off one or both *antennæ* of the moth, and pound them in a mortar with a drop of water, which is to be placed in the microscope; should this preparation be found to be free from vibrios or corpuscles, it may be naturally inferred that the body of the insect is also free from germs of disease, and in consequence that it is healthy. The moth may then be allowed to deposit its eggs. Should the contrary be found to be the case, then the moth should be destroyed.

Having found that the number of diseased moths in the sample does not exceed from 10 to 20 per cent., the moths in the remainder of the batch may be allowed to come out, and are considered as fit for the production of grain.

All moths must be rejected that have a weakly, wrinkled, or torpid appearance, as those of a leaden colour, hazy, with black spots or blisters on the scales of their wings, and imperfectly-formed moths should be thrown away without hesitation.

Having selected in this manner a quantity of healthy moths, they are then allowed to couple, and are afterwards separated.

For the isolation of the moths several plans have adopted.

1. A plan that is much in favour in Lombardy, Gonzaga, and in Piedmont consists in the use of muslin bags, in which a couple of moths (a male and a female) are confined. The coupling is in this manner natural and unlimited, and the grain is deposited in the bag, which should be kept until the hatching season in a dry and well ventilated place.

2. Another plan, and that recommended by Professor Cornalia, of Milan, is as follows:—The moths are placed in a tray, and their coupling is limited to eight to ten hours; in the meanwhile, two cloths for receiving the deposit of the grain should be prepared, and a number of cells made of cardboard or metal are to be placed in it in rows about 1 cent. apart; these cells are open at both ends, and are sometimes cylindrical, and sometimes in the form of a truncated cone 5 cent. in diameter at the base, and from 2½ to 3 cent. in height. A female moth is placed in each cell until she has deposited all her eggs, or, better still, until she is dead. Each of these cells should be numbered, and a corresponding number marked upon the moth. The dead moths are then collected, and enclosed one by one in a pasteboard box, which must be numbered in a like manner, to be kept for future examination.

To prevent the destruction of the moths by the *Dermestes lardarius*, an insect of the beetle tribe, that feeds voraciously on them, the cells containing the mummified moths should be collected in boxes capable of containing from 50 to 100, and any eggs or larva of this beetle will be easily destroyed by placing the boxes in an oven heated to from 80° to 100° Ream. (212° to 258° Fah.).

Whatever be the system of isolation adopted, there is always advantage in obtaining a separation of the infected from the healthy grains, and in this manner a means of rejecting those that have been laid by moths that on examination are found to be diseased.

A register of the results of the examination of each couple must be kept, and the eggs of those moths that have been found to contain germs of disease must be scraped off the cloth and burnt immediately.

For the production of grain on a large scale it is not considered necessary to examine the male, but when eggs are required for reproduction, the examination of both male and female is necessary; no precaution should be neglected in this operation, and every care taken to reject moths even infected ever so slightly.

The moths can be examined at leisure during the winter months, when the sericulturist has nothing else to do; or, should it be preferred, they may be sent in numbered boxes to some sericultural establishment, where they may be examined at a trifling charge by a professional microscopist.

Until the "pebrine," so fatal to the silkworm, has been effectually stamped out, the production of grain in the ordinary way must not be thought of. It is, therefore, a matter of the utmost importance for the future development of sericulture, that the selection by the use of the microscope should be extended to all silk-producing countries, for by its aid our cultivators will find a means of repairing their past losses, and the total regeneration of the silkworm will be insured.

In conclusion, it must be repeated that every silkworm educator should perfectly understand the use of the microscope, and it cannot be too strongly urged upon the governments of those colonies in which this important industry is now beginning to make rapid progress, that there is great necessity for the establishment of microscopical laboratories and permanent schools of sericulture, where the use of this indispensable instrument for investigation could be taught.

M. Vambéry asserts, in the *Allgemeine Zeitung*, that the physical, financial, social, and political difficulties in the way of the execution of M. de Lesseps' project of a Central Asian Railway from Orenburg to Peshawur make the whole plan impracticable under present circumstances.

The question of State ownership of railroads in Massachusetts is still agitated, but no general policy is agreed upon. A proposition was lately before the Legislature which contemplated the State owning one of three competing lines of railroad, all of which were to have the use of the Hoosac tunnel.

A company has been formed, with a capital of £1,000,000, to promote certain lines of railway connection in France, which will facilitate the route from Great Britain to India. The immediate project is to connect the Northern Railway of France, at Heison, with the Paris, Lyons, and Mediterranean line at Dijon, forming a direct route from Calais to Marseilles. All the necessary concessions have been obtained.

CORRESPONDENCE.

THE ECONOMY OF FUEL.

Sir,—May I ask you to publish the following description of an invention of mine for producing fuel from peat?

A description of the machinery for, and the manufacture of, peat-fuel.—Build a tank (into which steam can be conveyed in a frost) with a feeder, that will separate the peat when needed, and a shoot to supply a cylinder, built in a race or tank, with a shoot and tap at the bottom, about twenty feet in diameter, the width being according to the quantity to be manufactured, the sides or flanges to be closed about four feet, above which construct the opening to catch the peat from the tank-shoot, the periphery being a sieve (the fineness being according to the quality required); the inside of the cylinder to have projections or horizontal rods to carry the peat to an elevation from whence it will fall on water, in which the cylinder must be immersed about one-fifth of its diameter; let the peat run from the cylinder into a tank or truck on rails, made with a double bottom, also the sides and ends, if needed, which may be hurdles made to fit, having a space between, the upper or inside bottom being perforated and covered with a thick horse-hair cloth, or other material, through which the water will filter; the inside of the tank or truck to have a moveable frame, or partition, wedge-shaped, with the thin part at the bottom, the compartments being the size and shape the peat-fuel is required; the sides of the truck to be hung with hinges, and a moveable cover for the top with a tap, or the truck can be run into a cylinder, the whole to be air-tight, and a pump to be worked by the motive power.

To manufacture the peat-fuel, carry the peat from the bog with trucks or a tramway into the tank, from whence it can be conveyed by the feeder and shoot into the cylinder, which can be turned by a waterwheel, turbine, steam-engine, or other power, and which will disintegrate and separate the decomposed peat from the vegetable fibre or other extraneous substance. Let the peat from the race or tank of the cylinder into the tank or truck, the bottom of which connect by a pipe with a screw-joint to the pump, then pump away the water and remove the frame out of the tank or truck; then fix on the cover to the tank or truck, or remove it into a cylinder, and exhaust the air and humidity (and if necessary a dry-blast or exhaust) by a pump, let in air by means of the tap, remove the cover, let down the sides of the tank or truck, and remove the dense peat-fuel.

The vegetable fibre can be manufactured into paper or burnt, the ashes being a valuable manure.—I am, &c.,

G. N. Shore.

Lyme, Dorset, 10th July, 1873.

P.S.—It is computed that the machinery to manufacture 100 tons per day will cost £1,000, and 2s. 6d. per ton for labour. Any practical information for carrying out the above invention may be obtained on application to Mr. John Pinchbeck, C.E., of 27, Leadenhall-street, London, E.C.

The nitrate of potash trade of Peru has increased wonderfully within the last twenty-five years. In 1848 three vessels were sufficient to supply the demand, while now one hundred vessels are waiting for cargoes at the port of Iquique.

From the traffic returns of the Suez Canal it appears that in eleven months of 1872-73 five hundred and seventy-two vessels passed through, against two hundred and eighty-eight in the preceding twelve months, while the tonnage increased at a much larger rate—674,818 tons against 293,362 tons. This gives to the short cut 24 per cent. of all the tonnage passed at present between India and Europe and America.

GENERAL NOTES.

Patent Congress.—The preliminary arrangements for the International Patent Congress, which is to be held in Vienna this month, have been confided to a committee. The congress is to be composed of scientific men, artisans, political economists, and other experts. The United States Government have appointed Mr. John Thatcher, of the Patent-office, to represent it, and it is stated that a communication is being prepared at Washington embodying the views of the American Government. Mr. Thatcher is now on his way to Vienna. A meeting of the friends of an International Patent System was recently held to consider this subject. Mr. B. Samuelson, M.P., was in the chair. The assimilation of the various patent laws was advocated, and it was resolved—"That a deputation wait upon Lord Granville to represent to him that returns having been obtained from our embassies and legations abroad in reference to the patent laws of other countries, it is expedient that advantage should be taken of the meeting of the congress on patents at Vienna, in order to further the resolution of the Select Committee of the House of Commons on Patents for the sessions of 1871-72, in favour of international patent laws." Mr. Webster, Q.C., F.R.S., and George Haseltine, LL.D., members of the Society of Arts, have been specially invited by the Austrian authorities to attend the congress.

British Association.—The forty-third meeting of the British Association for the Advancement of Science will commence in Bradford on Wednesday, the 17th of September, on which day the first general meeting will be held, at eight p.m., when the President will deliver an address; the concluding meeting will be held on Wednesday, the 24th of September, at 2.30 p.m., when the association will be adjourned to its next place of meeting. At two evening meetings, which will take place at 8.30 p.m., discourses on certain branches of science will be delivered. There will also be other evening meetings, at which opportunity will be afforded for general conversation among the members. The sections are:—A. Mathematical and physical science; B. Chemical science; C. Geology; D. Biology; E. Geography; F. Economic science and statistics; G. Mechanical science.

Registration of Letters.—Considerable discussion was aroused by the recent issue of a Post-office regulation that all letters containing matters of value, including stamps, should be registered in the same way and under the same penalties as letters containing money. The new rule was to have come into force on immediately, but, as great dissatisfaction was caused by it, a notice was published explaining that the regulation was to be enforced only when such articles of value were so carelessly enclosed in letters as to make it easy to perceive them. The matter, however, was brought under the notice of Parliament, and it was understood that the regulation would not be put into force.

Mineral Oil in Australia.—A product of South Australia, just discovered, promises well. Kerosene oil has been made from a substance which exudes from the earth in large quantities at the head of the Coorong. Experiments have been made to test the stuff, which in appearance resembles asphalte, and has been called "caoutchouc." A ton of it yields seventy gallons of kerosene, thirty of lubricating oil, and seven of varnish. Tests have shown that the kerosene will not burn except through a wick, until heated to 152°.—*Builder.*

NOTICES.

SUBSCRIPTIONS.

The Midsummer subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

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FRIDAY, AUGUST 8, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

NATIONAL TRAINING SCHOOL FOR MUSIC.

1. The necessity for a National Training School for promoting the art of Music in this country has long been felt, and has at various periods been urged on the attention of successive Governments by the highest authorities. Such has been the unanimity of all those who are competent to give an opinion in this matter that it is needless to discuss the question here. Suffice it to say that the whole subject of Musical Education in this and foreign countries was investigated and fully reported on by a committee appointed by the Society of Arts in 1865.

2. Although it appears from the Reports of the Science and Art Department that the question of a State Training School was at one time under the consideration of the Lords of the Committee of Council on Education—Earl Granville being then Lord President—the Department of Science and Art up to this time has not taken any active steps towards its establishment. It has therefore been decided by the Society of Arts to take the initiative, and establish a Training School by voluntary effort, with the full intention that it should, and under the confident hope that it will, eventually, be transferred to the responsible management of the State.

3. The fundamental principle and primary object of the School is the cultivation of the highest musical aptitude in the country, in whatever station of society it may be found. In order to carry out this principle to the fullest extent, admission to the School will be obtained by competitive examination alone.

4. As the gift of musical ability is found in all grades of society, and frequently among the classes of very limited means, it is evident that in a large number of cases, the student must not only receive gratuitous instruction, but also be supported during the period of his training. To provide for this it intended to establish about 300 scholarships, for which the most influential support has already been promised, and further support is solicited.

5. The proposed scholarships will be of two kinds, the one to afford free instruction by paying the students' fees, the other to give free instruction with a maintenance allowance in addition. It will be open to any county, town, public body, or private individual to establish one or other of these kinds of scholarships for competition under given limitations. Should there be more accommodation in the school than is requisite for the instruction of these scholars, students paying their own fees will be admitted by competition to fill the vacancies, care being taken that they show sufficient aptitude.

6. It is proposed that the School should provide in the first instance for the free instruction of about 300 scholars. The school fee without maintenance, it is estimated, will be between £35 and £40 a year. The maintenance allowance for the support of the scholar will be in addition to this fee, and independent of the school.

7. The Council of the Royal Albert Hall are prepared to devote certain rooms, including two small lecture theatres, to the use of the School at a nominal rental, when proper arrangements shall have made been made for its conduct. This assistance is estimated to be worth about £1,000 a year.

8. The Royal Commissioners for the Exhibition of 1851 have offered a plot of ground immediately adjoining the Albert Hall for supplementary suites of practising and lecture-rooms, and have agreed to grant a lease of the same to Mr. C. J. Freake, a member of the Council, who has most munificently undertaken, at his own cost and risk, to erect the necessary buildings thereon. Indeed, the plans for these buildings are in a forward state of preparation.

10. The School is under a Committee of Management, consisting of two members appointed by the Royal Commissioners for the Exhibition of 1851, two members appointed by the Council of the Royal Albert-hall, and three members appointed by the Council of the Society of Arts, and the Committee thus formed consists of H.R.H. the Duke of Edinburgh, Admiral the Right Hon. Lord Clarence Paget, K.C.B., Major-General Eardley-Wilmot, R.A., F.R.S., Henry Cole, Esq., C.B., Major Donnelly, R.E., and Sir William Anderson, K.C.B.

All communications relative to the establishment of Scholarships, and all inquiries about the Training School, should be addressed to the Secretary of the National Training School for Music, Kensington-gore, London, S.W.

TECHNOLOGICAL EXAMINATIONS.

The subjects in which examinations were held this year, namely, Cotton Manufacture, Paper Manufacture, Silk Manufacture, Steel Manufacture, and Carriage-building, will be retained in the Examinations of next year, with the addition of Cloth Manufacture, Glass-making, Pottery and Porcelain, and the Manufacture of Gas.

The Programme is in preparation, and will be published as soon as possible.

ANNUAL INTERNATIONAL EXHIBITIONS.

The Council, having been informed that her Majesty's Commissioners do not intend to publish Reports on the different departments of the Exhibition of the present year, and looking to the great importance to Arts, Manufactures, and Commerce that these annual displays should not pass away without some record, have decided to undertake that duty, and for this purpose have engaged the services of gentlemen specially skilled in the subjects of the several sections, to prepare such Reports for publication in the Society's *Journal.* The Council, however, desire it to be understood that, in publishing these reports, they do not necessarily adopt all the views expressed in them, which must be taken as those of the writers only.

The following report is the eighth that has been issued. The remainder will appear as soon as they are complete.

SILK AND VELVET MANUFACTURES.

By Francis Bennoch.

As the Council of the Society of Arts do not desire any historical *resumé* of the introduction and progress of these branches of industry, I at once plunge into the review committed to my charge.

There are exhibited, as examples of ancient manufacture, 166 specimens, contributed by 36 private persons, 2 trading firms or dealers, Her Majesty's Commissioners, and the South Kensington Museum, whilst the examples of modern productions are furnished by 44 British and 26 Foreign manufacturers or exhibitors, and 4 Foreign States.

The various articles, when properly grouped, show that there are of British manufacturers, 6 contributors of ribbons; 5 of broad or dress silk; 4 of handkerchiefs and ties; 3 of black crape; 2 of poplins; 1 of lace; 3 of sewings and twist; 5 of furniture, or upholstery silks; 3 of elastic boot and other webs; 1 of broad velvet; 1 of umbrella silks; 1 of church decoration silks; 1 of flags; 1 of crape scarfs; 2 of gimps and fancy cords for trimming purposes; and 1 small collection of silk under-clothing.

The foreign contributors are, 1 of ribbons, chiefly black; 1 of fringes; 1 of sewing silks; 2 of lace; 2 of furniture silks; 2 of trimmings; 8 of dress silks; 3 of broad and ribbon velvets; 1 of plush for hats; 1 of handkerchiefs; 1 of elastic webs; with contributions from Japan, China, and Damascus.

When taken in the aggregate, the number of exhibitors looks meagre enough, but when they are subdivided and arranged under their separate heads, the character of the collection might appear to be almost ridiculous, as professedly an International Exhibition. Nevertheless, the thoughtful observer will find here much worthy his most careful scrutiny. By comparing the present with the past, he will find contrasts sufficient to prove the enormous advances that have been made.

To any one conversant with the position of our silk manufactures, and the almost fabulous amounts turned over in the course of the year, the first fact that forces itself upon the attention is, that so few manufacturers have taken any interest in the trade by which they live, or cared to exhibit their productions. Whether it arises from a listless indifference to the position they personally occupy, or a total disregard of the estimation in which the country may stand as respects its fabrications in silk, it is not for me to determine; still there the fact remains, and most humiliating it is.

The silk industry of Manchester and its immediate neighbourhood is represented by only one house, whilst Spitalfields proper, several towns in Essex and Somerset, have not a single representative, and only three exhibitors are found to sustain the reputation of the City of London. Fortunately for the credit of the country, and the interest attached to the International Exhibition, Coventry and Macclesfield have brought together a series of the productions of each locality so carefully chosen as to lift this department out of the slough into which it must have fallen but for the intelligent enterprise of these two towns.

If manufacturers have proved to be lukewarm, the great wholesale houses have been absolutely torpid, as not one of them has taken the trouble, small though it might have been, to bring a collection together. Fortunately, two or three of the most distinguished of the retail dealers have stood in the breach, and done much to redeem the character of the Exhibition. Their voluntary services demand the fullest recognition. These remarks apply chiefly to the lack of interest taken by those for whose interest this branch of the Exhibition was established. I shall presently show, when we come to consider the several classes of manufacture exhibited or indicated, that if the specimens of broad silks displayed, however excellent in themselves, do not fairly or satisfactorily represent the manufactures of the country, what must be said of the makers of, or dealers in, trimmings, foreign buttons, tassels, &c., in all their infinite variety, from whom and of whose skill in design and harmony of colour, not a single specimen appears, although there are many whose productions would hold their own if placed side by side with the best productions of foreign looms or continental handwork?

It was a happy thought of the authorities to bring together under one roof, and in one suite of apartments, the productions of past ages and the fabrics of modern times. It is by comparison alone we can sufficiently appreciate our progression or retrogression. After a very careful examination of every case, notwithstanding the narrowness of the basis afforded for decision, the advance in design and mechanical skill is, in my judgment, absolutely marvellous; and to this, as regards woven fabrics, we are solely indebted to the invention of the Jacquard loom.

Before the invention of Jacquard was completed, fancy figures were produced by the application of a great number of treadles, demanding the utmost skill and vigilance, and a life-long practice, to produce the design placed before the weaver; and even then, to complete the floral effect demanded by the pattern, recourse was frequently had to the needle to complete the blossom begun in the loom. It is the opportunity for contrast and comparison that gives such a deep interest to this small but excellent collection. What at one time demanded the trained experience of years to accomplish in a very imperfect manner, can now, thanks to the genius of one man, be undertaken and successfully carried out by ordinary talent, through a strictly mechanical agency.

I now proceed to the consideration of the articles in detail, and, so as to condense my observations as much as possible, I shall, as far as convenient, group the several productions under the names of the towns in which they are made. This, of course, can only apply to modern fabrics.

Ancient and Eastern Fabrics.

Many of these productions are interesting because they are curious. The process of manufacture having been superseded, the industry is dead, but the result remains, and manifests the skill and care bestowed to produce such results.

There is a collection of Japanese work recently introduced, and also of fabrics from Damascus, of which no catalogue was arranged when I visited the department for critical inspection. The designs are frequently grotesque, and the colouring somewhat sombre, as I presume the dyes are generally extracted from vegetables, and the colours are not always arranged in what would be considered as good taste. Sometimes the grounds of the fabrics are rough and irregular, as if made from common—very common—silk, carelessly reeled; and yet some of the raw silk exhibited in the same cases is of the most exquisite description, and shows the perfection of reeling.

In one branch of the manufacture, where metallic threads are introduced, we have much to learn, and should garments glistening with gold ever become fashionable, our manufacturers or embroiderers, or both, will do well to study carefully these productions of the East, produced as we know they are by the rudest appliances, yet with wondrous art. It is in this direction, and this alone, that I wish to draw the attention of manufacturers, for in all plain fabrics of simple colours, or irregular and barbarous stripes, the examples are of no value whatsoever. Indeed, throughout the whole department, the plain goods of modern times greatly excel the productions of past ages.

The collection furnished by Matheson and Co., of 3, Lombard-street (3,612), is very interesting, and the examples are full of merit, though generally inferior to similar fabrics produced in Macclesfield. The specimens of black taffetas possess no interest, whilst the occasional use of metal adds considerable effect.

The contributions of J. Summers and Sons are very interesting, more especially in a few brocaded dresses of various epochs (3,534) from 1700 to 1800. The designs are admirable, the colouring in good taste, and the fashion of the whole, especially one of a green ground of shot silk, would do no discredit to a fashionable lady of the present time. As a specimen of weaving it is of the highest order and worthy of the closest examination. These remarks apply also to an admirable specimen exhibited by Mrs. R. Carey (3,502). To those who take interest in priestly robes, chasubles, copes, &c., brocaded and embroidered, I commend the contributions of Lady Drake (3,514), whilst those who delight in the curious will do well to examine the specimens of old silks lent by Dr. Diamond (3,511). Here it may be noticed that some specimens, described as embossed, are in reality made of figures, &c., cut or stamped out, and attached to the original fabric by some adhesive substance. This is more particularly seen in the contributions of S. E. Nightingale (3,530). No bette rexample of Eastern skill in embroidery with gold can be observed; those in the Turkish jackets, &c., sent by Mrs. Clarke (3,505), and the whole of the case from the South Kensington Museum are choice specimens (3,535).

Modern Manufactures.

Leek.—From this prosperous town we have only one exhibitor, but he is a host in himself. As regards the special manufacture of twist and sewings, for which this locality has long been famed, nothing can be better than what may be seen in case 3,576. The ordinary observer could scarcely believe that those beautiful spools, diamonded on the top by the crossing of twelve threads laid side by side, are done by hand. Mr. Gibson deserves much praise, for he has shown excellent taste in hanging beside the finished articles the silks from which they are made, and adding a few cocoons to adorn his case. There are several other branches of industry carried on in this town, which ought, for the credit of its people, to have been shown.

The case of Marsden Brothers and Holden, of Halifax (3,610), may, with advantage, be examined in connection with the Leek case.

Derby has reason to rejoice in the public spirit of Mr. Higginbottom, who has done so much to delight the visitors to the Exhibition by showing his processes of silk-throwing described in the Report on Machinery. It is only my duty to draw attention to the case 3,591, where there are some excellent samples of elastic web. Mr. G. B. Unsworth supports Mr. Higginbottom, and shows some good examples of thrown and dyed silks, telegraph and other wires covered with silk, and the gimps, &c., used in the manufacture of fringes, tassels, &c., of which there are no examples in the Exhibition.

A very interesting and well-arranged case of fancy cords for upholstery and other purposes has been contributed by Mr. Woodroffe (3,044). The brilliant colours of his dyed silks, as shown by the picturesque bobbins on which they are wound, and the excellent taste manifested in the blending of the various shades in producing the cords, demand the highest commendation.

Nottingham is by no means fairly represented, and the few trifling things shown by no means indicate the marvellous mechanical power of that busy and prosperous town and its immediate neighbourhood. Knowing as we do the almost magical character of her imitative genius, we might have expected something worthy of her well-won and deservedly high reputation. But neither in lace, hosiery, nor fancy articles, does she exhibit anything worthy of remark. This indifferentism cannot be too severely condemned—it is almost a crime. Here was a good and inexpensive opportunity for a few of her gigantic manufacturers to bring together some interesting specimens of their highest skill; but they have not done so, and it will be almost a charity to avoid giving the number of the case in which the few insignificant articles appear.

Leicester has one representative firm—T. W. Hodges and Son—with a case of elastic webs (3533), which, for brightness of colour, evenness of surface and general elastic quality, cannot be surpassed. It is, however, a pity that others in the town have not followed their example, and shown specimens of their manufacture. It is by exhibiting honestly specimens of their ordinary manufactures that towns are benefited by International displays, and not by specially manufacturing for exhibition some curious thing for which there is not, never was, and never ought to be, any demand. On some future occasion Leicester may rouse herself from her lethargy, and show something worthy of herself.

Manchester.—Knowing the unlimited power of this city and the great variety of silk manufactures, one wonders how it happens that all her skill and enterprise are left to Mr. John Chadwick? Happily, if he has been left alone to sustain the credit of the city, he has done so worthily. His modest, unassuming case (3,536) of black and coloured silks for garments needs no flourish of trumpets to proclaim their merits; they are merely specimens of his ordinary daily productions, "warranted to wear." From this we gather that he has not been deluded by the *ignis fatuus* of a sudden profit, by being beguiled into the bog of abominable dyeing, which has ruined many and will ruin more. There are, as we shall find by-and-bye, men in Lyons who have built up immense fortunes on the reputation of dealing wisely by their silk, and thus honestly by their customers. If Mr. Chadwick will continue true to himself, the time may come when ladies will not be satisfied unless they can secure black silks of his manufacture even in preference to those of Lyons. The great variety of small wares, braids, trimmings, fringes, &c., made in Manchester, and into the manufacture of which silk largely enters, ought to have been exhibited, but they are not. There is, however, a Manchester branch of industry well represented by Mr. Linstead, (case 3,607), table covers embroidered by machinery. They lack the elaboration of handwork, but they are graceful in design and brilliant in colour, enabling by their cheapness all persons, even of very moderate income, to have their tables covered with something pleasant to look upon.

Reference to these productions naturally leads to *Birmingham*, where the altar covers and other church upholstery goods for decorative purposes, manufactured by Jones and Willis, of Birmingham and London, surpass all others of this class in quality of work, colour, and design.

Whilst considering the relative merits of upholstery and similar material, I may well draw attention to the manufactures of *Ireland*, where, in Dublin, the productions of W. Fry and Co. (3,573), and Pim Brothers and Co. (3,624) show some of the most notable articles to be found in the whole Exhibition. Their plain and figured poplins are unique, and no part of the world produces anything fit to be compared with them. The figured designs are in exquisite taste, and the richness of colour all that can be desired, whilst their fabrics for curtains and general rich upholstery are simply superb. Why should the manufacture of poplins and kindred stuffs be peculiar to Ireland, and how is it they can hold their own in competition with the whole of Europe? It must not be supposed that there are not hosts of imitators in France, Germany, and Switzerland. On the contrary, there are many, yet in those countries ladies rejoice in becoming possessed of an Irish poplin dress. This fact, coupled with the unmistakable natural taste and industry of the people, leads to another question: why are not other branches of silk industry established in Ireland? From the one great success, to which I have unaffected pleasure in referring, I am persuaded that in any special manufacture to which their genius may be directed they cannot fail to excel. In no former Exhibition have they made a display so creditable, and when the next period arrives, we may hope that still further advances will be made, not only in these special productions, but also in a much wider range of silk manufacture.

London.—From the consideration of these Irish fabrics, we naturally pass into the examination and description of a few exquisite things contributed by Jackson and Graham (3,595), whose silk damasks, tissues, and brocades for furniture and upholstery, chiefly designed by Owen Jones, are exceedingly beautiful. It may be objected that the patterns are too formal and angular, partaking too much of the geometrical, and not sufficiently of the flow and grace of curving scroll designs which characterise the French productions. That is, however, purely a matter of taste, and results from the prevailing opinion and fashion of the period in which we live. Doubtless such distinguished dealers and producers as Jackson and Graham wisely cater for their customers, and supply the class of articles absolutely in demand.

The two cases of upholstery fabrics shown by Norris and Co., Wood-street (3,615), contain several specimens of excellent workmanship and graceful designs. Occasionally the colours are a trifle dull, and have, for new goods, a faded or indistinct character. The general effect, however is creditable to the producer, who deserves double thanks on account of the interesting looms exhibited in another section. It is worth while to mark the precision of the work produced by means of the Jacquard loom, and compare it with some of the antique fabrics close at hand, such as are shown by Dr. Diamond.

Evan Howell and Co., of St. Paul's Church-yard (3,570), show a few specimens of plain coloured dress fabrics of exquisite quality and choice hues of colour, and the lighter seasonable shades to be added to, or to replace, these more sombre colours, will equally testify to the excellence of their manufactures.

The productions of G. and J. B. Hilditch, of Cheapside (3,502), are of a similar class to the above, and in all respects of equal quality of manufacture. In both cases there are admirable specimens of *moiré antique* which far surpass anything of the kind of foreign manufacture. The article is of foreign origin, and yet by native skill and determined perseverance the whole of the highest class of these goods is made in England. On these two enterprising firms the weight of sustaining the reputation of London's broad-silk manufactures has been cast, and they have most worthily maintained the character of our Spitalfields weavers. The responsibility was great, and they well deserve the credit their courage must inevitably bring, and, although Messrs. Lewis and Allanby, and Jay and Co., of Regent-street, and Jolly and Co., of Bath, show some excellent goods, they are either made by the gentlemen already named, or will be named hereafter when I treat of the manufactures of Lyons.

Norwich.—The productions of the Norwich Crape Company (3,616), Kay and Richardson (3,604), and French and Co. (3,572), are all of high merit, and being chiefly of black crape for mourning purposes, there is little room for criticism. It is only necessary to make one brief remark, and that is very satisfactory to our national pride. In this special manufacture England stands pre-eminent, and has attained her high position by persevering industry. Although two of the largest producers are "conspicuous by their absence," the reputation of Norwich is well sustained by the manufacturers named, as well as by Mr. Lilly Simpson, whose fabrics, shown under the name of William White, are exceedingly good; in fact, there are very few more attractive cases than 3,643, where a charming variety of crape scarves, shawls, squares, mufflers, &c., will be found.

Macclesfield is admirably represented in her main industries by carefully chosen specimens, well arranged, and most of them are well worthy the most careful examination. Many interesting details are suggested by bringing into juxtaposition the raw material and the manufactured article. In no department of silk industry has the advance been so rapid and striking as in the utilisation of the common Tussah silk, which, until very recently, had no commercial value; and the fabrics now displayed by Brocklehurst and Co. (3,55[illegible]), and Baker, Tucker, and Co. (3,553), possess infinite merit, because there seems to be no limit to the variety of fabrics into which this material may be introduced with advantage. The various threads spun from the various qualities of waste silk, some of it, apparently, as coarse as hemp, is most suggestive.

The various handkerchiefs of printed goods and specimens exhibited by these eminent firms demand the most careful inspection, whilst the great variety of printed handkerchiefs shown in the beautiful case of Mr. Alfred Selby, whose name does not appear in the catalogue, is worthy of all praise. The contributions of W. Smale (3,633) are excellent, and the same may be recorded of the examples shown by Potts and Wright, and J. and F. Jackson (3,596), whose productions are admirable. Macclesfield has shown herself equal to her reputation of many years' standing, and of steady growth in the manufacture of her handkerchiefs and of those lighter fabrics requiring the finest silk. Had she been as wise in years gone by, many of her former staples might have been retained; but strikes and price lists for weaving drove from the town and neighbourhood many of its most important branches of business.

Notwithstanding periods of terrible distress, Macclesfield has, by her energy and skill, steadily advanced in reputation during the last twenty years, and many of her products are eagerly bought on the Continent, passing, as they do, from hand to hand, not as the produce of English looms, but as the highest examples of foreign skill. In any future competition that may be instituted, I am persuaded that Macclesfield will hold a distinguished position. It would be almost inexcusable to close this brief reference to Macclesfield without drawing attention to a small case (3,634), contributed by the Society of Arts, containing two scarves made from silk produced at the Cape of Good Hope. These are, doubtless, the first articles made from silk produced in that colony, and prove that, with ordinary attention, there are numerous countries in which silk can be raised as well as in France, Italy, Spain, India, China, or Japan. We fully expect that, in a few years, far-away Queensland will supply the European markets with a considerable quantity.

Coventry.—The contributors from this ancient city are not numerous, neither do they exhibit a fair proportion of all the silk industries established there; but, so far as the collections go, they are very interesting. The plain ribbons shown by T. Bagley (3,552), J. and J. P. Caldecott (3,562), Carter and Phillips (3,565), Richard S. Cox and Co. (3,568), (with the addition of tartans), William Franklin and Son (3,571), Green and Son (3,580), James Hart (3,544), compare favourably with anything produced by the best looms of France, Switzerland, or Rhenish Prussia. Unhappily, there is only one case with which they can be compared, and that is exhibited by H. Borckenstein, of 8, Moorgate-street, as representing several makers of the Lower Rhine. These, unhappily, are all black, and, however excellent, there is no chance for a true assessment of value, as one cannot feel through glass, and must judge by the eye alone. The Coventry colours are exceedingly good, and so long as they possess the scientific chemical skill of such dyers as Hands and Sons, of Coventry, and Dickins and Co., of Middleton, they must be assured of every advantage in that respect. But, as showing the result of modest, unassuming, and steady enterprise, the productions of Mr. Thomas Stevens (3,635) cast all others in the shade. For Coventry generally, it is a great misfortune that the tide of fashion has set in for plain-coloured fabrics, as the skill shown must be confined to quality, colour, and price. That, however, will pass away, and when brocaded figures are in demand, we have no doubt that Coventry will rise equal to the occasion. Where so much effect, accurately and exquisitely produced, is made manifest by one man, we may naturally conclude that there lies dormant an immense amount of latent power, that only needs the stimulating influence of a profitable demand to bring it into life. Mr. Stevens evidently possesses a restless spirit, not easily subdued, and if the tide threatens to leave him for a time, he digs out a new channel for himself, and thus he has created a trade peculiarly his own. I have taken unusual interest in his productions, not only in the goods, but in the looms producing them, and I find that to make a "Forester's scarf," as exhibited, two and a half yards long and six and a quarter inches wide, requires the use of 16,000 perforated cards to make the figure, which is 15 inches long, and for the plain part 14,000 cards, making a total of 30,000 cards. The number of threads in the warp of each scarf is 1,800, and there are 15 different colours in the shutes; these figures are multiplied by the number of pieces being made at once; so that if ten pieces were making, 18,000 threads of warp would be in the loom. Hence the involved, and, to the untrained eye, the inextricable confusion of threads, as shown in the harness of the loom.

It requires about six months to fit up such a loom, and when it and the cards are all ready, it occupies a month to obtain one complete pattern. Eight pieces are made at once in the loom now at work, and with ten hours' labour a good hand will make the length of one scarf each day. The cost of the loom, the draft or design, the cards, and the value of silk in the loom, would make a total value of £500.

It is gratifying to know that every part of the work, mechanical and artistic, is English. Mr. Stevens has, in the course of his career, tried both French and Swiss looms, but found no special advantage in them, nor has he discovered any superiority of skill in their artisans, and cannot see any reason why, in the race of competition, England should not be well up to the goal. Mr. Stevens is a staunch advocate of perfect freedom of trade, and despises the idea of any protective duty. He avows that recent legislation has done much for Coventry, and will do more, when croakers diminish and the thoughtful brain supersedes and silences the noisy tongue, his motto being, "A fair field and no favour."

Rhenish Prussia.—The velvets shown in case 3,599, by Gustave Jacobiny, of Crefeld, deserve a special consideration. There are many similar manufacturers in that thriving town, but M. Jacobiny is the only exhibitor, and, had all Crefield combined, they could not have collected a better display of velvets than has been sent by him. In the higher class of broad velvets, Genoa, Lyons, and Spitalfields can compete, but in ribbon-velvets and coloured piece-velvets, for millinery purposes, Crefield and its neighbourhood have long taken the lead. But, to show how a trade all but lost may again revive and become eminent, it seems likely that ribbon-velvet manufacture will again become one of the prominent industries of St. Etienne, and that chiefly by the application of machinery. Whilst I cannot too highly commend the productions of M. Jacobiny, I do so with a sense of degradation. Why is it that England has entirely lost this branch of trade? These beautiful fabrics and exquisite colours are mostly made from spun silk, of which by far the largest proportion is made in England. The raw material is shipped by us, manufactured on the Rhine, and re-sold to England, not in small quantities, but to the amount of hundreds of thousands of pounds yearly.

There is no mystery in such work. There can be no mystery where thousands of persons are employed in the fabrication and finishing. Let us hope that before another Exhibition takes place some of our spirited manufacturers will be stirred up to enterprise, and remove what is really a discredit to our generally acknowledged zeal and industry. It has long been whispered that Lister and Co., of Monningham Mills, near Bradford, have invented some mechanical process, by which this reproach will be wiped out, and velvets made of surpassing excellence at prices hitherto unknown. We have no proof of the fact, for, although the name of that most ingenious and distinguished firm appeared in the catalogue, we sought in vain for the contributions we hoped to find, which might have been of national importance.

Lyons.—The case of specimens of fringes exhibited by Jules Gay (3,575) deserves the attention of all English makers of the class of articles here shown. The designs are admirable, their proportions perfect, and the material faultless. Why has no English maker given the public the chance of comparing the one nation with the other? Here, again, is a curious anomaly. Much of the raw material is produced in England, and sent to France to be dyed and finished. Much of it returns to England, to be used by our home manufacturers, because our dyers and finishers cannot cope with the foreigner—at least, they have hitherto failed to do so in this peculiar dye. The science of weighting, or charging the silk with foreign ingredients during the process of dyeing is here carried to its utmost limit. It can be weighted over 300 per cent., and yet retain its lustre when dyed, so that an article which costs in the raw or spun state 20s. per lb., may be sent to Paris, dyed, dressed, returned, and sold at 8s. per lb., and leave a good profit to the dealer. Much of it, of course, is retained to be made up in France, and comes to us in the exquisite patterns here exhibited. The spun silk thus treated does well for black, but not for colours; and for some time back the best coloured French fringes have been made from the solid sewings produced in England. Neither the French nor the Germans have yet attained to the perfection the English have done in making what is technically termed "large-skeined sewings," prepared for trimming purposes.

The Broad Silks of Lyons, how exquisite they are in beauty of fabric, grace of design, and even where only a plain ground is shown, how brilliant the colours! They are so admirable that they almost defy criticism, and prove the supremacy of Lyons in the highest branches of manufacture. I need only refer to the several cases:—

3,633, Schulz and Beraud, with various styles of fabrics, all good, and produced by the simplest means, which shows the perfection of art. There is a dress with a beautiful pattern in only three colours—a blue and two browns, so blended as to be most attractive.

3,579, Gourd, Croizart Fils, and Dubert, is not so good as the former, but, nevertheless, very striking.

3,605, with its few specimens of furniture silks, in velvets, brocades, and damasks, is unrivalled in the Exhibition in these special fabrics. The student may with advantage compare these specimens with the best antique fabrics, and learn at a glance how vastly superior the moderns are.

3,560.—Brunet, Lecomte, Devillaine, and Co. have a very choice collection of various fabrics, showing the great skill and thorough artistic knowledge of their business.

3,625.—J. M. Piotel's productions are of infinite beauty. Here are three specimens of chiné fabrics, on white or slightly tinted ground, absolutely perfect in quality, design, and colour. I cannot speak too highly of the dress fabrics of this eminent firm, but I regret to be obliged to speak unfavourably of many of their furniture silks. Some are, in my judgment, vulgar in design and bad in colour. I presume they are made for some market in which the very point we condemn may appear to be a surpassing beauty.

Specimens of nearly all these best and most popular manufacturers will be found admirably arranged in the case 3,606, by Lewis and Allenby, to which I have already referred.

I cannot close this criticism of the various woven fabrics without referring to the unobtrusive case of black goods shown by Van Bellingen, Fils, of Antwerp, whose fabrics, for durability, have a world-wide reputation. It is said they never become greasy, because the dye is pure; they never crack or split, because there is no metallic ingredient mixed with the dye to burn the fibre; and so it is said they will wear for ever.

In summing up these observations I cannot but inquire why is it that, as a rule, the foreign manufacturers excel us in all the higher branches of silk manufacture? In my opinion the answer is at hand. We dye as well, we weave as well, but, as a rule, the scientific manufacturers of France, Germany, and Switzerland have their silks specially reeled in a manner suitable for the goods required, whereas in England the manufacturers are, to a large extent, at the mercy of importers, brokers, and dealers, who care little for the success of our manufactures, so long as they can, without much thought, secure a profit in their own department of the trade. This is a fact so patent to the initiated, and so disastrous in its results, that persons interested will protest against it, and deny the statement; but it comes within the experience of too many to be successfully disputed, and the largest manufacturers in the kingdom deplore the humiliating fact.

In looking over the foregoing I am conscious of many things touched slightly, or altogether unnamed, which well deserved notice, but I have endeavoured to briefly touch on all articles possessing much merit. It is very agreeable to be able to remark with perfect sincerity that, although some of our manufacturers have been blamably negligent, in a duty they owed themselves and the public at large, by not showing the best specimens of their productions, or abstaining altogether, nevertheless, from a careful survey, deliberately made, I recognise in the best examples of French skill, and the unrivalled genius of Mr. Thomas Stevens, of Coventry, an immense advance in art and fertility of resource over every former Exhibition.

The silkworm eggs hatched at the International Exhibition were brought over to London from Orbe, in April, and were kept in a dry, airy place, and, when the weather became warm, near ice, to retard the hatching until M. Roland's arrival in England. On the 9th of May, notwithstanding the ice, the first worms began to come out, and more or less eggs were hatched daily until the 20th of May, when the eggs were placed in the cool orchid house at the west entrance of the Exhibition, the temperature of which was just under 70°.

The eggs were hatched on calico, stretched on a shallow wooden frame, hung from the roof, the corners of the frame projecting about two inches, and, to prevent mice or vermin eating the eggs, a sheet of glass covered the frame, but to give ventilation, small chips, the thickness of a penny, at the angles supported the glass over the frame. The eggs hatched well, and the worms were carefully gathered in tulle nets, and placed in the magnanerie. All the eggs appeared sound and good, and over 6,000 worms were obtained. For the first fortnight great difficulty was experienced in obtaining leaves; and it may be said for the first month the supply was obtained from the small trees brought from Lyons in the winter, an old mulberry tree at the back of the Exhibition-offices, near the Albert Hall, and small quantities obtained through Messrs. Veitch. Although there are many trees about London, it was difficult to find them, and, when found, to gather the leaves. As the worms began to eat 18 lbs. to 20lbs., and continued to demand increased quantities to 30 lbs. daily, the man in attendance could not spare time to attend to the worms and to gather and cut their food; but as one source of supply failed others sprang up, and the worms always had plenty to eat.

The worms kept in perfect health, and there was no sign of sickness or disease during any of the changes, nor was there any loss of worms, which, considering the variable weather, shows how strong and healthy the breed must be.

During the second age about 100 worms were put out on one of the small trees, surrounded by a manchon; but the smuts of the London atmosphere and the three engines near the magnanerie working the machinery in motion, soon destroyed them. More worms were put out at the third age, but they also soon died out.

The worms began to cocoon about July 18, and finished about the 26th. The worms mounted strongly, and formed their cocoons quickly and well. Most of the cocoons are well formed and of good size, some being very large.

When the cocoons were taken off the frames and counted, it was found that there were only just about 5,300 instead of nearly 6000, the difference having been carried away improperly by parties no doubt desiring to obtain seed from such a fine breed of worms.

The cocoons are now being reeled by the persons working the reeling machinery in the Exhibition, and they report the cocoons to be very good, and that they reel with little breakages. The average of the cocoons give about 1,500 yards of silk, and the weight is expected to turn out one pound two or three ounces.

In accordance with the resolution passed at the meeting for the promotion of technical education, at which H.R.H. the Prince of Wales presided, the Haberdashers' Company have sent to Lord Lawrence, for distribution by the London School Board, the sum of £20, as their contribution towards the purchase of tickets of admission to the London International Exhibition.

It has been notified to her Majesty's Commissioners, by the Worshipful Company of Coach and Coach-harness Makers, that the Company offer prizes of £3, £2, and £1, with certificate to foremen, clerks, workmen, and apprentices in the coach-building trade in the United Kingdom for the best reports on the present International Exhibition of Carriages.

With the view of extending the practical use of the Exhibition and diffusing technical information among the visitors, the Executive have engaged the service of Mr. P. L. Simmonds to deliver, at stated periods during the day, in various parts of the building, short descriptive lectures on the principal classes of objects shown, such as silk manufactures, life-saving appliances at sea, cooking stoves, the principal machinery, tobacco and pipes, and food and its adulterations. This is a popular step, which ought to be attended with good results to the many visitors who will be attracted to the Exhibition by the cheaper prices.

The number of visitors admitted to the Exhibition on Thursday, July 31st, was as follows:—Season tickets, 123; on payment of 1s., 2,207; total, 2,330. On Friday, season tickets, 125; on payment of 1s., 1,777; total, 1,908. On Saturday, season tickets, 183; on payment of 1s., 2,129; total, 2,312.

The number of visitors admitted to the Exhibition during the week ending Saturday, August 2nd, was as follows:—Season tickets, 859; on payment of 2s. 6d., 714; on payment of 1s., 10,486; total, 12,059.

The number admitted on Monday, August 4th, was, season tickets, 143; on payment of 1s., 2,043; total, 2,186. On Tuesday, season tickets, 156; on payment of 1s., 2,330; total, 2,486. On Wednesday, season tickets, 129; on payment of 2s. 6d., 714; total, 843.

EXHIBITIONS.

Works of Art at the Vienna Exhibition.—According to the official catalogue, the number of works of art contributed by the various countries at the Vienna Exhibition is as follows:—France, 1,537; Austria, 811; Germany, 725; Italy, 625; Russia, 437; Belgium, 296; Holland, 167; Hungary, 155; Denmark, 101; Greece, 37; United States of America, 15; Turkey, 7; Chinese, 2; Monaco, 3; and Brazil, 1; making in all 4,919.

Art Congress at Vienna.—At the time of the Holbein Exhibition, held at Dresden in the year 1871, a congress took place, and it was determined that the idea should be kept in view and the congress renewed upon the next favourable occasion, and a commission was nominated for that purpose. It is now determined that a congress shall take place in the Austrian Fine Art Galleries of the Vienna Exhibition on Sept. 1st to 3rd, to deliberate in common on matters touching the sciences connected with fine art. The following is the programme for the occasion:—1. What science requires with respect to the classification, cataloguing, and administration of museums. 2. The methods of preserving works of art, including pictures, public monuments, objects of religious art, miniatures, drawings, &c. 3. The teaching of the history of the fine arts in establishments for superior instruction and secondary schools. 4. On the formation of a repertory of the fine arts, and the necessity of drawing up an inventory of their history. 5. On the reproduction of works of art, and their propagation in the interest of museums and artistic education.

Exhibition at Madrid.—During the month of October an exhibition is to be held at Madrid of national products and manufactures, of agriculture, mines, chemicals, industries, and graphic arts. Foreign products will be received by the executive at Madrid if carriage paid. Goods will be sold by the executive on a small commission charge. This is to be the first of a proposed series of Spanish exhibitions.

PATENT CONGRESS AT VIENNA.

With reference to the congress at Vienna, it is worth record that the idea of an International Patent Law is by no means new, and that it was originated in our own Patent-office, as long ago as 1856. This is shown by the following letter of Mr. Bennet Woodcroft to Lord Chancellor Cranworth:—

Great Seal Office, November, 1856.

My Lord,—Availing myself of the vacation which has just terminated, I visited some of the patent-offices on the Continent, to make myself acquainted with the gentlemen who presided over them, and learn their mode of conducting patent business. My object was also to endeavour to bring about a weekly communication between their several departments and this office, in which I was successful in all cases, and to ascertain what views were entertained generally as to the desirableness of an International Patent Law.

It is proposed to introduce measures for the amendment of the patent laws of France and America in the course of the ensuing year, and an early change is contemplated in the patent laws of Belgium, Holland, and Austria.

I found in all the countries which I visited that the principal officers connected with the grant of patents were in favour of a law embracing some clauses in common, and desirous that a conference of persons duly accredited should meet next spring to draw up proposals to be submitted to their respective Governments, with the view of establishing the patent laws of the various countries on a uniform basis.

If such a meeting were held, and but one common clause resulted from its deliberations, such as limiting patent-grants to the true and first inventor and his legal representatives in his or their names only, I am satisfied that great general good would result.

In America I believe it is the practice not to grant a patent to any persons, native or alien, or their legal representatives, unless they are the true and first inventors, and then not to an alien except he makes his application before six months have expired from the date of the patent obtained in his own country.

In this respect the American law is superior to any other with which I am acquainted.

In England patents are granted to aliens, either in their own name or as "communications," and the result is that in a large number of instances the self-same invention is patented first as a communication from some person whose name is unknown, and afterwards to the original inventor.

Many such duplicate grants are annually made in this country, to the injury of the real inventor, and causing unnecessary trouble and expense in this office. As an example I may mention Patent No. 630, which was granted, March 20th, 1855, to an Englishman as a communication from a foreigner residing abroad.

Three days afterwards another English patent, No. 644, was granted to a foreigner for the same invention.

In the Vienna Patent-office I was told the same evil existed, from the facility afforded to pirates of procuring the English printed specifications, and their being more active than the true inventors in applying for patents.

This subject being one of such great national importance, I trust the Commissioners will excuse me for bringing it before them.

I have the honour to be, my Lord,
Your Lordship's obedient humble servant,
(Signed) B. Woodcroft.

The Right Hon. the Lord Chancellor, &c.

THE NEW FRENCH TREATY.

The following is the text of the treaty which has just come into force:—

Article 1.—The Treaty of Commerce concluded on the 23rd of January, 1860, between the United Kingdom of Great Britain and Ireland and France, as also the Supplementary Conventions of the 12th of October and 16th of November of the same year, are again put in force in all their stipulations and in their full tenour, and shall continue to have effect as before the Act of Denunciation of the 15th of March, 1872.

The High Contracting Parties guarantee to each other reciprocally, as well in the United Kingdom as in France and Algeria, the treatment in all respects of the most favoured nation.

It is therefore understood that, in conformity with the stipulations of Article XIX of the Treaty of Commerce, concluded on the 23rd of January, 1860, and of Article V. of the Supplementary Convention of the 16th of November of the same year, each of the High Contracting Parties engages to give the other, immediately and unconditionally, the benefit of every favour or immunity, every privilege or reduction of tariff in regard to the importation of merchandise, whether mentioned or not in the Treaty and Conventions of 1860, which have been or may be conceded by one of the High Contracting Parties to any foreign nation whatsoever, whether within or beyond Europe.

It is likewise understood that, in all that relates to transit, warehousing, exportation, re-exportation, local dues, brokerage, Customs formalities, samples, designs for manufactures, and likewise in all matters relating to the exercise of commerce and industry, British subjects in France or in Algeria, and French in the United Kingdom, shall enjoy the treatment of the most favoured nation.

Article II.—British ships and their cargoes shall, in France and in Algeria, and French ships and their cargoes shall, in the United Kingdom of Great Britain and Ireland, from whatever place arriving, and whatever may be the place of origin or destination of their cargoes, be treated in every respect as national ships and their cargoes.

The coasting trade, however, is excepted from the preceding stipulation, and remains subject to the respective laws of the two counties.

Article III.—The High Contracting Parties agree to settle by means of a Supplementary Convention, the ratifications of which shall be exchanged before the 31st of January, 1874, such arrangements as may appear to them to be necessary in regard to Consular attributions, to transit and Customs regulations affecting entry of goods, expertise, samples, and any other matters of the like nature, and they agree, moreover, to substitute this Supplementary Convention for the stipulations about simliar matters comprised in the Treaties and Conventions of 1860.

Article IV.—Mineral oils of British origin shall be admitted into France and Algeria from the 1st of January, 1874, or sooner, if possible, at a Customs duty of 5 per cent., that is to say, at the rate of duty levied previously to the passing of the law of the 8th of July, 1871. It is, nevertheless, agreed that the said oils shall, in conformity with the stipulations of Article IX. of the Treaty of the 23rd of July, 1860, again put into force by Article I. of the present Treaty, be likewise subject to the duty of 5 fr. or 8 fr. per 100 kilogrammes, established on crude or refined oils by the law of the 16th of September, 1871, or that which may be hereafter levied on the like oils manufactured in France.

A Commission, consisting of one member on the part of each Government, shall meet at Paris immediately after the ratification of the present Treaty, in order to settle, as hereinafter directed, questions concerning duties levied in France on British mineral oils, as well as to consider and report on any other questions which the High Contracting Parties agree, or shall agree to refer to it.

The benefit of the above provisions shall be extended to British mineral oils, to be supplied to persons in France under contracts entered into before the promulgation of the law of the 8th of July, 1871.

The Commission shall examine how far it would be possible to effect reimbursement of duties levied in excess of the duty of 5 per cent., and the tax of 5 fr. or 8 fr. per 100 kilog. above referred to, in the case of British mineral oils introduced into France since the promulgation of the law of the 8th of July, 1871, otherwise than in pursuance of contracts previously entered into.

In regard to the contracts above referred to, the settlement shall include indemnification for actions for breaches of contracts entered into before the enforcement of the law of the 8th of July, 1871.

The High Contracting Parties, before the exchange of the ratifications of the present Treaty, shall name some third person to act as arbitrator in regard to any points in connection with the questions above referred to which relate to mineral oils, and on which the Commissioners may themselves differ in opinion. The Commission shall refer any such points to the arbitrator, whose decision shall be binding on the Commissioners, and shall be reported by them accordingly.

The High Contracting Parties shall forthwith carry out the decision come to by the commission or by the arbitrator.

Article V.—The present Treaty shall remain in force until the 30th June, 1877. In case neither of the two High Contracting Parties should have notified, twelve months before the said date, the intention of putting an end to it, it shall remain binding until the expiration of one year from the day on which either of the two High Contracting Parties shall have denounced it.

Article VI.—The President of the French Republic engages to apply to the National Assembly for the necessary authorisation to ratify and give effect to the present Treaty immediately after its signature

The ratifications shall be exchanged at Paris as soon as possible, and the Treaty shall immediately come into force.

In witness whereof the respective Plenipotentiaries have signed the present treaty, and have thereto affixed the seals of their arms.

Done in duplicate at Versailles, the 23rd day of July, in the year of our Lord, 1873.

(L.S.) Lyons.
(L.S.) Broglie.

HINTS TO COLONISTS ON THE CULTIVATION OF SILK.

By B. Francis Cobb.

So many applications for information upon the subject of sericiculture have recently been made, that it has been decided to reproduce in the *Journal* of the Society a revised edition of the information under the above title, incompletely published in the *Silk Supply Journal* some three years ago, which is now unattainable by reason of that publication being out of print.

The cultivation of the mulberry tree and silkworm has been so long and so strangely neglected in the vast available tracts of our colonists, that it is worth while enquiring why so useful and easily propagated a tree, and so profitable an industry, should have so long remained unnoticed, or when tried experimentally generally failed.

The fact of its never having been an employment familiar to settlers, like sheep rearing, or many of the other agricultural pursuits, would appear at first glance to supply a reason, but then cotton raising, sugar planting, and many other occupations were equally unfamiliar. It would seem that certain opinions, founded originally in error, have been so long allowed to remain uncontradicted that they have eventually become accepted as facts. One of these is that English people can do nothing with silkworms, and that the worms cannot be reared at all, except in the recognised silk-producing countries—both errors, but the opinion of nine out of ten of the emigrants seeking new homes; and it is to these and the settlers already in suitable places, that these "hints" are more especially addressed.

The idea that silkworms cannot be reared in England is not so much to be wondered at when one considers the number of attempts that have proved failures, and yet, if examined into, there is nothing very extraordinary in their failures. Let us take the case of the celebrated company of 1825. This "corporation," for it was constituted under a royal charter, had one million sterling capital. It had governors, deputy governors, patrons, and directors, innumerable; there were counsel in England, counsel in Ireland, conveyancing counsel, architects, surveyors, solicitors, *et hoc genus omne*, and boards, both of patrons and directors, in fact, everything necessary, except perhaps the silkworms, which doubtless were too insignificant to be noticed by a Direction on which we find the names of Rothschilds, Barings, Montefiore, Henry Brougham, and other eminent sericulturists of the period.

But it would have evinced no greater sagacity to have prophesied that such a company would come to grief, than to foretell now that the system known as cottage cultivation of silkworms will, in this country, result in disappointment, so far as commercial success is concerned;

but, with proper appliances, and a certain amount of capital to erect "magnaneries," the silkworm might be as well cultivated in many parts of England and Ireland as in any other parts of Europe, where it is now done, and, while "graine," or eggs, maintain their present value, with very considerable profit to the cultivator.

In 1870, Monsieur Taurigny, then on a visit to this country, expressed his surprise that "graine" was not cultivated, and offered to remain and inaugurate the experiment, in which he would have been interested, and Monsieur A. Roland asserts that his open-air system will thrive here as well as in Switzerland. But in the colonies matters are much simplified. There, a genial climate, cheap rich lands, and a growth of the mulberry such as is rarely seen in Europe, are preliminaries which point significantly to the fact that it is an industry which may be successfully followed, both by the settler just commencing his new life, and the large landed proprietor who has thousands of acres uncultivated.

The number of square miles in our colonies available for sericulture is, in the aggregate enormous, and a slight resumé of the more prominent positions may convey a better idea than mere totals of figures. Commencing with our West Indian possessions;—the island of Jamaica has, upon the slopes of the beautiful blue mountains extending along nearly the whole northern side of the island, many thousands of fertile acres where the mulberry-tree will flourish luxuriantly, and where the climate is admirably adapted to the rearing of the silkworm; others of the islands, more especially the Windward group, are similarly favoured. Passing southward past thousands of square miles of suitable country in the vast continent of South America, we come to our several South African colonies. The Cape of Good Hope, the Eastern Cape Provinces, and Natal. This latter ought to be a mulberry garden, and were it not that but a few years ago the tree was unknown there, one might easily fancy it to have been the home of the mulberry, for nowhere in the world does it flourish more luxuriantly. This colony, situate without the tropics, rising by a series of terraces from the sea, well watered, and so peculiarly constituted as to grow both wheat and sugar within 50 miles of each other, seems specially adapted for the cultivation of silk, and only needs capital, properly applied, to give a profitable return in cocoons. From the Cape to Natal, what are known as the Eastern Cape Provinces form a coast line of 800 miles, all in the temperate regions; and from this far inland extend fertile hills and valleys, in some parts of which the mulberry is found growing wild, which fact was thus accounted for by Mr. Dickins, in a paper read at a meeting of the Society of Arts:—"Birds, after feeding on the fruit, void the seed, uninjured by the digestive process, in remote and solitary places, where it generates and in time becomes trees bearing fruit, from whence the process goes on again." Here, then, are known fields open to the enterprise of capitalists, for, where this is found to be the case, there can be but little doubt of the suitability of the locality, but were there any doubt at all the experiments at Stellenbosch, Natal, and other places, would dispel the idea.

Touching at the Mauritius, from whence have been received beautiful specimens of silk grown and reeled there, we proceed on to Australia, and here it becomes bewildering to go into figures so as to get at anything like an estimate of available and suitable lands. A good idea of this difficulty may be formed from a circumstance of late occurrence. When the geological reports of the Colony of Victoria were examined, with a view to ascertain if any special tracts were more peculiarly adapted to the cultivation of the mulberry, one tract was found to be so specially suitable that had the ground been prepared it could not have differed much from what was found ready. Upon reference, it was found this tract of country, consisting principally of hills and valleys, had a superficial measurement of 36,000 square miles! In New South Wales and Queensland the same features appear, and everywhere such is the case the mulberry flourishes, In New Zealand six districts are eminently suitable as regards geological and meteorological reports, but it is a question to be decided whether every sheltered valley in the islands will not grow the mulberry luxuriantly, as of the suitability of the soil there is no doubt.

In Tasmania, the products of the island prove beyond a doubt its capability for silk production; one has only to examine the list of the fruits now being grown there to be satisfied that the mulberry only requires an introduction to find itself in a suitable home.

From Ceylon the reports are encouraging, but, as if to place the matter beyond a doubt, the north part of the island swarms with the wild silkworm spinning its dark Tussah cocoon.

India, with thousands upon thousands of square miles, can be made to produce silk in great abundance, and it is cheering to see the Government becoming so alive to this important industry, and evincing a desire to give substantial encouragement to cultivators. The compilation recently published by the Government, entitled "Some accounts of Silk in India," contains much valuable information, and should be read by all cultivators in India.

By this short resumé it is evident that without touching upon the vast fields in the possession of our cousins in the United States, there are in the British Colonies silk-producing capabilities equal in the aggregate to the present silk production of the world; and it is not saying too much to state that in America there can be found as much more.

The question of labour is one which it will be well to consider before closing these "hints," but it will suffice for the present to say that Chinese labour is always available for this purpose; it can be imported easily to a very large extent, and will prove both efficient and economical, as it is an occupation peculiarly suited to the Chinese.

(To be continued.)

THE SIMPLON RAILWAY.

Steps are now being taken at Berne for the formation of a new company for resuming the long-abandoned works of the Simplon Railway, and in consequence of the former company (La Line d'Italie) having been dissolved, the Swiss Government have declared their intention of granting a new concession to a company, which, like that of the St. Gothard Railway, would have its residence in Switzerland, and under the management of Swiss subjects. The Italian Government also have declared themselves to being favourably disposed towards furthering such a scheme. In the Val d'Ossola, 24 kils. out of 36 kils. between Gravellona and Duoma d'Ossola were nearly complete more than 10 years ago, and since that time no steps have been taken to complete this line, or to connect it with the Italian net-work.

Negotiations are now going on between an Italian company and the government for the purchase of the railway between Novara and Gozzano, and for the concession for its extension, *viâ* the Lago d'Orta, to Omegua and Gravellona, whence it would join the Simplon Railway, and a projected line *viâ* Pallanza, Lutra, and west bank of Lago Maggiore, to Locarno and the St. Gothard line.

Another line is projected from Vercelli by the Val Sesia to Galtinara, Romagnano, and skirting the hills to Borgomanero, whence it would join the Novara and Gozzano railway. This line would have become the most direct route between Turin with the Simplon and St. Gothard.

With regard to the Simplon route, it is probable that even now communication could be opened between Italy and Switzerland in shorter time than by the St. Gothard, which is already in construction, as the tunnel under the Simplon would probably not be more than seven to eight kilometres in length.

SULPHATE OF COPPER:—ITS MANUFACTURE AND APPLICATIONS.

By W. H. Walenn, F.C.S.

If the number of properties and characteristics that are available in the arts determines the utility of a substance, assuredly sulphate of copper, or ordinary bluestone, is fully worthy of consideration to the manufacturer and the practical man. The characteristic and beautiful results of its chemical reactions are employed in chemical analysis, and in the formation of green pigments; its oxidising power, under certain conditions, enables it to be used in dyeing, as a resist for indigo; and the facility with which it gives up its copper under the influence of an electric current, recommends it for use in electro-deposition. Three other applications in which it is largely employed still remain, besides others that are not so important:—1st, for pickling seed-wheat to destroy the sporules of smut; 2nd, for the preservation of wood; and, lastly, in connection with common salt, and therefore in the form of chloride of copper, to reduce silver ores.

The names given to this beautiful salt, at various times, are—blue copperas, Roman vitriol, blue vitriol, blue stone, and now, according to the latest chemical nomenclature, cupric sulphate. Its formula, according to the Gerhardt system, is $Cu\ SO_4 + 5\ H_2O$, and it crystallises in large doubly-oblique rhombohedrons of a fine blue colour. At 212° Fahr. it loses four out of five parts of its water of crystallisation, and when heated to redness it loses all its water of crystallisation ($5\ H_2O$), and forms a white powder, which decomposes at a still higher temperature, leaving cupric oxide. Its specific gravity is 2·19. In its facile reactions this salt is a very Venus for beauty, but there are two magnificent colours producible therefrom in the laboratory which cannot be utilised by the dyer; one of these is the deep blue, or rather purple colour produced in an aqueous solution of cupric sulphate by the addition of excess of ammonia thereto; this colour will never be forgotten by any one who has seen it once; the other is a deep green solution, produced by dissolving the chromate of copper in ammonia, the chromate being thrown down from the sulphate by the addition of potassic chromate thereto. If a solution of potassic cyanide be added to either of these coloured solutions it is bleached. The reactions of cupric sulphate in solution by the addition thereto of other chemical solutions, principally of neutral salts, form the basis of the utility of this salt in the arts, therefore some of these it will be well to remark, passing over those that are only of interest in the laboratory. The pigment, mineral green, is obtained by adding carbonate of potash to a solution of cupric sulphate, and boiling the blue precipitate which falls down; a green granular precipitate forms. Blue verditer is also a carbonate of copper, which may be obtained from the sulphate. Scheele's green is an arsenite of copper, and is formed by mixing solutions of sodic arsenite and cupric sulphate; this pigment is of the most beautiful bright-green colour that the imagination can conceive, but, unfortunately, it is highly poisonous, and has given rise to much discussion as to the influence that paper-hangings and ladies' dresses coloured with this material exert over the health of the community. Here it may be remarked that most of the salts of copper are powerful poisons. Schweinfurt green is a compound of cupric acetate and cupric arsenite; this is a heavy granular powder, of a brilliant emerald green colour, and is even more poisonous than Scheele's green.

Since almost all the other salts of copper are derived from cupric sulphate, and many of its uses command an extensive sale, it is fortunate that the raw materials which furnish it are abundant, and that there are several means of manufacturing this salt. The coarser and more impure qualities are made from the pyritous minerals, by moistening them and exposing them to air; the article thus obtained is contaminated with sulphate of iron, and sometimes with arsenic, but it can well be used for the preservation of wood, or in agriculture, to prevent the smut in wheat. If desired, a great part of the iron may be precipitated, when the salt is dissolved, by previously crushing it very fine, and exposing it to the air for some time; when dissolved, after this exposure, a salt of iron will settle at the bottom of the solution in the form of a precipitate, and the supernatant liquid will be nearly pure solution of cupric sulphate. The spent dipping liquor of brass finishers may be employed to yield cupric sulphate, but it does not produce a pure salt, the impurity being sulphate of zinc in this case. The best specimens of cupric sulphate are produced by dissolving copper scales in sulphuric acid.

For dyeing purposes it is requisite that this article should be pure. Prussiate of copper (cupric ferrocyanide) is applied to cotton to dye it of a cinnamon colour. The cloth is passed through a solution of cupric sulphate, then through a dilute alkali to precipitate the oxide, and, finally, it is rinsed in a solution of yellow prussiate of potash (ferro-cyanide of potassium), containing a little hydrochloric acid. Cupric sulphate is used as a resist[*] for indigo. On dipping in the indigo vat, the first action is the percipitation of hydrated oxide of copper (hydrated cupric oxide, $Cu\ O + Aq$); this oxidises the indigotin in solution, and sub-oxide of copper (cuprous oxide, Cu_2O) is ultimately produced and cleared away by rinsing the goods in weak sulphuric acid.

In pickling seed-wheat to destroy the sporules of smut therein, four pounds of the sulphate are dissolved in two gallons of boiling water in a large tub; twenty gallons of cold water are added thereto. A wicker-basket, capable of holding a bushel and a-half of wheat, is placed in the liquid, and the wheat is gently poured into it. The light and imperfect grains, chaff, or small seed will float at the top, and may be skimmed off. The basket is then lifted and allowed to drain over the tub, emptied, and the next lot is proceeded with. While the seed is soaking the liquid should be stirred with a stick. The imperfect kernels thus brought to the surface are skimmed off. One pound of the salt does for four or five bushels of wheat. The seed should not be soaked too long. It requires only a short time to destroy the sporules.

The Chilian amalgamation process has reference to the recovery of silver from its ores. According to this method of working, chloride of copper (cupric chloride) is made from the sulphate, and is further reduced to subchloride (cuprous chloride). This, in the presence of sulphide of silver and metallic mercury, reacts upon the sulphide of silver, and an amalgam of silver, together with other products, is the result. The chloride of sodium (common salt) is dissolved in water to the extent of five per cent. This is used in amalgamation. The most approved means to put these principles into practice is as follows:—Cupric chloride is obtained from the sulphate by means of common salt, the solutions of these salts reacting upon each other, according to the equation $Cu\ SO_4 + 2\ (Na\ Cl) = Cu\ Cl_2 + Na_2\ S\ O_4$. This solution is boiled in contact with metallic copper, and cuprous chloride is formed, according to the equation $Cu\ Cl_2 + Na_2\ S\ O_4 + Cu = 2\ (Cu\ Cl) + Na_2\ S\ O_4$. To prevent decomposition of the cuprous solution it is slightly acidulated with sulphuric acid; but it must, in any case, be used immediately. The reaction of the sulphide of silver in the silver ore and the metallic mercury in the presence of the cuprous solution is represented by the equation $Ag_2 S + 2 (Cu Cl) + nHg = Ag_2 Hg + Cu Cl_2 + Cu S + (n-1) Hg$.

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[*] This name in England, and *reserve* in France, is given to the substance which possesses the property of counteracting the indigo-vat dyes, in the spots to which it is applied to cloth.

The power which cupric sulphate has of forming an insoluble and stable combination with albumen has been utilised in the application of this substance to the preservation of wood. One method of accomplishing this result was patented by Mr. Joshua John Lloyd Margary, of Wellington-road, St. John's-wood, on the 19th December, 1837. The patent is No. 7,511, and is entitled, "A new mode of preserving animal and vegetable substances from decay." The process consists in drying the wood, and then soaking it in a solution of cupric sulphate two days for each inch of its thickness. The solution is made by adding one pound of cupric sulphate to every five gallons of water, and is highly esteemed for this purpose.

In photography this salt has been used in a pyrogallic acid developer. In ink, sulphate of copper has been used in small quantities to prevent mouldiness, but this advantage is more than counterbalanced by the considerable destruction to steel pens which ensues from the use of ink so treated; in fact, its presence may be ascertained by immersing a bright steel pen in the suspected ink; in a few minutes the pen becomes coated with the copper in solution, and the pen is practically speaking destroyed, for the points of the pen are the first parts which yield to the solvent action of the liquid, accelerated as it is by the galvanic current set up by the contact of the deposited copper with the steel of the pen. Therefore, all those who value their pens, and are glad to retain an especial nib that suits them, until the poor thing is thoroughly but fairly worn out, instead of submitting it to a slow process of erosion, will do well to avoid ink that betrays the slightest symptom of containing sulphate of copper. The same may be said to those who value their health, in relation to the use of cupric sulphate in pickles and in bread; in the former it favours the production of a bright but poisonous green colour; in the latter it acts as a binding agent, but it is better to take this medicine in manner prescribed by medical science, than to be exposed to the chances of its being in the food of our everyday consumption, in quantities and under circumstances that we are not aware of.

Perhaps the uses of cupric sulphate in electro-deposition are not the most extensive, commercially speaking, but they are the most valuable in an artistic point of view. There are very few who have dabbled in this department of electrical work who are not aware of the facility afforded by the "single-cell process" for producing electro-casts of seals, busts, medallions, &c. In this process a porous vessel (composed of unburnt or biscuit stoneware) and an outer ordinary porcelain or glass vessel are employed. In the inner vessel is placed a weak solution of common salt, or of sulphuric acid, and in the outer vessel is an acidulated and nearly saturated solution of cupric sulphate. A rod of amalgamated zinc, of suitable size, is connected by a wire, well soldered or otherwise firmly fixed, to the object to be copied in reverse; the zinc is supported in the interior vessel, and the object in the external vessel. Care should be taken that the object is rendered conductive of electricity, unless it be so already, and that (either by means of a bag or a shelf) the solution be well and constantly supplied at its upper part with pure crystals of cupric sulphate. If these points are well attended to, the electro-depositor will have the satisfaction of soon seeing a beautiful pink coating of pure copper appear on his seal or cast, and in a day or two it will be of sufficient thickness to separate from the parent form, and to mount in the way that best brings out its artistic value. Frequently instead of using the porous-cell arrangement and the zinc therein, it is better to have the depositing cell separate from the means of generating the necessary electric current. In this case the wire from the zinc of a galvanic battery or from the negative pole of a magneto-electric machine, is connected to the object to be electrotyped, and the other, or positive wire, is connected to a copper-plate of suitable size. These electrodes are then placed in the sulphate solution, which need not be so well saturated as when the single-cell process is used. The difficulty of coating iron and zinc firmly, with good copper, by electricity is considerable, and has led to the employment of an alkaline solution of copper, which, however, may be made from the sulphate. Cyanide of copper (a green salt) is precipitated from the sulphate by the addition thereto of a certain quantity of cyanide of potassium, and is then washed and dissolved in the potassic cyanide solution. According to a patented process, which gives good adhesive metal at an economical rate, the author adds to the above cyanide solution hydrated oxide of copper and cupric ammonide. This modification of an old process enables any thickness of pure copper to be deposited upon either iron or zinc with absolute adhesion thereto. A similar solution (charged with zinc as well as with copper) is used to coat either of these metals with brass.

Another use of cupric sulphate, somewhat allied to that just described, is its employment in galvanic batteries of the constant kind, comprising those known as Daniell's and its modifications. These are greatly used in telegraphy, and a London firm of note have lately furnished a large amount of this salt to the vessels conveying the telegraph cable about to be laid across the Atlantic by a new route.

The annual consumption of this salt, compared with that of sodic carbonate, for instance, is not very great, although a firm in Newcastle supplies 100 tons of cupric sulphate of superior quality annually, and many hundred tons of inferior salt are used annually to destroy smut in wheat. The uses of a given commodity are, however, not always measured, in regard to their influence upon the arts, by the amount of consumption commercially considered, and, although not figuring in high numbers in the commercial annals of the country, sulphate of copper certainly figures greatly in its usefulness in the arts.

PRESERVATION OF FOOD.

M. Sau, of Neufchâtel, is said to have achieved remarkable success in the preservation both of meat and vegetables. His mode of operation is thus described:—The meat, &c., is packed in barrels, and covered and surrounded with one quarter its own weight of acetate of soda, in the form of powder; in summer the action of the salt is immediate, but in winter it is necessary to place the barrels or other vessels in a chamber heated to 20° Centigrade. The water of the meat is absorbed by the acetate of soda. At the end of twenty-four hours the meat is turned, and in twice that time the operation is finished. The meat may either be packed in its own brine or dried in the open air. If the barrels are not full, a solution of one part of the acetate to three of water should be added. When the brine is separated from the meat and evaporated to half its volume, it crystallises, and half the salt is saved, while the remainder is an excellent extract of meat, which represents, when reduced to a thick paste, ·03 of the weight of the meat. This extract is added to the preserved meat, and is said to restore its original fresh flavour. When the meat is to be used, it is steeped from twelve to twenty-four hours in tepid water, containing ten grammes of sal ammonia to the litre. Fish, fowls, ducks, and snipes have been preserved whole in this solution of acetate of soda, the entrails being first removed.

Meat loses one quarter of its weight by the action of the solution, and another quarter if dried. The flesh of warm-blooded animals may be dried with the aid of the stove; but most fish, and especially salmon and trout, can only be dried in the air.

Vegetables are treated in the same way as meat, but they lose five-sixths of their weight, except Brussels sprouts, which only lose three-quarters. When wanted for use, they are plunged in cold water for twelve hours, and are then cooked as if they were fresh. Before the vegetables are covered with the acetate, however, it is necessary to warm them, in order to get rid of their rigidity. At the end of twenty-four hours they are taken out and dried in the open air.

Mushrooms are steeped for twenty-four hours in a solution of equal parts of acetate of soda and water; the solution should be at 30° Centigrade. The mushrooms are finally strained and dried. Potatoes must be first cooked by steam, and then treated like other vegetables.

M. Sau declares that the same treatment succeeds well with thin-skinned fruits, such as peaches, plums, strawberries, and raspberries; and with thick-skinned fruits, such as apples and pears, provided they are first split or heated through.

All substances prepared by this process, if dried, must be kept from moist air, or they exude; and when exposed to the air, after having been soaked in water, they become mouldy, but do not rot.

The inventor insists strongly on the value of his plan in the case of vegetables, which can be prepared, he asserts, at one tenth, or even one-twelfth of the cost of preserving them by the ordinary modes in use. Should this system be as effective as the author of it declares it to be, it would undoubtedly be of great importance, and it would be easy to try an experiment in a small way in order to ascertain the effect of the acetate of soda on the flavour of meats and vegetables.

CORRESPONDENCE.

STATE PURCHASE OF RAILWAYS.

SIR,—Not having had an opportunity of taking part in the debate upon the "State Purchase of Railways," I would ask the favour of a short space in the pages of the *Journal* for the slight expansion of the notes I had prepared for the second day on which this discussion took place.

It was not my intention to have entered at length upon the general question, whether the proposed delinquencies of the present railway managers are so great as positively to demand the transfer, or whether the assumed benefit to be derived from Government management is so great as to command assent to the change. The affirmative of both questions appears to be held by the most prominent supporters of the plan, but it wants, I think, further investigation into the facts of the case, before either can be deemed a settled point. Neither did I propose going deeply into the financial part of the question, for, with whatever difficulties this may be beset, there can be little doubt that if once the purchase or transfer be determined on, means will be found to effect it. That the arrangements by which it is carried out will be favourable to the proprietors seems to be admitted; and with so powerful a body as these are become, it is not probable that the change will be made until they are in a position to enforce an advantageous bargain. It appears to me, however, that very insufficient attention has been paid to the effect which such an operation would have upon the money-market. Mr. Chubb* and others divert attention from the startling sums which have been named as those which would probably be required, by concentrating attention upon the interest or dividends which would have to be paid, and assume that it would be simply a nominal change to convert a four or five per cent. yielding debenture share or stock into a three per cent. Government stock of such an amount as would yield the same annual income. Now if this stock were inconvertible, or not saleable, no doubt the creation of capital would be merely nominal, and an addition of two or three hundred millions would be of no account. What, however, would be the first result? The debenture holder, finding that in lieu of a bond yielding him £4 a year, which would not sell in the market for more than £100, he became possessed of £133 6s. 8d. in the Government funds—which he could sell for £120—would seek to realise the bonus of £20 per cent. upon his capital, and to invest in some other undertaking promising to yield four or five per cent. on his improved capital. This process would be adopted by others, until so much of the new stock would be thrown on the market as to depreciate its value—for it must not be forgotten that the public funds owe the maintenance of their high price as compared with other securities, not only to the guarantee which the state affords, but also to the limited amount of them which are available for the purposes of purchase or sale. Taking the large amount of stock held by trustees and that class of holders, to whom security rather than income is of paramount necessity or importance, it is probable that not one-half or one-third of the national debt is in the market at all, and the creation of new stock (at the lowest computation equal in extent to that already existing), would treble or quadruple the quantity in which dealings would take place. Nor is this all; the withdrawal of so large a quantity of high-interest-bearing securities from competition with others already existing would enhance the value of those remaining available for investment or speculation; and so long as the government stock retained anything approaching its present value, would help to flood the country with new schemes, promising to yield a greater return. No doubt, in course of time, an approach to equalisation would be attained, by the lowering in price of the funds, and the advancement of other securities, to the detriment of the unfortunate present possessors of Government stock, and the enrichment of the present holders of shares in steam-boat, gas, and analogous public or private companies. For nothing is more certain than that a very large proportion of those who are now content to risk their capital for a high rate of interest would be encouraged to seek for similar means in which to invest the proceeds of the stock of which they became possessors. The experience of the telegraph transfer is of no value, for the inconsiderable extent of stock thus created—six or seven millions only—furnishes no guide to the dealings which would take place in the vast amounts necessary to be exchanged for the amount of railway securities existing at the present time.

The point, however, to which I wished more especially to direct attention was the fitness or otherwise of Government management for the improvement of our railway system. As an old servant of the State, I should be the last to disparage the service to which I belong, but I am not, therefore, the less ready to consider whether the machinery be that which can be most advantageously employed in the performance of this work. To form anything like a correct judgment in this matter, it is necessary to consider it under three heads:—1st. The formation of the line, and the maintenance of the permanent way. 2nd. The conduct of the traffic over the line. And 3rd. The acquisition of that traffic, and obtaining payment for its transit. Each of these points must be viewed in regard to both efficiency and economy. On the first there can be but little doubt that great advantage would be possessed by State authority. The absence of litigation and consideration of private interests in determining whether a line should be made or not, would cause the best routes to be chosen, and the best accommodation to be given to the various parts of the kingdom. Government has, or might have, at its command as much interest and honesty as any private employer; it could purchase its materials in the best market and at the lowest price; and it would maintain the lines in the best condition. It is not quite so clear that the whole cost, either of construction or maintenance, could be kept down—for whilst, on the one hand, no employer of labour pays so low for the brain-power it uses, none pays so high for the respectable mediocrity which it often has to be content with; and as to the manual labour, which forms the principal element of cost, it is possible—now that in almost every trade the labourers are the masters also, and to a great extent the electors of our legislators—that there would be a tendency to an increase rather than a diminution in the rates of wages given. So also as to the working of the traffic. There can be no reason why the State should not possess as much and as good rolling stock as any company can have; nor yet why its engine-drivers, signalmen, and porters should not be as well suited for the purpose as those which private enterprise can educate or obtain. Post-office and telegraph employés are, to say the least, as able and intelligent as those which any other service produces. Given the work to be performed, the number and size of the trains to be run, the destinations they are to seek, and the stoppages to be made on the way, and there would be no fear that there would be less safety, comfort, or punctuality than is at present afforded. Indeed, in all these points, the order, regularity, and discipline of a well-officered corps of servants ought to procure many decided advantages.

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* *Statistical Journal*, June, 1873.

It is when we come to consider how the traffic is to be obtained, and at what rate it is to be paid for, that the difficulties of Government management become apparent. To receive a letter or telegraph message at one point, and deliver it at another, charging the same sum, whether the intervening distance be long or short, is a very simple process, especially where no competition exists; but to determine the rates to be charged for the several descriptions of passengers or goods would involve many questions more fitted to be decided by mercantile enterprise than by the routine processes necessary to a Government office. In theory, save for the trifling increase of watching necessary for safety, there is no more cost in carrying a ton of gold than a ton of coals, but if the same rate were applied to both, all the gold would be carried by Government service, and all the coals by some cheaper conveyance. In practice, the charge for this service must be regulated, not by its value, but by the price at which others are able or willing to perform it in some other way; and unless the Government also became possessed of every channel of communication, a constant contest would be going on with those possessed of other routes, quite inconsistent with the propriety or dignity of a State department. Competition between individuals or bodies of traders is ultimately settled according as their private interests or means dictate. In the end the longest purse or the shrewdest head wins the day, but the very idea of a railway board, in possession of the nation's funds for carrying on the contest, and backed by the influence of the State, entering into competition with Messrs. Pickford's vans, or the vessels of the General Steam Navigation Company, is one we are scarcely yet prepared to entertain. Then, too, there would arise complications where one part of the service had to be performed by the Government, and another part by a private body, as, for instance, in the carriage of goods or passengers from London to Dublin. Unless the Government became possessed of the intermediate steam-vessels, endless difficulties would arise. And if steam-vessels to Ireland why not to France, and even to India and China? At present, all the necessary details are the subject of arrangement between two equal bodies or individuals, each governed by the same principle—a desire to make the most profit out of their respective parts of the transaction, and each answerable to its constituents for the use of the power they possess. With a Government body it would be far otherwise. Most of this business, again, is of too speculative a character for the State to engage in. Take, for instance, such an occasion as the recent visit of the Shah. It answered the purpose of the railway companies to put on express trains and engage steam-vessels to carry passengers to meet the fleet in the Channel. No civil officer in a State railway corps could have adopted such a step without the Board's sanction, and few would be found to originate such a proposition, from which, if successful, they would receive no benefit, while, if unsuccessful, they would be sure to meet with severe censure. A thousand cases of similar difficulty must occur to the mind of every one who gives even a slight consideration to the details of such a system. To meet these Mr. F. Hill's* scheme for leasing groups of railways to different companies, appears to be an insufficient remedy. The great argument for State interference to secure uniformity of charge and convenience would be destroyed if these several companies had power to make arrangements according to their different views, interests, and caprices; and without this power none of them would undertake to pay the State sums of money dependent not upon the work performed or the recompense earned, but upon the charges the line had to bear from the capital expended or the dividends to be secured.

If, however, on the one side, reasons of State policy render the transfer either desirable or necessary; and on the other, the obstacles to a Government working of the lines be almost insuperable, it was on my notes to suggest an intermediate course of action; not that I have been able to collect such evidence or adduce such reasons as might carry conviction in its favour, but simply as one worthy of consideration and inquiry—namely, whether it might not be practicable for the State to resume its ownership of the highways of communication, and its power to regulate the traffic, thus leaving it to the enterprise of individuals, or, more probably, powerful companies, to contract for the transit of both passengers and goods upon such terms as the Government Board would require or arrange. This would lessen the financial inconvenience, by leaving the value of the machinery and rolling-stock out of the purchase, the State simply paying for or creating stock to represent the value of the roads and buildings. The details of such a method of dealing with the question I am not prepared to give, nor could I on the present occasion ask you to find room to insert them, but either of two systems might, I think, be successfully adopted. On the one plan, the Government Railway Board would fix the numbers and times of trains to be run, contracting for the train and engines at a fixed price, and receiving payment for the transport. On the other, it would receive tenders for the privilege of using the lines by a particular train, receiving such a price as might be offered. In either case it would fix or agree upon the charges to be made and the conditions to be observed, so as to obtain the lowest charge and the best accommodation for all who might travel upon or use the lines. The present companies, or new ones to be formed, might possess all the engines, carriages, trucks, &c., and possibly the goods' sheds and offices necessary for the transaction of their business.

Trusting that these few observations, which I would have verbally addressed to the members of the Society, may be deemed worthy of insertion in the *Journal*, but forbearing to enlarge further upon them,—I am, &c.,

Ste. Bourne.

Harrow, 23rd July, 1873.

Sir,—I have read with much interest the paper by Mr. Galt, on the "Purchase of the Railways by the Government," and the discussions thereon, and I regret very much that my engagements prevented me from attending any of the meetings.

I have had great experience as a railway traveller, having to do business with all the companies in supply ing a portion of the rolling stock from the commencement of the system to about six years back, and my observations extend from John o'Groat's House to Land's End, as well as the length and breadth of Ireland and part of the Continent. It has frequently occurred to me that if the railway directors and leading officials generally were placed on the same footing as other passengers, and had to pay their fares for every trip on the line, they would then be able to realise the soundness of the theory that, "A million pence is a more appreciable source for dividend than a thousand shillings."—"Private interests must give way to public good."—This was the principle on which the makers of railways pulled down the dwellings and places of business of the town's-people, and claimed to take the lands of the rural districts. Now, on the same principle, I contend that railway directors and shareholders should not be allowed to act to-day "the dog in the manger" over again; but as they have not the moral courage to see their own interests in the interest of the public, they should in like manner be compelled to stand on one side on equitable terms, based upon cost price, and not upon consequential or prospective profits; remembering the action which compelled the Government to give seven millions for the telegraph system, when it ought to have been had for two.

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* *Journal of the Society of Arts*, June 20th, p. 609.

As regards the price to be paid for the railways, it will be necessary to be prompt on this point, for if purchase be based on the market price of the day, and Government only adopt a portion as an experiment, the residue will rise to fabulous prices, and thus the country will be made to pay extravagantly, as in the case of the telegraphs. In my opinion, the best way to arrive at a fair adjustment of the price would be to take an average of the last five years' dividend, and let the Government guarantee this perpetually, giving coupons, or dividend certificates, in exchange for the script of the present owner, cancelling the latter, and letting the other, *i.e.*, the annual dividend, be a negotiable document, doing duty as a Bank of England note. This would in great measure prevent periodical monetary panics, and destroy the pernicious effects of the Bank monopoly. In a very few years after this scheme had been carried out, we should have an increase in our traffic to such an extent as to be able to double our lines on all the great trunk-ways, so that, like our American brethren, we might carry goods on one pair of lines and passengers on the other, and thus avoid accidents.—Yours truly,

T. Briggs.

Haversham Lodge, Fallowfield, Manchester,
June 24th, 1873.

GENERAL NOTES.

National Training School for Cookery.—The Executive Committee desire to call the attention of those who are interested in founding a National Training School for Cookery to the fact that it would be prudent to secure a capital, say of £5,000. The Executive Committee accordingly invite donations, annual subscriptions, and guarantees, and request friends of the movement to collect subscriptions on behalf of the school. Assuming the necessary capital to be provided, the Executive Committee hope that they may be able, before the end of the year, to establish courses of practical instruction in the kitchen, as well as lectures. Arrangements will be made so that courses may be severally attended by pupil teachers in training for public education, by domestic servants, and by ladies. The experiment of this school will be first tried in London, and if it succeeds, similar schools will be established in the large towns. All communications on the subject of the school should be addressed to the secretary (*pro tem.*) of the school, Annual International Exhibition, Kensington Gore, London.

Coffee-roasting.—It is proposed to economise the caffeine now wasted during the roasting of the bean. A pound of coffee will yield, on an average, 75 grains of caffeine, and as the annual consumption in England amounts to 13,000 tons, the amount of caffeine wasted is 140 tons. By attaching a condenser to the revolving drum it is thought that a great part of this can be saved.

Ice-Making by Machinery.—On Tuesday afternoon an inspection took place at the works of Messrs. Pontifex and Sons, King's-cross, of a machine for manufacturing ice, the invention of Mr. R. Reece. This machine has before been brought under the notice of the Society, as a committee was appointed in the Session of 1869 to report upon it. Their report will be found in the *Journal* for September 24 of that year. It states that the process, as then shown, was not to be recommended for general use, but required certain modifications. A full description of the machine will be found in a paper on "Artificial Freezing and Refrigerating," by Dr. Paul, published in the *Journal* for December 18, 1868. The principle of the invention is that liquefied ammonia is vaporised in a close vessel, surrounded by the water to be frozen.

Mineral Wealth of Birma.—According to a memorandum laid before the Indian Department of Agriculture, Revenue, and Commerce, by Capt. G. A. Stover, our political agent at Mandalay, Upper Birma is richer in metals and minerals than any other country in the known world. Gold exists in profusion in the rivers and streams, and in many districts the gold quartz is found in abundance; but the localities are generally malarious, and the mines are not developed. Silver is found in quantities sufficient, with importations from Yunan, to serve all the requirements of the country. Rich deposits of copper exist, but are unutilised. Iron abounds in the Shan States and the districts south of Mandalay. His Majesty has engaged two mining engineers, and is procuring machinery from England to work the ore. The surface hematite alone will feed a large foundry for many years. Lead is plentiful, but only sufficient to supply the country is at present produced. Tin exists in the Shan States to the south-east of Mandalay, but the mines have never been worked. Coal beds of excellent quality, "equal to the best English coal," have been discovered in many districts, but so far inland that transport would be difficult.—*Engineer.*

Purchase of Railways by the State.—The advocates of the State purchase of railways in England will find it instructive to study the history of opinion on the same subject in America. In many of the American States the public feeling against the monopoly enjoyed by the railway companies is far stronger than anything of the kind in this country, but it is curious to observe the instinctive aversion with which even the boldest and least scrupulous politicians seem to regard the remedy which is so popular with a certain class in this country. In the speech made by General Butler the other day in the course of his canvas for the governorship of Massachusetts, this feeling was curiously enough illustrated. The speaker admitted fully that "the special privileges granted to corporations in the matter of transportation gave away from the people the control of the carriage of the necessaries of life and the common highway carriage of persons. In a neighbouring State a single individual had through special privilege amassed a fortune of 75 or 100 millions, and much of the country's production had been absorbed by the few to the exclusion of the many. The remedy, however, proposed for this state of things is founded upon a curious revival of almost forgotten projects and ideas." The State should open competition to all in the traffic over railroads, which are its common highways. The land and right of way of all the railroads in the State had been taken by law under the constitutional principle that the taking was by Government for the common convenience and necessity of the whole people. If that were so, then let every man enjoy the common convenience. All that was required was to return to the old idea of empowering every man to put his car upon the railroad to go over it at a reasonable toll to be fixed by the directors, and subject to appeal to a proper tribunal in case of disagreement between its owner and the railroad. It is worth noticing that the idea of State assumption of railways is only mentioned to be dismissed, as a course likely "to superadd to the wrongs of corporate exactions the corruptions incident to the frequent changes in political party machinery."—*Pall Mall Gazette.*

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FRIDAY, AUGUST 15, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

NATIONAL TRAINING SCHOOL FOR MUSIC.

1. The necessity for a National Training School for promoting the art of Music in this country has long been felt, and has at various periods been urged on the attention of successive Governments by the highest authorities. Such has been the unanimity of all those who are competent to give an opinion in this matter that it is needless to discuss the question here. Suffice it to say that the whole subject of Musical Education in this and foreign countries was investigated and fully reported on by a committee appointed by the Society of Arts in 1865.

2. Although it appears from the Reports of the Science and Art Department that the question of a State Training School was at one time under the consideration of the Lords of the Committee of Council on Education—Earl Granville being then Lord President—the Department of Science and Art up to this time has not taken any active steps towards its establishment. It has therefore been decided by the Society of Arts to take the initiative, and establish a Training School by voluntary effort, with the full intention that it should, and under the confident hope that it will, eventually, be transferred to the responsible management of the State.

3. The fundamental principle and primary object of the School is the cultivation of the highest musical aptitude in the country, in whatever station of society it may be found. In order to carry out this principle to the fullest extent, admission to the School will be obtained by competitive examination alone.

4. As the gift of musical ability is found in all grades of society, and frequently among the classes of very limited means, it is evident that in a large number of cases, the student must not only receive gratuitous instruction, but also be supported during the period of his training. To provide for this it intended to establish about 300 scholarships, for which the most influential support has already been promised, and further support is solicited.

5. The proposed scholarships will be of two kinds, the one to afford free instruction by paying the students' fees, the other to give free instruction with a maintenance allowance in addition. It will be open to any county, town, public body, or private individual to establish one or other of these kinds of scholarships for competition under given limitations. Should there be more accommodation in the school than is requisite for the instruction of these scholars, students paying their own fees will be admitted by competition to fill the vacancies, care being taken that they show sufficient aptitude.

6. It is proposed that the School should provide in the first instance for the free instruction of about 300 scholars. The school fee without maintenance, it is estimated, will be between £35 and £40 a year. The maintenance allowance for the support of the scholar will be in addition to this fee, and independent of the school.

7. The Council of the Royal Albert Hall are prepared to devote certain rooms, including two small lecture theatres, to the use of the School at a nominal rental, when proper arrangements shall have made been made for its conduct. This assistance is estimated to be worth about £1,000 a year.

8. The Royal Commissioners for the Exhibition of 1851 have offered a plot of ground immediately adjoining the Albert Hall for supplementary suites of practising and lecture-rooms, and have agreed to grant a lease of the same to Mr. C. J. Freake, a member of the Council, who has most munificently undertaken, at his own cost and risk, to erect the necessary buildings thereon. Indeed, the plans for these buildings are in a forward state of preparation.

10. The School is under a Committee of Management, consisting of two members appointed by the Royal Commissioners for the Exhibition of 1851, two members appointed by the Council of the Royal Albert-hall, and three members appointed by the Council of the Society of Arts, and the Committee thus formed consists of H.R.H. the Duke of Edinburgh, H.R.H. Prince Christian, Admiral the Right Hon. Lord Clarence Paget, K.C.B., Major-General Eardley-Wilmot, R.A., F.R.S., Henry Cole, Esq., C.B., Major Donnelly, R.E., and Sir William Anderson, K.C.B.

All communications relative to the establishment of Scholarships, and all inquiries about the Training School, should be addressed to the Secretary of the National Training School for Music, Kensington-gore, London, S.W.

P. Le Neve Fo[illegible]r, *Secretary.*

HALL-MARKING OF JEWELLERY.—PRIZE FOR ESSAYS.

1. It having been brought to the knowledge of the Council of the Society of Arts that what is termed "Hall-marking" of jewellery and articles of gold and silver, is inadequate to secure to the public that protection in the quality of the materials for which it is intended, they have accepted the offer of one of the members, Mr. Edwin W. Streeter, to place £25 at their disposal, to be awarded as a prize for an Essay treating on this subject, with suggestions for an improved system.

2. The Essays must be sent in not later than the 1st of November, 1873, marked with a motto, or cypher only, accompanied by a sealed letter, with the corresponding motto or cypher marked outside, giving within the name and address of the writer of the Essay.

3. Brevity will be considered a merit.

4. The Council shall have the right of publishing the prize Essay in the *Journal*, and they reserve the right of withholding the prize altogether, or of awarding a lesser sum, if the judges shall so recommend.

P. Le Neve Foster, *Secretary.*

TECHNOLOGICAL EXAMINATIONS.

The subjects in which examinations were held this year, namely, Cotton Manufacture, Paper Manufacture, Silk Manufacture, Steel Manufacture, and Carriage-building, will be retained in the Examinations of next year, with the addition of Cloth Manufacture, Glass-making, Pottery and Porcelain, and the Manufacture of Gas.

The Programme is in preparation, and will be published as soon as possible.

ANNUAL INTERNATIONAL EXHIBITIONS.

The Council, having been informed that her Majesty's Commissioners do not intend to publish Reports on the different departments of the Exhibition of the present year, and looking to the great importance to Arts, Manufactures, and Commerce that these annual displays should not pass away without some record, have decided to undertake that duty, and for this purpose have engaged the services of gentlemen specially skilled in the subjects of the several sections, to prepare such Reports for publication in the Society's *Journal*. The Council, however, desire it to be understood that, in publishing these reports, they do not necessarily adopt all the views expressed in them, which must be taken as those of the writers only.

The following report is the ninth that has been issued. The remainder will appear as soon as they are complete.

RECENT SCIENTIFIC INVENTIONS AND NEW DISCOVERIES.

By Robert James Mann, M.D.

Late Superintendent of Education in Natal.

The objects contained in this department of the Exhibition cover, as usual, a wide range of application and design. They are very numerous, and comprise among them many interesting, and some valuable and meritorious, efforts of mechanical and inventive ingenuity.

Foremost among the notabilities of the group on the present occasion stands a large case of implements and castings (4,829 of the catalogue) contributed by the Phosphor Bronze Company, of Cannon-street. The metal of which the articles is made is a new kind of bronze, patented by Messrs. Montefiore and Kunzel, and is composed of varying proportions of copper, tin, and phosphorus. The alloy is capable of being made tough and malleable, or hard, at will, according to the proportion of the several ingredients. It is rendered so liquid in the molten state by the addition of the phosphorus that it forms very clean castings. The purposes to which it is proposed to put the bronze are well illustrated in the numerous objects shown, which comprise heavy bearings of machinery; cogged wheels, guns and cartridge cases, wire, tuyeres for blast furnaces, and ornamental castings of various kinds; tools and appliances, such as hammers, knives, scissors, hinges, locks, keys, bells, netting and sieves, are constructed of it for powder magazines, on account of the impossibility of their yielding sparks. The bronze is in somewhat extensive use in these forms in the Government Powder Mills at Waltham. Several railway companies are employing it for the bearing parts of machinery exposed to great strain. Messrs. Merryweather have drawn upon it for their fire engines. Messrs. Mackean have had rock drills and pinions made of it. Messrs. Brotherhood and Hardingham have adopted it in some parts of their large three-cylinder steam engines, and Messrs. Thorneycroft, of Wolverhampton, use it for pit ropes, a purpose to which its constructors consider it is especially adapted, on account of its immunity from corrosion by damp. They also propose to apply it instead of copper for the sheathing of sea-going ships.

Messrs Wright and Company, of Birmingham, exhibit an interesting series of gas-burning apparatus (4,892 a), contrived by Mr. J. Wallace, applied to heating purposes; the foundation idea in the whole of which is an improved form of Bunsen burner. This burner consists essentially of a brass tube, throwing a jet of gas into a hemispherical chamber, into which air is drawn as well as gas by the expedient of leaving an opening, or break of continuity, in the gas-tube, ensheathed only by a covering of permeable safety-lamp wire-gauze, just before it enters the hemispherical chamber. Upon the well-known principle that jets of fluid, escaping under pressure from an orifice, travel on in their original direction of motion a certain distance before they begin to disperse, the gas leaps across the open chasm, and enters the hemispherical chamber, dragging in with it a current of air through the wire-gauze sheath. The air and gas mix in the chamber, and then rise through a transverse internal diaphragm of wire-gauze, to issue from a burner at the top. The flame produced under this arrangement is an emerald, amber-tipped cone, of very remarkable heating power. It gives a temperature of 3,000° Fahrenheit, and readily melts brass, silver, gold, and copper. The burner is made with 1, 4, 12, 16, or 24 flames, according to the uses to which it is to be applied. In one form exhibited, a furnace of 30 burners affords heat enough for generating steam in a horse and a half power steam-boiler. Mr. Wallace shows in connection with this burner a very ingenious method of making a gas-stove regulate its own heating power. An air-chamber of thin metal, when closed by an appropriate valve, under the air expansion caused by further increase of heat in the room, drives a column of mercury up a horse-shoe shaped tube, until it closes an inverted bell-mouth, through which gas has been previously passing to supply the burners of the stove. When the bell-mouth is closed, the stream of gas is arrested, and the burners are extinguished, excepting one small flame which is fed by an independent gas supply, and therefore endures. When the gas flames are extinguished, the room begins to cool, the air in the air-chamber contracts, the mercury falls back, the gas once more flows through the bell-mouth to the burners, and the flames in the gas-stove are relit from the one left burning for the purpose. The apparatus is so sensitive that the gas flames in the stove may be extinguished by grasping the air-chamber with a warm hand. In the steam-boiler furnace the burner-tubes are longer, and the gas is thrown into the mixing chamber from 12 curved pipes, getting their gas supply through open orifices around the bottom of the chamber without any wire-gauze protection. The burning gas acts upon the water in the boiler through a series of tubes, the heated air and products of combustion being conveyed to the top of the apparatus, and then through an outer jacket to an escape below. One purpose to which this steam-boiler is applied in laboratory work is shown in a piece of apparatus which enables it to maintain a hot-blast blow-pipe. The steam is thrown into the spiral tube of a condenser, dragging in with it a current of gas. The steam and gas go on together to a reservoir below, where the condensed water collects at the bottom, and the gas is driven out by the pressure established by the still incident steam, to be burned in a blow-pipe, which gives more or less air upon turning a cock armed with an excentric plate, so that either an oxidizing or reducing flame may be maintained. The apparatus has also a very ingenious regulator attached to it, by means of which the gas is shut off whenever increase of steam pressure in the boiler drives water more strongly upon a flexible india-rubber diaphragm, and in so doing lifts a plunger, or bolt, up into the gas way, so as to impede or intercept the stream. A spiral spring attached to the diaphragm allows an adjustment of the regulator to its work. The twelve-flame furnace is adapted by Mr. Wallace to a very convenient form of portable vapour-bath.

Mr. T. Fletcher, of Warrington, also shows a gas-furnace (4,831) for the production of high temperatures. A mixture of air and gas is consumed in a series of 55 burners, placed under a conical chimney. The intensity of the heat produced is proportional to the height of the chimney placed over the burners. A colourless cone of flame, two inches high, acts upon suitable fire-clay vessels, and with chimneys varying from two feet to eight feet, melts gold, silver, or cast-iron, or gives white incandescence with silicious substances, in periods varying from 10 to 35 minutes. Mr. Fletcher has also a hot-blast blow-pipe, in which the air is blown by the mouth through a coiled tube that passes over three gas-flames, and issues from a blow-pipe aperture at the proper point of a fourth flame.

Messrs. Fearnley and Son, of West Brompton, show in one of the engine-houses, in full operation, their domestic gasmaking apparatus (4,830), which consists of an iron retort fixed over an ordinary kitchen-range, so that the gas is distilled while the usual processes of cooking are in progress. The retort holds forty pounds of coal, a charge which is exhausted in an hour and a-half, and yields 160 cubic feet of gas. The coke is then drawn and used for supporting the fire, and a fresh charge of coal is supplied to the retort. The gas issues from the top of the retort to the worm of a condenser, and through it to a petroleum chamber, and then passes on to a purifier, consisting of four perforated floors charged alternately with layers of lime and sawdust, and having found its way through these is conveyed to a reservoir of the usual construction in the outer air capable of holding 250 cubic feet of gas. One ton of coals gives 9,000 cubic feet of gas. A second form of the apparatus is intended to be fixed independently in some out building for the generation of gas alone, and is calculated to supply it for domestic use at a cost of 2s. 2d. per 1,000 cubic feet. The price of the two forms of apparatus is respectively eighty and fifty guineas.

Mr. A. Common, of South-bank, Regent's-park, supplies some ingenious apparatus for protecting water-pipes from injury by frost (4,821), in which the essential part is a closed hemispherical vessel of thin copper, filled with water, which changes its form, and protrudes its flat bottom when the contained water freezes. In one piece of apparatus the protrusion presses in a steel spring and sets free a catch, so that a heavily-weighted arm falls, and in doing so turns off the cock at the water-main and opens a waste from the service pipes of the house. In another contrivance a pipe passes from the frost vessel, left in the outer air, through the wall to the lower part of the service-pipes of the house, and when the flat bottom of the vessel is protruded by frost it pushes a plunger through the pipe, and thrusts a closely-fitting valve off a shoulder, so that a drip is established from the house service-pipes through a waste opening. When the frost ceases the plunger is drawn back by the tension of a spring, and the drip is stopped. A third form of the apparatus in principle resembles the first, but is intended to be fixed upon the supply outlet of a cistern, so that on the occurrence of frost the falling of the loaded arm closes the cock, and prevents any water from passing to the service-pipes, unless when the lever is drawn up by a cord. If the frost is still present the cock is again closed as soon as the cord is loosened, but if the frost is gone the catch comes once more into play, the arm of the lever is detained, and the cock left open.

The British Telegraph Manufactory, of Great Portland-street, exhibit one of Wheatstone's elegant magnetic clocks (4,812), driving six dials simultaneously by magneto-induced currents of electricity. The clock-train is moved by a very heavy weight, and has elastic spring contact-arms for the teeth of the escapement, to prevent the pressure of the weight from injuring this delicate part of the mechanism. The bob of the pendulum is composed of hollow coils of copper wire, which swing to and fro over the poles of horse-shoe magnets. Every time this hollow bob passes from one pole to the opposite one a current of electricity is called up inductively in the coils, and flows off through the wire to the series of dials. The current induced is of an opposite nature at each side of the swing. In each dial an astatic permanent magnet, suspended on a pivot, and surrounded by a coil of the wire, feels each alternate impulse of the currents, and rotates on and on as its poles are impelled by the influence, giving motion to a train of wheel-work by a pinion attached to its own axis. The clock has power enough to drive 70 dials, and as in the Exhibition-room it drives only six, a resistance coil, placed on the wire where it starts from the clock, affords due compensation for the lightness of its labour. Without this arrangement the magnetic influence secondarily called up in the coil would be strong enough to arrest the swing of the pendulum. When the swing of the pendulum becomes unduly large, a bridling arrangement is brought into play by the rod striking upon a screw, and pressing down into use a friction spring, placed on the frame ready to catch the enlarged vibration. Every two hours the clock is capable of being regulated by the electric influence of a standard clock, placed in communication with it at each close of that interval. A magnet is made at the instant, which pulls an armature acting upon a series of levers, so that if the clock is right a pin enters clear into a notch in the rim of a brass disc, and no compensation is effected; but if the clock is going at a false rate, the pin is drawn in upon the sloping side of the notch, and either lifts or drops a secondary pendulum attached to the principal one by a system of levers, so that the rate of the vibration is either made quicker or slower by raising or depressing the centre of gravity of the swinging mass.

The revolution-counter exhibited by the same manufacturers has its gas-meter-like train of wheel-work driven by electric currents, induced in a coil of wire whenever an armature is dragged away from soft iron arms projecting from the poles of permanent magnets. The induced currents act through temporarily-induced magnets formed in other coils of the wire. The bell apparatus is rung by the production of electric currents in the same way, through the separation of an armature from magnets; the temporary magnet formed by the currents withdraws a detent in the bell apparatus, and allows clock-work to ring the bell.

Mr. Preece has sent to the Exhibition a complete set of the apparatus (4,866) he employs for the "block" system of railway signalling on the South Western line. The fundamental principle in this system is that trains on the same line are to be kept apart by a certain and unvariable system of space, instead of by an uncertain and unreliable interval of time. In Mr. Preece's method the signal which opens any "blocked" section of line is made by the signalman at the advanced end where the section has to be cleared, and no signal is held to be effective and complete until it has been acknowledged by the receiver, and "repeated" back to the sender. Mr. Preece also lays great stress upon the fact that the miniature apparatus which he employs in the signalman's room, and which is the apparatus that is shown in the Exhibition, shall all have identically the same form as the instruments used for displaying the effective signals on the line. The switch in both instances is worked by the same movement of the arm. In both instances the horizontal red arm on the signal post means the same thing. A strong and uniform association is thus established in the mind of the signalman, which becomes almost an instinct, and is never confused or disturbed in moments of emergency. It is also an important part of the arrangements that the horizontal, or "danger" position of the semaphore arm is maintained by gravity, and it is the dropping of the arm that is brought about by electrical action. If any accident occurs to the electric wires, so that the transmission of the currents is arrested, all that can happen is that the danger signal remains resolutely and obstinately displayed, and that all traffic is for the time suspended. The effective parts in the instruments are of extreme simplicity. In every instance, excepting one, the movement is effected by converting a core of soft iron into a magnet when an electric current is sent through a surrounding coil. The semaphore-arm is dropped by an induced magnet pulling up its weighted end. The bell is rung by an an electro-magnet acting on the vertical elastic rod of its hammer. The semaphore sends back a "repetition" signal for itself to the station from which it is worked, to show how its arm is placed; and it does this by turning on a current from one or other of two distinct batteries by their negative or positive pole as required. The current, as it rings the bell, acts on a permanent magnet, hung between the poles of the electro-magnet, so that the magnet is drawn to the right or to the left, as the "danger" or "all clear" signal is to be recorded. The best method of working the system requires three wires between the stations; one wire to connect the bells and repetition signals of both stations, a second to connect the switch of one with the semaphore of the other, and a third to connect the semaphore of that station with the switch of the other. The advantage of this is that the currents which effect the signals are maintained so long as these have to be displayed, and lightning, electric clouds, and earth currents are powerless to produce derangement. Each signal station, unless it is a terminal one, needs a double set of the four instruments; namely, bell-key, bell and repetition signal, switch, and semaphore post. By a differently arranged apparatus one wire can be made to work all the signals; but the current is then a momentary and interrupted one, and other expedients have to be brought into play for obviating the occurrence of disturbance from lightning or earth currents. The bell key turns on its electric current by pressing the end of a flat spring, which forms one pole of the battery, into contact with a metallic pin or standard in communication with the other pole —the switch accomplishes the same thing when lying across a brass arc in one direction, but not when it is thrown fully back the other way. The brass arc, a little above the pivot of the switch handle, it will be observed, is cut through. The pivot is in communication with one pole of the battery, one half of the interrupted arc with the other pole, and the other half with the earth. The three binding screws of the switch accomplish these three different communications. The largest semaphore instrument shown by Mr. Preece is an apparatus contrived to warn a signalman when a signal lamp that is out of the range of direct observation is extinguished. A brass arc placed above the flame of the lamp is expanded, and pushes up an elastic bar, so as to "break contact" and interrupt an electric current; when the lamp goes out, the arc cools and contracts, the bar settles back and renews contact, and an electric current is turned on to the signal room, to make a temporary magnet there pull over an index so as to show "light out" on the face of the instrument.

Mr. Harley, of Barnsbury, proposes to work the "block system" of railway signalling by a single wire that shall have complete immunity from disturbance from lightning, electric clouds, or earth currents, and the apparatus which he employs, and which is shown by him in the Exhibition (4,842), is of an altogether novel construction in one particular. The needle which swings vertically on the dial is *not a magnet.* It is a pointer of soft iron, suspended upon a centre pivot, carrying horizontally beneath the pivot a flat soft iron ring. The ring hangs a little way beneath the pivot by a rigid connection, and when horizontal keeps the pointer vertical by its weight. A permanent horse-shoe magnet above directs its poles towards the flat edges of the ring, and, at the same time, the ring is invested by the coils of an electric-current conveying wire. When no current is traversing the coil the flat ring keeps horizontal, because it is pulled up equally both ways by the poles of the magnet, and is held back equally by its rigid attachment to the pivot. But when a current traverses the coil the flat ring becomes temporarily an induced magnet, and is pulled up on one side and pushed down on the other by the opposite poles of the permanent magnet, and the pointer, at the same time, is consequently moved on the dial in the same direction. The signal-man who sends a signal can turn on either a positive or a negative current by using one or other of two contact levers at discretion, As he turns on one or the other he makes the needle traverse to the right to signify "all clear," or to the left to signify "stop." When the receiving signal-man is warned by a bell that a signal is coming, he presses a knob and so twitches the current, from the bell instrument to the signal instrument. In doing so he draws back two ivory pins which allow the needle pointer to traverse freely to either side; and when he releases the knob the pins start back and intercept the needle, and so fix it as a continued record. It is a distinctive attribute of this ingenious apparatus, due to the inventor of the soft iron ring and pointer, that extraneous magnetic force is absolutely powerless over its indications. While the apparatus is at work Mr. Harley flashes a powerful magnet about it, above, below, and around, in a way which would put the ordinary magnet-needle instruments of the needle-telegraph entirely out of the field, but without producing the slightest derangement in its signalling operations.

Messrs. Carr and Barlow, of Old Palace-yard, propose to dispense with the large staff of signalmen in working the block system, and to make the travelling engine which drags the train do their work. The arrangement by which they conceive that this may be effected is shown in a working model. A signal instrument is placed on the engine, where it is under the eye of the driver. When the engine enters upon a distinct segment of the railway, a trigger is pressed as its bottom passes a projection on the line, and this drops a screen on the signal instrument, and shows "stop," unless a preceding train has passed out from the other end of the segment, pressed down a lever there by its wheel, and turned on a backward current of electricity; then the current is communicated to the engine signal-instrument, at the same time that the trigger is pressed, by two curved metal springs on its bottom rubbing against corresponding metal plates on the line, and two screens are dropped on the instrument, one mechanically and one electrically, and "Go on," instead of "Stop," is displayed. Midway of the block-segment a transmission instrument and galvanic battery are placed, the former on a low post near the line. Contacts are made, and electrical currents formed on this instrument by a very pretty contrivance. A kind of flat brass hammer falls into a wedge-shaped interval, separating two steel faces. When the hammer is down, the current passes from one steel face to the other through it; when the hammer is up, the current is interrupted. As the engine passes abreast of the transmission instrument it presses a lever by its wheel, drops one hammer, and establishes a backward current, and lifts the other hammer to interrupt the current coming in from the front. When the engine passes out at the far end of the block-segment it drops again the second hammer, and re-establishes its current to give the signal "All clear."

Several different patents and methods for rendering stone and brick structures repellent of water are exhibited. All of them are colourless enamels rather than paints, and do not affect the colour of the material. Mr. J. Spiller's process (4,883) is the application of superphosphate, or arsenio-phosphate of lime. Limestone by this preparation is coated with a kind of bone earth. The cost of the solution is about 5s. the gallon, covering something like 300 square feet of surface. Mr. Dent uses a solution of oxalate of lime (4,826), but he also has a very excellent preparation of paraffine, dissolved in coal-tar naphtha, well suited for dressing too porous bricks. This solution costs 4s. 6d. the gallon.

The Indestructible Paint Company (4,847), and Mr. J. Murphy, of Penzance, show building stone dressed with other kinds of solution, of which the composition is not stated. Messrs. Gay and Company exhibit a large slab of brickwork (4,833), which is rendered waterproof by a process that is more costly, but that seems to be very perfect. It can only be applied by their own skilled workmen, using artificial heat, at a cost of 2s. 6d. per square yard.

Mr. M. Neil Greig, of West Brompton, exhibits a very excellent drain trap (4,836), that deserves to be extensively known. It is made of stout glazed earthenware, and so planned that a capacious and well-formed water-chamber receives sewage refuse, and waste water, by separate channels, and that the air-space of the trap can be kept free of sewer-gas by a special ventilation. One of the practical excellencies of the trap is a distinct man-hole, by which its interior is always readily accessible in case of accidental stoppage. A small and simple form of trap is intended to replace the common bell-trap for sinks, yards, and areas.

No. 4,885 of the Catalogue alludes to a process (Sandford's) of deodorising sewage material by means of charcoal, which is being carried out by a company of which Major Gen. Synge is chairman. The principle of the process is to make dry carbon, in place of liquid water, the vehicle for the removal of excrement. Buildings are in process of erection beyond the annexes of the Exhibition to show the mechanical arrangements by which the purpose is accomplished. The carbon employed is produced from seaweed, by burning, at a cost of 30s. the ton. It absorbs ammoniacal gases from refuse, and is then distilled in close retorts, and becomes a sort of animal charcoal, which can be used as the absorbent vehicle over again. The animal charcoal is worth £5 a ton, and sulphate of ammonia, acetate of lime, and tar are also manufactured from the product of the distillation. The company estimates the value of the excrementitious waste of each individual member of the body politic at 8s. 4d. per year, and undertakes to supply the charcoal, and remove the sewage accumulation at its own cost; and to do this for a town population of 20,000 at a cost of £2,530, and with a surplus profit of

£2,330 per year. The bearing of the process upon the vexed question of the pollution of rivers is obvious.

Behind the West Annexe of the Exhibition closets are in process of erection in which the brick-work is set in cement made from the deposits effected in sewage by General Scott's process (4,878), which consists in treating sewage water with a certain definite admixture of lime and clay, collecting and drying the deposit, and then burning it in a kiln. The organic matters contained in the deposit serve the purpose of fuel, and are entirely destroyed by the burning. The proportions of the clay and lime are so arranged as to give the cement valuable hydraulic properties. With some proportions, and in some circumstances, a cement very nearly resembling Portland cement is produced. The residual liquid, after the mixture with lime, appears to be inodorous and harmless in a sanitary sense.

Professor Gustav Bischof, of Glasgow, illustrates a plan he has devised for filtering water through spongy iron and pounded limestone (4,811). The iron is placed in the upper moveable chamber of an earthenware filter, and powdered limestone is arranged in a separate layer below. The iron is procured in a powdery spongy state by the reduction of an ore without fusion, after the extraction of sulphur and copper by heat. It removes all albuminoid and nitrogenised compounds, and also lead contaminations, from the water; and a trace of iron taken up by the water is separated by its subsequent passage through the limestone. One charge of the material, costing one shilling, secures efficient filtering for ten gallons of water per day during 200 days.

Messrs. Schaffer and Budenberg, of Manchester, have sent a series of steam-engine appliances of very good construction, among them the now somewhat generally known "Buss pseudo-static governor," in which the balls are depressed, instead of being lifted, by centrifugal action on rapid rotation. Each ball is placed on a pivoted arm, with a counterpoise which keeps it pressed home towards the centre when at rest. Upon rapid rotation the two balls fly asunder, and the two weights are lifted, carrying with them the muff. The governor is very compact, the counterpoised ball being mounted upon a comparatively short arm. Its constructor claims for it the attributes that it is smaller and lighter than any other governor of the same sensibility and energy, and that it is absolutely isochronous or even-paced, and has given his explanations of its excellence in two very elaborate papers, a German pamphlet and a French contribution to the *Chronique de l'Industrie* of Brussels. In the steam gauge the pressure of the steam from the boiler is thrown upon a corrugated steel plate, which moves the indicator by a series of levers after the fashion of the aneroid barometer. In the hydraulic gauge a curved steel tube is straightened by internal strain, and moves indicating levers. In the engine-counter hardened steel projections on the end of a lever work round a ten-toothed wheel as the lever oscillates, and the wheel turns the next of the series one tooth by an entire revolution of its own. The vacuum gauge is a barometer in a strong glass tube cover, which begins to record by a fall in its columns, when a pressure of one atmosphere is taken off the cistern. The "steam-trap" relieves any steam-heating apparatus of its condensed water by a jar-shaped float, sinking when the accumulating water overflows its lip, and by its fall opens a valve for the outflow of the condensed liquid. The patent pulley-block holds the rope fast by the pressure of a weighted lever, until the weight is lifted off from its clip by pulling upon a cord fastened to the outer end of the arm.

Messrs. E. J. Hill and Latimer Clark again exhibit their boat-lowering apparatus (4,845), which was shown in the Exhibition of last year, on account of improvements which they have recently made in its mechanism. They have now added a safety catch to the ingeniously-formed hook, which frees it for casting loose the boat, when this is within a few inches of being water-borne, by a cord that is fixed to the ship above, turning it over as soon as it is taut. A side loop has also been placed upon the ring, which enables the boat to be cast loose at will by a sudden jerk from the hand. There is, besides these important improvements, a new arrangement for keeping the two ropes of the falls mechanically wedded together as they pass round between three pulleys in a single conically-shaped groove. When one rope is lowered away the other runs out, *pari passu*, with it, although left loose, and so keeps an even keel on the boat, or the holding fast upon one fall checks both.

Mr. Gumpel, of Leicester-square, shows a boat-lowering apparatus (4,837), in which a ring, passed into the slip of a forked holdfast, is caught by the point of a hook turning in beneath it. When the weight of the boat is on the ring, the hook cannot be drawn back sideways from beneath it without a very violent exertion of force. When the boat is water-borne, the hook slips away under the slightest strain, such as might be given by the drag of the boat when afloat upon a cord fixed from the ship.

Dr. Nicholas, of Wandsworth (4,860, shows how a boat may be turned out from a ship's side upon a hinged frame, and deposited loose upon the water.

Mr. Anderson, of Caterham, has contrived a new form of propeller (4,804) for steam-ships, which is about to be applied to a steam launch. It is a kind of spade-shaped paddle, which is dug round in the water by a crank, and feathered with the back stroke by the expedient of passing the square, but spirally-turned shank of the paddle through a collar, supported in gimbals. The feathering of either paddle can be altered without stopping the machinery, so that the steering of the vessel may be assisted, or the paddles may both be made to back water. Mr. Anderson also exhibits the model of an equilibrium cabin (4,804), in which the cabin remains steady by its own weight, while the ship rolls as an unsteady floor beneath it. The cabin traverses by rollers upon semi-circular rails hollowed down into the hull of the vessel.

Mr. Wright, of Bermondsey, shows the model of a life-boat (4,892), which rights itself in an instant if capsized, with its masts and sails set, in virtue of its own buoyancy, and empties out any water it may have received. The method by which this is accomplished is not explained.

Mr. Coryton, Essex-court, Temple, contributes a brass model of his very interesting form of anchor (4,822) in which the cable drags the broad flukes into their holding ground by a shackle placed between them, the grip of the anchor increasing with the strain, but in which the hold is immediately released when the pull is vertically up. Mr. Coryton has also a curious pair of models (4,822) to illustrate his idea of the best form for a vessel, to confer upon it buoyancy and speed. He considers that the bow end of the vessel should be a vertical wedge, and the stern a horizontal wedge. This, of course produces a very nove shape. Messrs. Redsdale and Co., of the Minories, show a form of ship's port, in which the port can be wholly or half opened, or in case of need, securely closed, by powerful clipping screws driving home a circular flange into an india-rubber packed groove. A reversible deck light of the same exhibitors is capable of being turned upon a circumferential pivot, so as to present either a dead light or an open ventilator to the deck, as may be required. Their "pillar telegraph," for night signalling from the bridge of a steamer to the steersman, is a bright lanthorn, which can be shown white, green, or red by moving a handle, to intimate "steady," "starboard," or "port." The Rev. Mr. Kilner's elastic riding gear is a sliding block carrying the shackle of a ship's cable, and pulling against 20 india-rubber rings, with metal rings intervening between each pair, to give elasticity and to absorb sudden strain. Mr. Kilner's grab-link is a lever that holds a boat's chain, by a horse shoe clip pressing upon one link, until a lashing is cast loose. Captain Hans Busk's model of a steam life-ship (4,814) is based upon the plan of two longitudinal air pontoons carrying a sliding keel that can be raised or dropped between. Mr. Mackie's very elegant model (4,851) of what has been catalogued as a "proposed Channel steamer," is really a design for a sea-going ship of large dimensions, built throughout of cellular iron beams, having its paddles enclosed in internal water-ways lying between the main foundation beams, and furnishing a saloon space 300 feet long, 60 wide, and 12 feet high.

Among the suggestions for the application of science to purposes of domestic service, there are a few notable objects. Mr. Webber, of Chelsea, illustrates, by a drawing (4,888), a plan for inserting terra-cotta tubes into chimney-flues, so that while the smoke and hot-air pass through the tubes, vacant air-spaces around them may receive cold fresh air through the outer walls, and pass it in when heated through inner walls, to carry its acquired warmth to the interior of rooms. Messrs. Posser and Russell, of Dorset-street, have a reversible fire-grate of very good construction, in which coals can be placed upon a live fire, and the grate be then turned over for the fire to be brought to the top, so that the fuel may be burned from the top downwards, upon Dr. Arnott's principle, for securing slow and steady combustion. Mr. Looker, of Kingston, has constructed fire-clay tiles (4,850), suited to ordinary forms of grates, and so shaped as to secure freedom of surface combustion and ready radiation with small consumption of fuel. Mr. Meaken, of Baker-steet, has added to the convenient form of pulley-moved window sash, exhibited last year, a contrivance for readily attaching fresh sash-lines (4,855). A metal casting drops into a groove in the side of the sash-frame, and is fixed there by a pin, which can be drawn out in front to release the casting. He also exhibits a very good kind of door-handle, which spontaneously adjusts itself to right working position in the act of fixing, in consequence of conical collars attached at each end of the spindle being carried in conical sockets or rose plates.

Mr. Zimdars, of Red Lion-square, has improved the fixture arrangements of his pneumatic bells exhibited last year (4,893) by adding a metal socket, which is to be permanently fixed in walls for the reception of the air-capsule receiving the pressure of the finger-knob, so that the capsule can be immediately renewed at will. He has also some improvements for dropping the tell-tale, where air-tubes from different chambers converge upon one bell.

Mr. Harvey's bottle-washing apparatus (4,844) is a series of iron frames, carrying pairs of bottles meeting each other neck and neck, so that the bottles can be shaken round, each end up alternately, with a charge of water and fragments of calcareous spar, the cleaning charge being then passed from an upper to a lower bottle by turning an intervening cock.

Mr. Read's twin bottling apparatus (4,869) is a double-headed tap, by which the stream of beer or wine issuing from a cask can be shunted from one bottle to another without arresting the stream or rendering the liquid turbid by the shock incident to frequent opening and closing of the tap. The bisulphite of lime spray injector by the same inventor is an apparatus for injecting the spray of a solution of bisulphite of lime into an empty inverted bottle, and allowing all but the infinitesimal portion clinging about the glass to run back. The bottle then retains the exact fixed quantity that is required to check injurious fermentation in beer, and to prevent it from becoming turbid or tart. As small a proportion as the two hundred-thousandth part of the beer treated by the preservative is sufficient for securing the desired result. Mr. Maclean's smoothing irons (4,852) are kept hot when in use by gas burners delivering the flame downwards in the interior upon the ironing plate. Two flexible tubes supply gas and air to the interior cavity of each iron. Mr. Sopwith's monocleid cabinet (4,811) has all its closets and drawers opened when the central flap is unfastened and turned down; curved brass bars are drawn out by the act from catches at the back of the drawers. One of the closets holds a series of keys presumed to belong to safes, or other extraneous depositaries, and cannot be closed unless all the keys are in their proper places. Mr. Shirley's mechanical cot (4,879) is an infant's cot swinging upon upright rods, one of which is kept in vibration by an india-rubber crank worked by a train of clock work. Messrs. Hammersley and Volk's "Volta Foglia" (4,839) is a mechanical contrivance for turning the leaves of a music-book by spring power, when a knob is pressed to release each successive member of a train of brass arms.

Mr. Chester, of Croydon, exhibits an excellent gate-fastening in the form of a bolt, which is thrown in upon a spiral spring, as its end comes upon a sloping striking plate, until it reaches the centre, when it is shot into a slot, from which it has to be drawn back by the hand when the gate is to be opened. Mr. Hughes' garden roller (4,846) is a small inner cylinder travelling round upon circular concave ridges in the interior of the large external roller. The object is to make the roller more easy to move. Mr. Kieshug's railway warmer (4,849) is an iron or copper case for the carriage floor, carrying inside cakes of burning charcoal, and supplied with air to fan and sustain the combustion by tubes passing through the carriage floor. Mr. Griffith's railway lamp, a form manufactured by Messrs. Clement, of Birmingham, and at the present time under trial on the Great Western line, is a naphtha lamp with brilliant combustion produced by a cone of glass fitting upon the dome of the burner, and by a metal upcast chimney above. An annular reflector above the flame throws a bright light through the glass cone. Rosa's mining lamps (4,871), contributed from Liege, have a strong glass cylinder continued upwards into a round sheath of safety gauze. An internal chimney hangs over the flame, and a transverse diaphragm of safety gauze connects the top of the glass with the internal chimney. The air passes in outside the central chimney, through the transverse layer of metal gauze, and escapes from the top of the inner chimney through the outer gauze. In Mr. Barton's filter respirators (4,808) air is to be breathed through a cylindrical mouth-piece containing flannel, cotton-wool, glycerine, and charcoal or lime. An air-tight contact between the mask and the face is very ingeniously made by india-rubber tubes filled with water. The larger form of apparatus is a bag for pure air, to be carried over the shoulders in actually irrespirable atmospheres, and it carries enough air for from 20 to 30 minutes' service. Mr. Bateson's vermin asphyxiator (4,809) is an iron combustion chamber, in which paper saturated with sulphur can be burned, so that the fumes may be distributed into any closed spaces by the revolutions of a fly-wheel throwing a current from the chamber through a flexible tube. Mr. Schucht's equileverage key (4,877) is a key for pianoforte or organ, in which the finger produces the same mechanical effect at all parts of its length. A short equal armed lever, lodged out of sight beneath, receives the impress of a pin fixed under the visible key at its inner end, and rises at the other end, in obedience to the impress, to strike up the hammer. The iron channel way of Messrs. Mowlem and Co. (4,858), shows an uninjured segment of iron plate that has been laid in the traffic of the Surrey side of London Bridge, by the side of granite blocks that have been worn and crushed out of shape, in the same situation, in half the time. The steel-blade disc and fluted rollers of Messrs. Baker and Sons, of Bristol (4,622) show the most essential parts of the machinery used for manfacturing flour by the Bucholtz system. The husk is scraped away from the grain by the rapid rotation of discs, made of projecting blades of thin steel packed alternately with layers of pasteboard, and the decorticated grain is then cut into "semolina grains," and ground into fine flour, by being passed between fluted steel rollers revolving at different rates of speed. The flour manufactured by the process is absolutely free from a ferment known as cerealine, which exerts an injurious influence upon bread; and the profit realised by the system of manufacture is much larger than by the old millstone method. Mr. Dennis's sentinel whistle (4,825) only sounds when the pressure of steam in a boiler is sufficiently strong to drive up a spiral spring, and open an outlet for the steam to the sounding disc. Mr. Chedge's pump (4,817), is lined by a smooth casting of glass to allow acid liquids to be operated upon by a piston of hard wood. Messrs. Brewer and Jansen's continuous treadle motion without a crank is given by two long arms, worked by a treadle, pulling round two drums by the intervention of straps. The arms work alternately, winding up one drum as the other is unwound, and the drum bites upon the axis, by an internal rachet, only when its motion is in one direction. Messrs. Kent's ironing machine is an elastic horse-hair roller moved by a hand-winch against a metallic plate kept hot by a row of gas burners beneath. Lieut. Col. Clay's turning tools (4,820) are massive instruments for heavy iron work, kept cool when under strain by streams of water thrown through their substance from elastic tubes, and delivered close up to their cutting edges. Mr. Snowdon's screw-cutting apparatus is a compact piece of machinery that enables bolts and screws of iron or brass to be fashioned and cut under a vertical drill, as one or other kind of tool is brought into operation by shifting appropriate levers. Mr. Sand's ordinary road steam carriage (4,875) travels upon broad rollers that have neither spokes nor axles, but carry the steam piston and connecting cog wheels in their interior, in their place. The rollers are driven round by the cogged wheels acting upon toothed bands fixed upon their inner surface. The furnace and boiler lie between the pair of rollers. The idea is mainly that of a huge steam-driven chronometer put to locomotive work by turning the outer rim of its own case by its train of wheels. Mr. Clay's drawing of a tramway steam-carriage (4,818) suggests the communication of the motive power to a broad india-rubber shod driving wheel in front through bevelled gearing. Mr. Webster's railway switches fix the switched segments by thrusting stout wooden plugs between the iron rails, the plugs being inserted and drawn by the same movement that works the switches. Burn and Son's, and Mr. P. Williams' railway crossings aim at improving the contact of the facings of railway points, or superseding them altogether by making the metal lines continuous.

Mr. Ramsbottom's model shows how the Liverpool Lime-street Railway Tunnel is ventilated by a steam-driven revolving fly-wheel, exhausting its interior, and throwing the exhausted air up a cyclopean chimney-shaft. Mr. F. Claxton Filder's rigid suspension-bridge has at each side suspension chains of two rigid built-up rib-links, pivoted only at the centre and ends of the bridge, and having the top flange of each link flat, and forming a tangent to the parabolic curve of the lower flange of the link in communication with it at the centre of the structure. The model of Mr. Dank's revolving puddling furnace (4,823) shows the arrangement of the steam-driven revolving puddling chamber, with the furnace closely faced to it at one side, and the flue, outlets, and feeding aperture at the other. The molten iron is puddled by the chamber being revolved eight revolutions in a minute, and is then withdrawn in lumps to be subjected to the mechanical action of a squeezer, and to be left by it fit for rolling off into bar. Colonel Sir Andrew Clarke's model of the Floating Bermuda Dock (4,818) shows how the dock is lifted with its incarcerated load by pumping out the water from between the hollow sides of the structure through the influence of eight powerful steam-engines. Mr. Anderson's range indicator (4,804) is a handy instrument, contrived for ascertaining the distance of floating objects at sea by sighting them through sights carried by an horizontal arm, of which one has a vertical graduated sliding-scale read off by a vernier, to express the distance on comparison with a duly prepared table. Lieut.-Col. Mapleson's military tent (4,853) is a very convenient form of canvas pyramid, upheld by a centre-pole and cross rafters, and furnished with a door-canopy, and charming little window pouches. The simple mode of attaching the curtains by lacing cordage-points through rings, is worthy of note. Lieut. Abney's papyrotype illustrations (4,802) are pictures rolled off by a press from paper photographs prepared by a process which he is engaged in perfecting, and then treated in a special way with greasy ink. "The death-warrant of Charles I." shows how the photographic picture may be transferred to stone for the press-printing, if this method of proceeding is preferred to printing from the paper. Mr. Wigzell's drawing-board (4,890) fixes its paper by pressing its edges, when moist, into grooves, through the instrumentality of metal rods and button-like clips. Mr. Russell's bi-centro-lineal (4,874) is a kind of pentagraph apparatus, enabling perspective lines to be traced mechanically upon paper. M. Adolph Petry shows (4,864) how rudimentary arithmetic is taught in the Government schools of Belgium, by adding vertical rods to the old form of abacus, so that the ascending orders of numeration may be illustrated to the eye by balls. Dr. Gardner's perpetual almanac and calendar (4,852) is a printed card, with a central adjustible slip, in which the fundamental idea is the consideration that the relation of the months to the weeks in any year is ruled by the day of the week upon which the year begins. Appropriate tables furnish the means of adjusting and using the calendar. The little red book of M. Niethe, of Berlin (4,861) explains the system on which the correspondence of cyphers and words are used for the purposes of telegraphy by the Chancery of the German Empire. Captain Hans Busk's model of the planet Mars (4,814) presents very elegantly at a glance the distribution of land and water on this planet, in a form which boldly suggests the fact that Mars is a world with some dearth of water, a limited allowance of air, an overabundance of dry land, and clear atmosphere It will be observed that the oceans are sinuous, and form sprawling mediterranean seas, rather than broad, rounded basins, like the leading oceans of the earth.

There are only three foreign exhibitors in the department of scientific inventions this year. Two Belgians exhibit, one mining lamps, and the other school apparatus. One German exhibitor contributes an illustration of the State cypher code for telegraphs.

At the time of the preparation of this report there were some articles named in Division 3, Class 14, of the Official Catalogue, which had not yet appeared at the Exhibition.

INTERNATIONAL EXHIBITION FOR 1874.

The following are the regulations for exhibiting Manufactures, with the Raw Produce, Machinery, and Processes employed:—

Division II.—Classes 8 to 13.—(Manufactures.)

(*Rules extracted from the Directory*).

In 1874, Division II. of the Exhibition will consist of the following Classes:—

Class 8—Lace (Hand and Machine made).

Class 9—Civil Engineering, Architectural and Building Contrivances:—*a.* Civil Engineering, Architectural and Building Contrivances. *b.* Sanitary Apparatus and Constructions. *c.* Cement and Plaster Work, &c.

Class 10—Heating by all Methods and Kinds of Fuel.

Class 11—Leather, including Sadlery and Harness.—*a.* Leather. and Manufactures of Leather. *b.* Sadlery, Harness, &c.

Class 12—Bookbinding.

Class 13—Foreign Wines, in the Vaults of the Royal Albert Hall.

Under Division II. (Manufactures) will be exhibited selected specimens of the finished manufacture, as well as the raw material of the fabric in its different stages of production, and the machinery and processes employed in its manufacture.

All industrial objects submitted for exhibition should be limited to such specimens as are necessary to show the manufacture and patterns in a satisfactory manner. No mere duplicates can be admitted; the same design in a fabric may, however, be shown with different combinations of colours.

With the view of increasing the educational value of the Exhibition, by chronicling the progress of manufactures. Her Majesty's Commissioners will reserve certain spaces in the Industrial Division for special collections of ancient works.

In the case of industrial productions, the special reasons (such as excellence, novelty, cheapness, &c.) why it is exhibited, should be stated, and, whenever possible, the average retail price at which it can be bought.

Exhibitors of machinery must construct all necessary foundations, and provide their own driving-belts and driving-pulleys, which are to be in halves, and bored to the proper diameter of the main shafting, as notified to them by her Majesty's Commissioners. They must also supply and erect, at their own expense, any counter-shafting (including the necessary foundations) which they may consider requisite to increase or reduce the speed to suit their own particular machines.

In order that exhibitors of machinery may recoup the cost of the operations illustrated, they will be permitted to sell to visitors such results of the operations as are actually manufactured within the Exhibition building, on condition of the payment of a moderate royalty, based upon a head money payment on the total number of visitors to the Exhibition.

The following information should be supplied, with the form of preliminary application (No. 10), by proposing exhibitors of machinery (Form No. 10*a*):—*a.* A plan of each machine, showing the position of driven-pulleys, the minimum space required for attendants, and indicating the parts of the machine which should be placed most prominently for inspection by the public. An elevation would also be of use, if it could be supplied without inconvenience. *b.* A plan and section of the foundations required. *c.* The weight of the machine. *d.* The amount of motive power, in actual horse-power, required from main shafting. *e.* Should water, steam, or gas be required, all necessary information as to the quantities of the requisite supplies, which must be paid for by the exhibitor.

Exhibitors must make their own connections for gas, water, and steam. They must also provide and attach meters of sufficient capacity to measure the quantities of gas or water which they consume, and for which they must pay monthly to her Majesty's Commissioners, at the rates actually charged at the time by the Companies.

The latest days appointed for receiving the different classes of goods are as follows:—Tuesday, 10th February, Specimens of ancient lace. Monday, 17th, Class 10. Heating by all Methods. Wednesday, 4th March, Machinery of all Classes. Thursday, 5th, Class 9. Civil Engineering, Architectural and Building Contrivances. Friday, 6th, Class 11, Leather, Saddlery, and Harness. Saturday, 7th, Class 12, Bookbinding. Tuesday, 17th, Class 8, Machine-made and Modern Lace. Foreign Wines (Class 13) must be delivered punctually on the days which will be announced hereafter.

Exhibitors in Class 9 who may wish to show new methods of construction in actual operation during the Exhibition, will (with the Committee's approval) be allotted space in the West Annexe, wherein to build or to erect their plant, &c., in view of the visitors to the Exhibition.

Applications to submit objects proposed for Exhibition to the official Committees of Selection, should be made on the Form of Preliminary Application (No. 10), which can be obtained at the Offices, 5, Upper Kensington-gore, London, S.W.), and should be forwarded to the Secretary before the 1st January, 1874.

Division III.—Class 14. — Recent Scientifc Inventions and Discoveries of all Kinds.

(*Rules extracted from the Directory.*)

Division III., Recent Scientific Inventions and Discoveries, will consist of objects the excellence and novelty of which are considered by the Committee of Selection to be so great as to render it undesirable that their introduction to the public should be delayed until the proper year for the exhibition of their Classes of Manufacture in Division II.

No objects will be admitted into Division III. which have been shown in previous International Exhibitions of this series, unless very important alterations or improvements have been added to them since the date of their previous exhibition.

To assist the Committee of Selection in judging of the qualifications for admission of any invention submitted for exhibition in Division III., it is desirable that the Form of Preliminary Application (No. 10) should be accompanied by a statement of the inventor's special claims to novelty and excellence, and (if possible) by the written opinion of some scientific gentleman of repute who has practically examined the invention.

The Act of Parliament for the Protection of Inventions exhibited at the Annual International Exhibitions is entitled "The Protection of Inventors' Act, 1870," 33 & 34 Vict., cap. 27, and dated 14th July, 1870.

The latest day appointed for receiving objects in this Division is Wednesday, 11th March, 1874.

Applications to submit objects proposed for exhibition to the official Committees of Selection, should be made on the Form of Preliminary Application (No. 10), which can be obtained at the offices, 5, Upper Kensington-gore, London, S.W., and should be forwarded to the Secretary before the 1st of January, 1874.

The number of visitors admitted to the Exhibition during the week ending Saturday, August 2nd, was as follows:—Season tickets, 722; on payment, 18,883; total, 19,605.

EXHIBITIONS.

The Principality of Monaco at the Vienna Exhibition.—Although the smallest of European monarchies, the principality of Monaco is better represented at the Vienna Exhibition than many a larger country. A building in the Pompeian style occupies the centre of a garden tastefully laid out, and planted with specimens of the Flora of Monaco. Amongst a fine collection of flowers the irises and Japanese lilies, now in full bloom, deserve especial praise. The pepper-tree, with its graceful foliage, the aloes, the cypress, the olive, orange, lemons, and a number of odoriferous plants, give the garden quite a tropical character. Foremost amongst the industries of Monaco is the manufacture of perfumery; and the specimens from the laboratory of Monte Carlo are especially worthy of mention. The "Eau de Cologne" manufactured at this establishment is in every respect equal in quality to that distilled in the city from which it takes its name. *Gallia*, a liqueur which is reported to possess rare hygienic qualities, is also a specialité of this place, and is said to have been used in the hospitals during the late Franco-German war in preference to any other tonic remedy. A fine collection of pottery is also exhibited, and is remarkable for the delicacy of form and richness of colour. The specimens of cabinet work are excellent, and made from native wood, such as olive, cypress, &c. Amongst the other productions of this country exhibited are olive oil, wine, &c.

The movement of passengers in steamers through the Suez Canal appears to be steadily increasing. In 1872, the number of persons who went through the canal in this manner was 67,640; in 1871, the corresponding total was only 48,421; and in 1870, 26,758.

Among the novel manufactures lately introduced into Japan are those of paper hats, to imitate felt ones, and paper "slates" for schoolboys.

The yearly production of maple sugar in the United States, its territories, and the British possessions, may be fairly considered as amounting to 60,000,000 pounds, with molasses to the amount of 50,000,000 gallons.

It is stated that the South-Eastern Railway Company are willing to use peat instead of coal in their engines if they were able to obtain it at 8s. per ton, exclusive of carriage from the bog.

SOME NOTES ON THE RHEEA FIBRE.

By P. L. Simmonds.

Considering that the Society of Arts awarded its Silver Medal nearly 60 years ago to Captain Cotton, a director of the East India Company, for the introduction of this nettle fibre, the slow progress it has made in commerce is somewhat strange. The Government and officials of India, the authorities and botanists of many of our Colonies, and various foreign Governments, have done much to diffuse information and stimulate inquiry. The recent public notice from the India-office, that they are prepared to supply green stems of the plant for those who desire to experiment upon them, affords a fitting opportunity for publishing a few collected notes on the plant.

In 1854, the late Dr. Forbes Royle prepared a valuable circular on the Rheea fibres of Assam, which was printed and extensively circulated by the Governor-General of India. In 1860, in his elaborate paper brought before the Society of Arts "On the chief fibre-yielding plants of India," (*Journal*, Vol. vii., p. 48), Dr. J. Forbes Watson also drew attention to the Rheeas, observing that the fibres of *Urtica nivea* and other plants of the nettle species will occupy a place second only to that of flax.

Although it has been a long time taking its place in commerce, owing to the mechanical difficulties which have hitherto stood in the way of the preparation of the fibre on an extensive scale, there can be little doubt that the Rheea nettle fibre, which has passed popularly here under the misnomer of China grass, will ere long become of great importance and of widely-extended production. Like jute fibre and alpaca wool, there is a great opening for it, and the India Board are doing their best to stimulate inventive experiments as to the best and cheapest mode of stripping the fibre cheaply on an extensive scale. A great deal of scattered information has been published of late years about these plants, but chiefly on the Continent,* and as the Society of Arts has long been zealous and energetic in this direction, and has afforded many opportunities for the discussion of the subject of fibrous materials, it may be desirable to call attention to what has been written and published, and concentrate some of the scattered information for the benefit of those who are interested in the matter at home and in our colonies.

When we consider that it is nearly a quarter of a century ago that attention was prominently drawn, by fabrics and specimens, to the beauty and value of these nettle fibres, at the first International Exhibition in London in 1851, it is somewhat strange that so little comparative progress has yet been made in this direction. I drew public attention to this China grass, in a long article soon after in the *Merchants' Magazine*, and have subsequently written on it frequently in the *Technologist*, and other publications of my own.

Although there are various species of nettle which seem to yield in the East strong and useful fibres, yet that most generally employed and widely distributed is apparently the *Boehmeria nivea*, which appears to be known as rheea in Assam, pan in Burmah, ramie in Malayah and Java, calooe in Sumatra and China, and Chuma in China.

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* I may enumerate the following works and papers for reference:

La Ramie, ou Ortie Blanche sans dards, &c. Par Theophile Moerman. 112 pp. Gand: 1871.

Description et culture de l'Ortie de la Chine, precedées d'une notice sur les diverses plantes qui portent ce nom, leurs usages et leur introduction en Europe. Par Ramon de la Sagra. 64 pp. Paris. 1870.

Du Traitement Industriel des plantes filamenteuses. Par J. Masse. 84 pp. Paris. 1864.

Nomenclature Usuelle de 550 Fibres Textiles, leur provenance, leurs usages, &c. Par Professor Bernardin. pp 80. Gan 1872.

The Fibrous Plants of India. By Dr. Forbes Royle. pp. 344 374. London: 1855.

Culture et Emploi de l'Ortie de la Chine. Par Paul Madinier. 16 pp. Journal de l'Agriculture des Pays Chauds. Paris: Nov., 1865.

Messrs. Decaisne and Lemaout consider *B. nivea* and *B. tenacissima* as two distinct species, while Dr. Royle, Weddell, and others class them as the same, the *B. nivea* of Hooker and Arnot. Dr. Blume is inclined to think that *B. tenacissima* is obtained in the islands of Sunda, by the culture of *B. nivea.*

Possibly the transplanting to the mountains may produce a more robust plant, which loses the white colour of its leaves, even as in China, where they have a distinct mountain variety, and a variety grown in the plains. If Science, following the example of Weddell in his Monograph of the *Urticas*, should assign to one single species the name of *Boehmeria nivea, utilis, candicans, tenacissima,* &c.,[*] it would be better to adopt, as a specific name *utilis*, or *textilis*, which better expresses their economic value and superior textile importance.

In the province of Su-chuen, in China, a large commerce is carried on in this China grass cloth, known as hia-pou, or summer cloth, which is made from several varieties of ma, or fibre, but chiefly from that of *Urtica nivea*, tchou-ma. The fibre of this plant, which grows in moist soils, furnishes a pearly white thread. of great strength. It is used to make light tissues, bed curtains, mosquito nets, pocket handkerchiefs, sacks for grains, and cordage.

The northern limit of the plant appears to be about 36° in Corea and Japan, its southern limit between 9° and 10° S. lat. in the Moluccas.

In Japan (the ma-wo of Siebold) it is found in the southern part, but is not common, nor does it form a regular article of culture; for it does not seem to be mentioned by recent travellers. Kaempfer, Thunberg, and Siebold mention its use, but principally for cordage.

In the Corea, where the climate is less extreme than in the Chinese continent at the same latitude, the plant is grown and utilised, as in China, for fabrics, under the name of mao-chi-pei (Siebold, tom. v., p. 34.) In China it does not extend beyond Hoang-Ho, for in the provinces of Chan-Toung and Tchi-Li, the textile plant most grown is *Corchorus capsularis*, the jute of Bengal, or a variety. The nettle (tchou-ma) is found growing spontaneously in the island of Chusan, according to Fortune, Macgowan, and N. Rondot; at Ningpo. and at Nankin, according to Lelancher, but apparently the species named by botanists *utilis.*

It is also cultivated, but chiefly in the provinces of the interior of the empire as houpe. according to Blakiston, on the borders of the Yang-Tse-kiang; in Su-chuen, where Father Bertrand enumerates two varieties under the names yuen-ma, and chau-ma, or hemp of the plains and the mountains; in Koue-Tcheou (Fortune and Perry); in Yunnan, where, according to M. Chauveau, it is known by the generic name of yuen-ma, but comprises two varieties, the black, or tsing-py-ma, and the white, or houang-py-ma, and here the production of the plant is extensive. The yarn and thread obtained here supply the chief towns of the littoral, where it is not grown. The manufacture of the grass cloth fabrics is a special industry, in which the Chinese excel, and the products attract the admiration of all foreigners.

In Cochin China this nettle is found represented by two plants, which Loureiro and G. Aubaret in their works distinguish under different names; the former calls them cay-gai and pa-ma, and the latter che-ma and hac-ma. It grows wild, and has not yet been subjected to culture, and is only used for fishing nets.

Dr. Oxley states the plant to be indigenous to Singapore, and Finlayson that it is cultivated in Penang. Colonel Burney obtained specimens in 1836 in the Shan provinces of Burmah.

In the Chinese province of Yunnan, to the west of the Indo-Chinese mountains, we find it in Assam, under the name of rheea, and in Northern Bengal, in the provinces of Dinajhpoor and Runghpoor, under the local name of kunkhoora. It is cultivated there in gardens, and furnishes the thread with which the fishermen make their nets and cordage to moor their boats. (Buchanan's papers, II., p. 845.) In the Eastern Archipelago the plant is widely spread, and there appear to be several varieties. The fibre is generally known under the Malay name of the plant, ramie. It is only used for making rope and fishing-nets. At Java it is cultivated on a small scale, but it is only in Sumatra that it is extensively grown on the borders of the large rivers. The native name is caloee, according to Marsden, and kloni or goni, according to Miquel. The fibre obtained is sent to Batavia, made up into bundles of twine, from which the Javanese make their nets. It is also found in the Moluccas, passing under the name of inau at Amboyna; and in Celebes, called gamki; at Macassar, in the Philippines, where, according to Father Blanco, it is common in the northern part of Luzon and the Batan islands, Gaudichand found it under the name of sidjiafi, at Guam. (Journal de l'Agriculture des Pays Chauds, 1867. p. 201.) When we perceive how widespread is this useful plant, it is evident that large supplies of the fibre could be obtained with the aid of a suitable machine.

The plant is properly speaking a frutescent or suffruticose shrub—that is, the stem at first is soft or herbaceous and afterwards becomes woody, or half-woody, half-herbaceous. The natural habit of the plant is to throw up a number of strong shoots annually from the root, of 8 or 10 feet in height, producing a number of racemes, or bunches of flower and seeds, not unlike the black or red currant. When these shoots are more than one year old, and the bark or cuticle of a dark colour, they are then too old, and unfit for producing good fibre. The fibre has arrived at full perfection as soon as the stem is observed to turn dark or brown spotted about 6 or 8 inches next to the root. At this stage of growth the bark is readily stripped from the stem and cleaned, or if dried with the cuticle on it, could be sent to be properly cleaned by efficient machinery.

Its magnificent length and strength, exceeding, with few exceptions, every other fibre, together with its peculiar beauties and qualities, adapt it for far more valuable employment than was once suggested, to enter into competition with coarse-stapled cottons, or at least to scarcely fill a place capable of being filled by fibres of half the cost. Towards its preparation for those more suitable and valuable uses, many attempts have been made with mediocre success. It appears generally to have baffled all efforts, either to completely separate it into its cells, or to retain in these the length and strength which they naturally possess.

Some five or six years ago, Messrs. Mallart and Bonneau, of Lille, operated upon this fibre, by cutting it into lengths of about two inches, and treating it with oil and alkalies, to work up as a cotton substitute. The cells of the fibre are from 3 to 18 inches long, and bear a striking similarity, when not too closely viewed, to some longstapled hairs and wool; about equal to medium and fine mohair.

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[*] *Ramium majus.*—Rumphius, Herb. Amboin. (1750), v. p. 214, fig. 79.

Urtica nivea.—Linnæi, Hortus Cliffortianus (1737), p. 441; Jacquin Hortus Vindobonensis (1770), fig 166; Loureiro, Flor. Cochin Ch. (1793), ii. 683; Thunberg, Flor. Japon (1784), p. 71, fig 33; F. L. Gilii e G. Xuarez, osservaz. fitolog. (1789), p. 50, fig. 7; Blanco Flora di Filipinas (1837), p. 697.

Procris nivea.—Gaudichaud, Voy. de l'Uranie, part Bot. (1826), p. 499.

Urtica tenacissima —Roxburgh, Flor. Indica (1832), iii. 590; Wight, Icon. plant, India (1840-42), ii. p. 688; Blume, Museum Botan. (1851-52), iii. p. 210, fig. 56.

Urtica candicans —Blume, Bijdr. tot. de Flor. v. Nederl. Indie. (1825-26), p. 503. *Boehmeria candicans*—Hasskarl, Cat. Bot. p. 79.

Urtica (*Boehmeria*) *utilis.*—Blume, de Indische bij. (Leyden, 1853), No, 4, p. 163.

Boehmeria nivea.—Hooker et Arnott, Bot. voy. Beechey, 214; Hooker's Journal of Botany (1851), iii p. 317; Weddell, Monog des Urticees (1856), p. 381, pl. 11, fig 10-17; Miquel, Plantæ Junghuhnianæ (1851), p. 33; Miquel, Flor. Indiæ Batavæ (1858), i., 2nd part, p. 252-254; suppl. primum.; Prod. Floræ Sumatranæ (1861), p. 170.

M. de la Blanchere, jun., in the 7th volume of the "Bulletin of the Society of Acclimatisation," Paris, shows by quotations from Virgil's "Georgics," and other authors, that the native country of this nettle is Laos, and that this must be the silky substance spoken of, which was thence carried through Thibet to China.

The late M. Ramon de la Sagra, in a communication to the Paris Acclimatisation Society, in 1869, drew attention to the fine plants which were growing in the Bois du Var, Nice, and various other localities of the country, raised from seeds distributed by the Society, from which three cuttings a year could be obtained He pointed out Corsica as well fitted for its culture and preparation, as there M. Dupre had chemical works and machines ready for its preparation. This new and important industry, it was stated, was specially suited for France, which imported annually 64 millions of pounds of textile materials, far less valuable than this nettle fibre.

For fineness, colour, strength, and easy production, the fibre cannot be surpassed. In tropical cultivation this plant has a wider range than any other, and has been even successfully grown in the temperate regions of Europe and America. In Jamaica, attention has been given to its propagation now for several years, and the plant bids fair to vie with the rankest weeds, for it will bear cutting down several times in the year. This luxuriance of growth, combined with its easy reproduction, the colour and strength of its fibre, and its very high price, are advantages seldom to be met with.

Thanks to the efforts of Father Voisin, who was the first to promulgate the idea of acclimatising the plant in Europe, and to the communications of MM. Guillemin, Chauveau, Stanislas Julien, Dabry, Father Bertrand, and other members of the Paris Society of Acclimatisation, the plant has succeeded perfectly well in France, and may now be considered naturalised.

Its importance led the Society to offer a prize of £20 for the industrial use of its fibres, and those occupying themselves with this question have only to imitate the Chinese, who obtain from it tissues as fine as cambric.

The Colonial botanist who reports on the experimental culture at Jamaica, states that the weight of the unprepared dry fibre, taken from a measured portion, was at the rate of 300 pounds per acre at each cutting, of which five are yielded annually there, making thus an aggregate of about three-quarters of a ton per acre per annum, or about 10 cwt. of prepared fibre per acre.

This plant, he observes, as in other countries, will be found to thrive best where there is considerable moisture, either in soil or climate, and particularly at the foot of hills, and in ravines and gullies, where showers are frequent and the land well drained. In more dry localities, manure well decomposed must be resorted to, to secure rapid and perpetual growth. When cultivated in a field of any extent, I would recommend the plants to be planted in rows of 4 feet apart, and 18 inches or 2 feet in the row. This would be found a distance sufficient for the development of the plant and production of good fibre. The second year the plants would cover the surface and keep down the weeds. The quantity of fibre per acre produced in the East is stated to be 12 maunds, or 984 lbs., and this, too, it must be borne in mind, without the application of science in tilling the ground. Indeed, the plant seems to grow so freely as to be within the scope of any one's ability to grow it to perfection.

Although the fibre of this plant is the strongest and most valuable known, from the peculiar growing character of the stem, it has hitherto been found impossible to separate it from the skin in the same manner as flax, hemp, and jute, &c., by water-retting. It is therefore necessary that the outer bark of the stem while in a green state should be scraped away from the underlying fibre. By this means its great strength, silky lustre, and whiteness are preserved. Chemical steeping injures the strength and brilliancy of the fibre.

The Indian Government have been very energetic in endeavouring to stimulate mechanical enterprise and invention in this direction. A few years ago they offered a reward of £5,000 for a machine which would clean the stems at a cost of £15 per ton, so as to enable the prepared fibre to be sold in the European market at £50 per ton. Some machines were submitted, but there is still much to be done to render them extensively and practically useful. One of the most promising tried appeared to be that of Messrs. D. and J. Greig, Edinburgh. Its principle may be thus explained:—A quantity of the stems are laid on an endless travelling web, or feed-table, by which they enter the machine between a series of fluted iron rollers, which break the inside cores in short pieces and flatten the green skin, where the fibre lies underneath an outer coating of tenacious mucilaginous vegetable substance. In order to clean the stems by mechanical process, they must be scraped by knives having a rapid circular motion, and while being scraped the skins must be firmly held. In consequence of the scrapers rotating, and the rollers which hold them being circular, there must be a portion of the length of the stems left untouched, representing the distance between the centres of the scraping cylinders and the centres of the gripping rollers. Herein consists the novelty of this invention. The small ends as they pass down are cleaned, and immediately drawn by a simple contrivance between a pair of elastic catch-rollers, whence they are thrown out on the delivery web. The moment the crushing-rollers let go the last portion or thick ends of the stalks (seven inches of which are still to scrape), the latter are thrown down (by the momentum given to them by the upper scraping cylinders and by their own weight) between another pair of scraping cylinders, which complete the cleaning of the whole length of the stalks, and this is done while the fibre is still held firm and travelling out of the machine by the delivery web.

Mr. Fortune, in his "Three Years' Wanderings in China," observes that, "There is a species of *Urtica* (nettle), both wild and cultivated, which grows about three or four feet in height, and produces a strong fibre in the bark, which is prepared by the natives, and sold for the purpose of making ropes or cables." But this allusion by Mr. Fortune to a fibre prepared from a species of the nettle tribe is interesting in another point of view, because it assists in confirming an opinion expressed by Dr. Roxburgh more than 40 years previous, and which opinion was based on information received from a friend, a resident in Canton, that the grass cloth of China is made from the same plant that yields the fibre called calooe by Marsden, in his "History of Sumatra." Now this calooe is also made from a shrubby species of nettle, to which Dr. Roxburgh has given the specific name of *tenacissima*, because of the great strength of its fibre, the strongest indeed, with one exception, of all the vegetable fibres (European hemp included), which he subjected to experiment. And while he thus bears witness to the strength of the fibre, he speaks also most favourably of its beauty, softness, and fineness. He found, however, some difficulty in preparing it, and was obliged to adopt a different process to that recommended by Marsden. The plant was first introduced into the Botanic Garden at Calcutta by Mr. Ewer, the Governor of Bencoolen, of which place it is also a native; it is likewise found in all parts of the Malayan Archipelago. So readily does the plant grow there that Dr. Roxburgh was enabled in one year to rear above 1,000 from the four received from Dr. Ewer. He says it is as readily cultivated as the willow from cuttings, throwing up numerous shoots as they are cut down for the fibres of their bark, which may be done three or four (rarely five) times every year, if the soil is good, and care taken of the plants. Dr. Roxburgh obtained a further supply of these plants from a friend at Pinang, where it is known by the name of ramie. The Malays, he observes, use the bark for sewing thread and twine, and for making fishing nets, "but the quantity is so small that they require for these purposes, that they have not had recourse to any particular mode of stripping or cleansing it; they merely steep the shoots in water for 10 or 12 days, and then pull off the bark and dry it in the sun. I have heard that the thread is injured by salt water, but I do not think that the account I have had of the circumstance is to be depended on, and certainly, from the nature of the plant, the facility with which it appears it may be cultivated to any extent, the great strength of the fibre, and the threatened scarcity of ropes for the use of the navy, it is worth while making experiments on it." Colonel Low, in his "Dissertation on Pinang and Province Wellesley," published 30 years after the above remarks were penned, alludes to the same plant, and by the same name (ra-me ra-me), as yielding a sort of hemp, and used for the same purposes; and he observes that it might be easily manufactured into the linen which in China is called grass cloth. "The Chinese here (he adds) call the plant cho, and allege that it is the same as that which grows in China, where it is used for making the cloth just mentioned."

Mr. Crawfurd, in his "History of the Indian Archipelago," speaks of the same plant:—"The Ramie (*Ramium majus*, Rumphius) is a species of *Urtica*, or nettle, growing to the height of five or six feet. This plant is everywhere an object of culture, for from the bark of the stem is obtained the material of an excellent cordage, used by the Indian islanders for almost every purpose for which we use hemp, but particularly for the manufacture of fishing-nets. It is very generally recognised by one name (*Ramie*) throughout the Archipelago."—(Vol. i., p. 442.)

The same description of nettle is indigenous to the Philippines, as we learn from a work in the Spanish language, compiled by Father Manuel Blanco, and published at Manilla, under the title of "Flora do Filipinas."

As the writer likewise alludes to the circumstance of the plant being supposed to be the same that yields the grass-cloth of China, I think it as well to give the following translation from his work:—

"This plant is common in the northern part of the Isle of Luzon, and in the Batan islands, attaining the height of one yard or more. The prepared bark is spun into thread and woven into cloth. From it is made, it is said, the celebrated linens of Canton. Of this I have been assured by many persons. But when in the north of the Island of Ilocos, I learnt respecting the cloth of the Batan Islands that it is made from a plant named *labuis* or *lapuis*. As I have often noticed a singular and unexpected coincidence in the names of plants, even of remote countries, I was led to suspect that the plant employed for the above-named fabric must be the *napæa*, called also *lapuis*, and not the *Urtica nivea* (*U. tenacissima*, Roxburgh). It remains for further investigation to solve this doubt."

It also appears that the plant grows abundantly in the Shan States. Colonel Burney, when resident at Ava, sent a quantity of the fibre to the Agri-Horticultural Society of Calcutta, and mentioned that the Shans used this material in manufacturing every species of cordage, and weaving a stout kind of cloth, of which they make bags. It is called *Pan* by these people. This information has since been fully confirmed by a traveller in that country, Mr. Sanders, who met with an untimely death in the neighbourhood of Zimmie. That gentleman stated that, though the Shans possess several other fibre-yielding plants, they neglect them entirely in favour of this particular one, which, in consequence of its great strength, they employ for every purpose. He moreover mentions that it can be, and is frequently, converted by them into the finest sewing thread, and for other domestic uses. If the plant is not indigenous to the Tenasserim Provinces, its introduction there from the Shan States is well worthy of attention. That it is common to Assam (where it is known as the *Rheea*) we have the authority of Major Jenkins, who communicated the circumstance many years ago to the Agri-Horticultural Society of Calcutta, and forwarded the specimens at the same time. From that officer's letter, published in the third vol. of the "Transactions" of that Society, I find that it requires a very limited degree of cultivation in that province, where it occupies highlands of little or no value. But coming more to the westward and nearer the Bengal Presidency, we learn from Buchanan's "Statistics of Dinajepore," that this nettle is cultivated in that district, where the bark is used to make a kind of hemp for fishermen's nets, and, being one of the strongest materials that can be procured, it is also used in making rope for tracking boats. Buchanan adds that the native name is *Koonkhura*, and that he has not seen it anywhere else except in this district; but Roxburgh states that it is also cultivated in Rungpore, where it goes by the same name; from which it is not improbable that the plant is to be met with in other parts of the northern and eastern districts of Bengal. Assuming therefore this nettle to be the plant yielding the fibre from which the China grass-cloth is manufactured, it will be observed that we have in our Eastern possessions the means of providing the raw material very largely for export, should there be any great demand for it on the part of English manufacturers.

THE RESOURCES OF PERSIA.

The remarks made by Consul-General Jones, the British representative at Tabreez, possess especial interest at the present moment, under the circumstances of the recent visit of the Shah, and the attempted development of the resources of Persia. During the Crimean war the East, in a great degree, engaged the attention of Europe; and when peace was re-established between Russia and the Porte, many European houses, chiefly Greek, had already made arrangements to take part in the Persian trade. At the present time, British commerce is represented there by three firms, having their head-quarters at Manchester. The chiefs of these houses are naturalised British subjects; their agents and *employés* in Persia have invariably been foreigners, for the most part Greeks or Germans. Obstacles and drawbacks have continually occurred to impede the development of European trade in this country. Those which were apparently insurmountable, and which no forethought could guard against, were the successive failures of the silk crops in Ghilan from 1863 up to the present time; the increased price of cotton goods, consequent on the civil war in the United States; and the visitations of cholera and famine which have so frequently devastated the country, but more especially during the last three years. It is at all times difficult to obtain even an approximate estimate of the real value of the Persian trade, from the following causes:—The natural disinclination of those who farm the customs revenues to publish the annual amount of their gains; the practice of keeping count merely of the number of horse-loads of each article entered, without stating the intrinsic or declared value of the same; and the extended contraband trade which is carried on with the adjacent provinces of Russia and Turkey. It appears that, as early as the year 1849, Mr. Consul Stevens called the attention of the Manchester Commercial Association to the inferior quality of the British cotton goods exported to Persia, and represented that unless the manufacturers discontinued supplying such, British prints would gradually fall into disuse, and be superseded by the fabrics of the country. Since this complaint was made the quality of these fabrics has in no way improved, and the same causes are still in force to produce inferior articles; cheapness is above all the characteristic which finds favour with Persian customers, and to this they are prepared to sacrifice every other consideration. With regard to the exports of Persian products, there can be no doubt that, with improved means of transport, a very extensive trade might be carried on. At the present time, owing to the expense of carriage, the neighbouring provinces of Turkey and Russia offer the only outlet where the produce of the country can be profitably disposed of. According to the returns of the Customhouse at Tabreez, silk, tobacco, shawls, carpets, dried leather, galls, safflower, tallow, orpiment, wax, and dried fruits form the chief exports to Turkey. To Georgia are sent British calicoes, dyed in Persia, carpets, silks, drugs and dyes, fox and martin skins, dried fruits, and whatever cotton is produced in the province; besides which a considerable traffic is carried on in horses, sheep, and black cattle by the wandering tribes in the frontier. The chief cause of the inelastic nature of the Persian trade is, undoubtedly, the want of staple exports. On this account the heavy balance against Persia must be paid in specie, and the country is thus becoming rapidly drained of money in every form. The distances to be traversed are so great, and the mode of transport so tardy and expensive, that, with the exception of silk, few Persian products can be profitably placed in European markets. It is only in the neighbourhood of the chief towns, or the caravan road, that the peasantry grow more corn than is absolutely necessary for their own consumption; and it not unfrequently happens that, in exceptionally fruitful seasons, the proprietor only reaps what he requires for the wants of his household, and allows his cattle to feed on the remainder, as he can find no market for the surplus crops. What is even of higher necessity in this arid land, so frequently devastated by famine succeeding drought, is a more copious water supply, and a more economical system of irrigation. The traveller in Persia sees on all sides the remains of the canals which formerly irrigated the land, once so fertile and well peopled, now so barren and desolate. The restoration of these water-courses would speedily change the face of the country, as, wherever water is present in Persia, the soil, apparently so sterile, becomes all at once covered with the most exuberant vegetation.

To increase the foreign trade of this country it is first of all necessary that the welfare and prosperity of the people should be attended to, and no measure would be succeeded by more immediately profitable results than the matter of irrigation. The Persian, like the Arab, is by nature a trader, and from the earliest times this class has been held in high honour in the East, and favoured with many privileges. The shifty and tricky character which the native trader bears seems more characteristic of the resident Turk than of the real Persian; neither, however, have been slow to learn from the example of Europeans—many holding high and responsible positions in the country—how to defraud their creditors with impunity. Bad faith and venality so pervade all classes of Government officials, that merchants would rather forfeit their claims than seek the assistance of the local authorities to enforce them. Both these causes tend to check enterprise on the part of the European merchants, few of whom extend the sphere of their operations beyond Tabreez, where they confine themselves to the wholesale sale of the goods they import, receiving the value in specie or in silk from the Caspian provinces. No European trader is to be found except in those cities where a consul resides, namely, Tabreez, Tehran, Resht, and Bushire. All Persians concerned in the advancement of their country have to struggle against the opposition of a bigoted, interested, and powerful faction. Whether it be the improvement of the currency, the importation of grain, or the introduction of European capital for local improvements, it is sure to meet with the organised opposition of a certain class, supported generally by the priesthood, who foresee that the contemplated measures will curtail indirectly their peculations for the future. The prospects of the country at present were hopeful. The chiefs of the present administration, warned by the terrible mortality which followed three consecutive years of famine and pestilence, have at length turned their attention towards improving the means of communication between the different provinces of the kingdom, and providing a more abundant supply of water. Casting aside the timid and jealous prejudices which have hitherto characterised every measure emanating from the Persian Court, they have accepted the assistance of European capitalists, and consented to allow the country to be served by the hands of strangers.

OBITUARY.

Sir Francis Ronalds.—The death of Sir Francis Ronalds, at Battle, in Sussex, has just been announced. If not the first inventor, he must at least be allowed the credit of having been one of the earliest to put an electric telegraph into actual operation, for in 1816 he had in his garden near London some eight miles of wire suspended on poles, through which a current could be sent so as to signal by means of pith balls suspended before a figured dial-plate. It was, however, only frictional electricity which he employed, the high tension of which of course presented considerable difficulties in the working; and it was not till the discoveries of Oersted, Faraday, and others, with regard to galvanic electricity and its influence upon the magnetic needle were brought out, that Cooke and Wheatstone were able to develope the electric telegraph into a commercial undertaking. It was in 1870 that Sir Francis was made a knight, a similar honour having been previously conferred on Sir Wm. F. Cooke and Sir Charles Wheatstone. Sir F. Ronalds superintended for a short time the Meteorological Observatory at Kew on behalf of the British Association, and the Government conferred upon him a small pension for his services to science. Lately he was engaged in preparing a catalogue of the published books and papers on electrical science. It is understood that by his death the Royal Society, of which he was a Fellow, will come into possession of the finest collection of electrical works in England, as he some time since expressed his intention of leaving his books to that institution. Sir Francis was in his 86th year when he died.

GENERAL NOTES.

City Companies and Education.—The *School Board Chronicle* is informed that the Fishmongers' and some of the other City Companies are considering the question of offering sums of money to the London School Board, wherewith to found scholarships in connection with the Board schools.

Krupp's Steel Works.—The celebrated steel works of Krupp, of Essen, in Rhenish Prussia, have recently been insured against risk from fire, and some idea of their importance may be formed, when it is stated that they were insured for a value of not less than 6,561,330 thalers (about one million sterling). This, of course, only represents the value of that part of his works that would be liable to fire, and does not include the foundry, or value of tramways, telegraphs, and stores of metal. The policies are held by 12 different German insurance companies.

Paper from Hops.—A discovery has been made, says the *Garden*, by a French firm of paper manufacturers, which seems likely to interest English hop-growers. At the last general assembly of French paper-makers, MM. Jourdeuil, Parizot, and Gusseo submitted some samples of a new textile fabric, namely, the sheath of the hop-stalk. By removing this outer skin, and subjecting it to a certain chemical process, a textile substance possessing qualities which make rags so valuable in paper-making—length, suppleness, and delicacy of texture—has been produced. The invention has been patented.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

GENERAL EXAMINATIONS.

The Programme for next year is in preparation, and will shortly be published. The subjects will remain the same as at the last Examination.

With reference to the suggestions made at the Conference, the Council have decided as follows:—

1. They do not see sufficient reason for restoring the subject of Latin.

2. The rule which prevents a candidate who has once obtained a first-class certificate in a subject from being again examined in that subject with a view to gaining a prize, has, in accordance with the wish expressed at the Conference, been rescinded. In future, therefore, a candidate who has obtained a first-class certificate in a subject may be again examined in that subject, but not more than one first-class certificate in any subject will be counted for the Prince Consort's prize, and no candidate will be entitled to take a prize of the same grade twice in any subject.

TECHNOLOGICAL EXAMINATIONS.

The subjects in which examinations were held this year, namely, Cotton Manufacture, Paper Manufacture, Silk Manufacture, Steel Manufacture, and Carriage-building, will be retained in the Examinations of next year, with the addition of Cloth Manufacture, Glass-making, Pottery and Porcelain, and the Manufacture of Gas.

The Programme is in preparation, and will be published as soon as possible.

HALL-MARKING OF JEWELLERY.—PRIZE FOR ESSAYS.

1. It having been brought to the knowledge of the Council of the Society of Arts that what is termed "Hall-marking" of jewellery and articles of gold and silver, is inadequate to secure to the public that protection in the quality of the materials for which it is intended, they have accepted the offer of one of the members, Mr. Edwin W. Streeter, to place £25 at their disposal, to be awarded as a prize for an Essay treating on this subject, with suggestions for an improved system.

2. The Essays must be sent in not later than the 1st of November, 1873, marked with a motto, or cypher only, accompanied by a sealed letter, with the corresponding motto or cypher marked outside, giving within the name and address of the writer of the Essay.

3. Brevity will be considered a merit.

4. The Council shall have the right of publishing the prize Essay in the *Journal*, and they reserve the right of withholding the prize altogether, or of awarding a lesser sum, if the judges shall so recommend.

P. Le Neve Foster, *Secretary.*

SIR JOSEPH WHITWORTH'S PRIZES FOR THRIFT ESSAYS.

Sir Joseph Whitworth has offered prizes of the value of one hundred pounds, to be awarded by the Society of Arts, for the best Essays on the "Advantages that would be likely to arise if railway companies and limited companies generally were each to establish a savings-bank for the working classes in their employ." With this offer he has transmitted the following observations:—

1. Is not a good rate of interest, with perfect security, more likely to promote the habit of saving than any other plan that can be devised?

2. Sir Joseph Whitworth suggests that the interest to be paid on the deposits should be the same as the dividend, with a guarantee that it shall not be less than 4 per cent.

3. By paying the same rate of interest as the dividend earned, there is a bond of union established between labour and capital.

4. An Act of Parliament might make the deposits of the industrial classes the first charge on the estate.

5. The proprietor of a private establishment, whose profits are not made known, might undertake to pay, say 7 or 8 per cent. when the profits reached that amount or more, the proprietor giving an undertaking to pay not less than 4 per cent.

6. In the case of Agriculture, each county might have its savings-bank for the savings of both men and women in the said county, and the interest to be paid might be 6 or 7 per cent.

7. To do this there might be a rate collected along with the poor-rate, to be called the interest or industrial rate.

8. As this rate increased, no doubt the poor-rate would diminish, and if the habit of saving became general among the labouring classes, there would probably be great gain to the property-owning classes, considering the great variety of ways in which they have now to contribute for the support of the unfortunate who now make no provision for themselves.

9. In order to realise what might be the probable saving to those who encourage the savings-banks thus suggested, Sir Joseph Whitworth points

to the list of charities, also institutions, such as infirmaries, hospitals, union-houses, prisons, police, &c., &c.

10. In any establishment, if only one-third of those employed deposited savings, they would have immense influence over the other two-thirds of their fellow-workmen.

11. Men who spend all their earnings are generally reckless, and become the dupes of agitators; but the man who has put by some of his earnings will be likely to exercise forethought, and will not be led away by others.

12. In South Wales is it likely there would have been the late turn-out, if the different establishments had each had such a savings-bank as that proposed?

13. In the case of a man or woman falling into distress from causes beyond their control, what better proof could be given that they were deserving of sympathy and assistance from their friends, than the fact that they had put by savings at a time when they were able to do so? The rule of action should be to do as little as possible for those who do as little as possible for themselves.

14. Some of the points to be considered by the essayists will be the amount to which the savings shall be limited, and when the depositor wishes to withdraw the whole or any part of the sum deposited, what notice shall be given.

15. The co-operative system is no doubt effecting much good, but if the system here sketched out were adopted, the greatest good, in the shortest time possible, might be effected.

To the above observations Sir Joseph Whitworth has added the following:—

I think it will be admitted as desirable that one-third of the period of man's existence should, if possible, be spent free from the necessity of labour and toil.

The middle period of life is, therefore, the time when man's energies should be put forth, and the greatest amount of work should be done that strict obedience to the laws of health will permit. The experience of industrious men goes to prove that the most pleasurable existence is insured by following this course.

It is therefore wrong, in every sense, for the Amalgamated Engineers and other Trades Unions to combine and endeavour to compel young and middle-aged men, in the prime of life, to limit and reduce their hours of labour to the extent now being attempted, and thus prevent them from saving so much, and laying it by for that period of life when man's energies begin to fail, when work becomes irksome, and when rest is necessary in order to pass a comfortable existence. May not the case between the industrious working man who saves part of his earnings, and the man who is reckless and will not save part of his earnings, be fairly stated thus:—

That the man who does not save when he is in health and strength, robs the man who does save, because the law compels him to support those who have not saved, and to bury them when dead?

The principal subjects which the essayists should consider are the preceding.

After commending these observations of the enlightened and liberal donor to the consideration of the competing essayists, the Council, however, would further call their attention to the liability to frauds of various kinds to which such a system may be subject, such as, for instance, that of colourable investments being made by parties investing, in their own names, moneys not bonâ fide their own; and would impress upon the competitors the importance of suggesting the best means of preventing such abuses.

There will be two prizes, £70 for the best, and £30 for the second best essays. The judges reserve the right of withholding the prizes altogether, or awarding lesser sums.

The following are the conditions to be observed:

1. The essays must be sent to the House of the Society of Arts, Adelphi, London, addressed to the Secretary, on or before 1st December, 1873.

2. They must be delivered either in print or in manuscript. If in manuscript, they should be written distinctly on foolscap paper, on one side of the paper only. Every paragraph must be numbered.

3. They must be sent in sealed, with only a motto or cypher; and a separate letter, also sealed, with the motto or cypher marked outside, must accompany the essay, giving the name and address of the writer.

4. Brevity will be considered as a merit.

5. They may have been published anonymously before being sent in.

6. The Society is to have the right of publishing the two prize essays in its *Journal*.

7. The award of the judges will be final.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The first lecture of the third course of Cantor Lectures for the Session, "On Wines; their Production, Treatment, and Use," was delivered by J. L. W. Thudichum, Esq., M.D., on Monday evening, April 21st, 1873, as follows:—

Lecture I.

Description of the Vineyards of Serez de la Trontera—Geographical and Geological Position—Climate—Varieties of Vines Cultivated, particularly those used for Wine-making—The Vintage of Jerez—Implements and Processes—Fermentation—Vinification.

Note.—The topographical descriptions occurring in this lecture are best appreciated with the aid of the excellent map of the Jerez district, published in 1867 by Don Jorge G. Suter, the English Consul at Jerez, and sold by E. Stanford, Charing-cross.

The land measure, termed the *aranzada*, is equal to 44·72 French ares, and is therefore a little larger than the English acre, which is equal to 40·47 ares.

The measure of length, *vara*, is equal to 0·843 metres, or 2·782 feet English, and is therefore a little shorter than the English yard, which is equal to 0·914 metres.

The *butt* of wine or must (mosto) measures thirty *arrobas*, equal to 106·5 imperial gallons; one arroba is equal to 16·133 litres.

The *real* is equal in value to 2½d. English; four reals, value 10d., are equal to a *pesota*, the Spanish franc; its value is five per cent. higher than that of the French franc.

The *peso* is an imaginary unit of value by which wines are bought and sold. It is equal to 15 reals.

I divided the district into nine parts, radial sections of a circle, of which the town forms the natural centre, and the roads which lead to and from it form the natural radii, and made each of them the object of a special scientific reconnaissance.

1. Balbaina section and group of vineyards, N.W. of Jerez, S.W. of new road to San Lucar, between it and the road to Rota.
2. Corchuelo section, N.N.W. of Jerez, between old and new carriage road to San Lucar.
3. Macharnudo section, N. of Jerez, between the old road to San Lucar and the road to Trebujena.
4. Carrascal section, N.N.E. of Jerez, between Trebujena and Lebrija road.
5. Section of the plain, or north-eastern section between Lebrija road and Arcos road. This section I divided in two parts, one N. of the Seville road, the other between Seville road and Arcos road.
6. Eastern Section, between Arcos road and Hijuela de Pedro Diaz.
7. Monte Alegre section, South of Jerez, between the Hijuela of Pedro Diaz and the Carretera to Puerto, traversed by the road to the Cartuja.
8. Torrox Section, S.S.W. of Jerez, between the carriage-road to Puerto and the bridle-road to the same place.
9. Carrahola Section, W. of Jerez, between the bridle-road to Puerto and carriage-road to Rota.

The territory is entirely of the so-called tertiary period. It consists of undulating hills, with gently-inclined sides accessible to cultivation over their entire surface, and slightly-excavated valleys between them. The hills consist of a sand and clay pervaded chalk-rock, which crops out at their tops, or is easily reached by digging a few feet—sometimes only one foot—into the disintegrated surface. It is mostly white, here and there coloured by some iron oxide, and contains chalk or carbonate of lime, clay, or silicate of alumina (some say also alumina in the free state), magnesia, iron, quartz, and gypsum, or sulphate of lime. The lower parts of the inclines of the hills and the flat valleys between them are covered by alluvial formations of different periods. These are full of clay, and contain much iron oxide and sand, and in many parts pass into mere sand, more or less coloured red by iron-ochre, or white by clay and chalk. These chalk-rocks, clays, and sands give rise to the several descriptions of surface-soil distinguished by the Jerezanos under the denominations of *albariza*, *barros*, *barro-arenas*, or *arenas*, and *bugeo*.

The Albariza, also termed Tierra de Anafes, Tierra blanca ó Tosca, is the white soil of the hills, the disintegrated chalk rock. According to the analysis of Louis Proust (the French chemist, who lived at Madrid from the time of the first revolution to the Napoleonic invasion of Spain) the soil contains from 60 to 70 per cent. of carbonate of lime, a considerable quantity of clay, a little silica, and some magnesia. When the clay and other ingredients disappear or diminish greatly, so that the soil is little more than chalk, it is no longer termed "tosca" by the natives. The coarse mixture of chalk, sand, and clay is more suitable to viticulture than the finer chalk. Its colour is a dead white; its texture fine-grained and rough, with harder nodules, which appear when the mass is left to disintegrate under the influence of sun and water. In that case it breaks up a great deal. When introduced into water it gives out bubbles of air, and falls gradually into a loose pasty mass. When dried again it falls into powder-like particles, and does not cohere in lumps or separate by deep fissures. On the hills it occurs in layers, which have a thickness of several yards, and become thin in other parts, so as almost to disappear. It contains no flints. It is supposed to be an impure chalk, and to repose upon a sandy formation. The greater part of the vineyards of Jerez, San Lucar, and Trebujena, are upon albariza soil. The vineyards of Paxarete contain it in the immediate subsoil. It is here termed "albero." A thousand vines planted on albariza at San Lucar produce about 80 arrobas of mosto; exceptionally in favoured portions of special territory from 110 to 120.

Barros is the name given to quartz sand agglutinated by chalk and clay, and coloured red or yellowish by iron ochre. It forms horizontal layers of great size along the coast, from the mouth of the Guadalquivir to Conil. These banks are traversed in all directions by fissures, filled with almost pure sand. The barros is never so hard that it cannot be disintegrated with the fingers. It is easily washed away by the tide and by rain, and becomes very slippery when wet; but continued rain washes out the chalk and clay, and leaves the stones and sand on the surface. Clemente believes the barros of Jerez to be a small portion of the immense formation of sandy chalk and clay which runs in one uninterrupted course from the shore at San Lucar to Gibraltar. The vines planted upon barros give double the harvests produced by the same number on albariza. Near Jerez, the barros contains many large stones of hard grey chalk, which occur in layers, and are repeated at intervals down to a depth of eighteen feet. It also contains fossil shells, such as ostrea, cardium, pecten, and others, which become so numerous in some parts, *e.g.*, near the Badalejo, as almost to constitute the bulk of the soil. Barros and sand mixed form the soil of the plain to the north and north-east of Jerez (*Tierra barro arenosa*).

Arenas (better, barro-arenas) form the third variety of soil. The pure, nearly white, shifting sand, such as occurs principally near the sea-shore, is only rarely found in the Jerez district, being limited to some localities in the East, towards Cuartillo, and along the road to the Cartuja. This sand admits of being transformed into fruitful gardens and vineyards, as can be seen at San Lucar and Rota. At the latter place particularly I was surprised to see the work and care bestowed upon this mere sand, which has actually to be protected against the wind by frequent small enclosures, ridges, and deep furrows. These gardens are called *nabazos*. On such sand the vine produces as much mosto as on the barros, but its quality is as much inferior to that of the barros vineyards as the latter is inferior to that coming from the albarizas. The commonest arena mosto in these days is sold at about half the price of the albariza mosto.

Bugeo is the greyish black earth which at Jerez and San Lucar occupies the dales between, and lowest slopes of, the hills of albariza. It consists of clay mixed with carbonate of lime and fine sand, and a certain quantity of vegetable mould. During the heat of the summer this soil forms enormous fissures, and this is said to be the cause of its inaptitude for viticulture. But at Jerez, as well as at St. Lucar, there are vineyards on bugeo. They are very fertile, bringing up to six botas per acre, but the wine is said to be coarse.

The albariza vineyards give the finest, cleanest, and strongest mostos, but produce little quantity. The barro-arenoso lands produce twice as much as the albarizas, and are also much easier to work, but their mostos are less fine and thinner. The bugeo vineyards produce as much as the barro arenosas, and give mostos of as much or even more body than the albariza mostos, but they are neither fine nor clean; and the bugeo soil requires much labour, because it becomes quickly covered with weeds, and cracks in a manner dangerous to the roots of the vines.

In the trade of Jerez wines are sometimes distinguished as wines of the pagos de arena, wines of the pagos de barro, and wines of the pagos de afuera. The latter term is not a geognostic distinction at all, as the pagos de afuera have soils of all descriptions, and is not comparative to the other two terms. It simply means pagos which are out of the circle of the city boundaries, and at such a distance that the labourers receive an addition to their wages for distance.

It must, however, be stated that there are few vineyards, and hardly any pagos, in which all the wines stand upon uniform soil; and if a pago is termed of a particular soil, this is to be understood to mean that that soil is the prevailing, not the exclusive soil. There are, further, a few special names for particular mixtures of soil, which I will indicate. Lustrillo is a mixture of white marl and albariza and red barro-arenoso soil, interspersed here and there with strata of chalk, or gypsum. Another kind of earth, produced by the accumulation of old building rubbish, is termed "Tierra de villares," or "Almaduras." The names of "Balejuela," and "Lentejuela," are applied to greatly broken up albariza mixed with a certain material of agricultural improvement or bugeo. "Tajon," the earthy vein in the limestone, and "toxa," the rough earth, are forms of albariza which occur in special strata. There are also stony territories which surprise the proprietors by a curious phenomenon, namely, that the stones have a tendency to come to the surface, of course by the action of the rain. But the proprietors prefer the mysterious to the evident, and believe that these stones are constantly being formed, or being worked upwards by some mysterious power in the earth.

The different soils are planted with varying sets of vines, according to empirical traditions which do not admit of precise exposition. In the albarizas the palomino prevails, and is generally mixed with a certain proportion of perunno, cañocazo, albillo, Pedro Jimenez, and mantuo, which are said to impart to the palomino wine superior qualities. In the Barro-arenose territory the mantuo castellano prevails, mixed with much mollar, beba, and other vines in small numbers; in the sand there is a little tintilla, and much beba. The moscatels and Pedro Jimenez grow best in the black earth or bugeo.

The climate of Jerez is determined by its geographical position between the 36th and 37th degree of north latitude, and under the 6th degree of longitude west of Greenwich.

The summer season is characterised by great heat and long-continued drought, during which most of the vegetation, except vines, olive trees, and pines, comes to a standstill, and most annuals die off. The arable land, the grassy plains, and the dry swamps then look like arid deserts, and are avoided alike by animals and man.

The autumn and winter consist in a rainy season, and frost is never observed. Snow has fallen at Jerez only twice in this century. The first fall occurred in 1819, and no particulars regarding it have come to my knowledge. The second and last fall happened on the 9th of December, 1867. The snow lay on the ground for two days, and destroyed many delicate plants. The autumnal rains are copious, not rarely very much so. Thunderstorms of extraordinary severity appear now and then. The north wind in summer is dry and hot; the west wind refreshing and agreeable. The east wind (Levante) easily becomes a storm, which may continue for days without intermission, and do much damage to all kinds of crops. It is said that the vines are kept low on the ground on account of the danger to which they would be subjected on the part of the Levante if they were raised higher and fastened to poles.

Extent and Position of the Vineyards.

The vineyards are estimated to have a surface of 14,000 aranzadas, or 6,287 hectares. They are grouped round the town of Jerez in a manner which is best appreciated by inspection of the map. The districts to the N. and N.E. of Jerez are perfect plains, whereas those to the N.W., W., S., and S.E. consist of a series of more or less round hills and hillocks, separated by glens and dales. The hills are mostly covered with vines all over, whereas the glens are mostly not stocked with vines, but with fodder plants, or used for growing the strong reeds (cañas) which are employed for making the stakes for young vines, and the fork-like supports for fruit-laden branches, and give their names to the dales themselves (cañadas). Like land everywhere else in Europe, the whole of the cultivated land round Jerez is divided into sections bearing distinctive names, so-called pagos. These pagos, again, consist of several fields or properties; only rarely one entire pago, still more rarely several pagos, also form a single property. The pagos are very unequal in size; many are entirely covered with vineyards.

For a list of the Jerez pagos reference may be made to a brochure on the viticulture and trade of Jerez, by D. Diego Parada y Barreto, which appeared in Jerez in 1868.

The Balbaina Districts.

The district of Balbaina is perhaps the oldest viticultural pago in the neighbourhood of Jerez. It lies in a N.W. direction from Jerez, on both sides of the new road to San Lucar, mainly between that road and the road to Rota. In consists of five great divisions, of which three only belong to the community of Jerez, while two owe municipal allegiance to Puerto. The Jerez Balbaina properly so called lies on the N.W., or right side of the San Lucar road, past San Julian, and includes Candelero and the Llano de las Tablas. It was to this part that my excursion of Sept. 16 was directed. S.W. of it lies the largest part of the district, termed Balbaina alta, to distinguish it from the contiguous Balbaina baja, of the Puerto vineyards. Farther to the N.W., also on the left of the road to San Lucar, is the pago of los Cuadrados, with the contiguous Balbaina of Puerto properly so called.

Balbaina with Balbaina alta and including the Puerto Balbainas, comprises more than twelve hundred aranzadas of vineyards. Its soil is albariza and bugeo; its vines are palomino, perrunno, cañocazo, albillo, Pedro Jimenez, and mantuo, and its mostos are held in great esteem. The most reputed vineyards are the Cañas, la Campanilla, del Arcon, and del Sargento mayor. The Jerez monks once held a great part of this district, and a particular plantation they termed the vineyard of God. Candelero, which is contiguous to Balbaina towards San Julian, is a pago of about eighty aranzadas, in the valley which bears its name. The soil is for the greater part bugeo, and its vines palominos. A special vineyard in the pago also bears its name. North-west of Balbaina, and bordering upon the Cañas, is the Llano de las Tablas, a pago of forty aranzadas, bordering in the north upon Marihernandez.

Just across the San Lucar road is Balbaina alta, a vast expanse of green hills and dales. The first sub-pago nearest to Jerez is Sida, a pago of forty aranzadas, with albariza soil, planted with palomino and Pedro Jimenez. Noted vineyard, la Miranda. Sida derives its name from that of an old Jerez family. Farther on is the Cañada de Huerta, a pago with bugeo soil, and palomino vines. It borders upon the Gallega group of pagos, and upon the Rincones, a pago with albariza, bugeo, and lustrillo soil, and palomino stock. At the southern end of Balbaina alta, and close to and at the right of the road to Rota, is the pago Cruz de Husillo.

At the north-west end of Balbaina alta, and opposite los Cuadrados, we find the pago of Plantalina, forty aranzadas of bugeo and lustrillo soil, with palomino prevailing. Far to the north-west is the pago of los Cuadrados, two hundred aranzadas, with albariza and bugeo soil. The palomino reigns. A noted vineyard is la Soledad. Close by is the pago of las Peonias, with a good vineyard of the same name.

In this neighbourhood I observed a beautiful plantation of albillos. These vines are not ordinarily kept on separate plots of ground, like the palominos, or Pedro Jimenezes, but grown interspersed in uncertain numbers with the prevailing varieties. The Albillo castellano ought to be particularly good for wine making, as will appear from the following description. It is a slender vine, with many canes, lying on the ground, of a silver-grey reddish colour, small palmate leaves, with heart-shaped sinuses, green, but a little reddish when first developed, falling late; the bunches are pyramidal, of middle size; no side bunch; stalk very short; does not shed unripe berries. The ripe berries are very sweet and juicy, and are easily emptied of their contents. The juiciness of the grapes is their most striking characteristic. Clemente says that each bunch may be considered as a bagful of mosto. The ants are great friends of these grapes. Mosto weighed 11 and 12 B. on September 15th and 19th. It readily passes into wine of the quality called fino, but is less good for olorosos, and rarely produces amontillados.

There are two other varieties of albillo, which are less frequently planted in the Jerez vineyards than the former, they are:—

Albillo pardo, also termed *Uva pardilla*, has leaves which are more rough than those of the other varieties of albillo, its grapes are of a yellowish-green, light colour, less mild, and taste more sour, than that of the other albillos, but capable of yielding finos.

Albillo negro. Not frequently planted. Differs from the white albillo by the black colour of its grapes, its thinner husks, and larger bunches. Its canes are also lighter, and the leaves less incised and almost entire.

I also observed some Jaenes, vines which may be supposed to bear their names from a more northern province of Spain.

Jaen negro. Stock of middling size, with many short, greyish-red canes, small leaves of lively yellowish-green colour. They bear many dense bunches of medium size, round, blackish-red grapes, with hard skins, though fleshy. Mosto weighs 11 to 12 B. *Jaen blanco*, also termed *Garilla*, is analogous to the former, but its grapes are white.

I obtained some instruction on the means generally adopted for forming new plantations, and on the modes of working established vineyards, which I embodied in the following notes:—

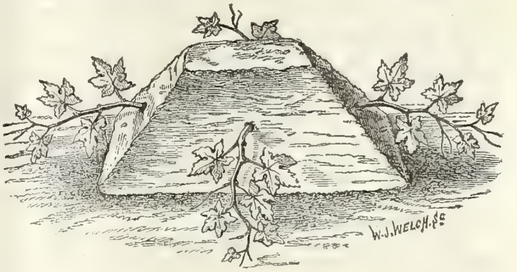
New Plantations, Young Vineyards, Majuelos.

The soil is mostly prepared by deep digging, trenches being drawn, and the top earth filled in while the deep soil is brought up. These turnings are more than a vara in depth. They are generally effected in July or August, and if the soil turned up be lumpy, it is left to the atmosphere for a year without any plantation. The young vines are produced mostly from canes, rarely from rooted vines prepared in a nursery. Their distance from each other is from a vara and a half to two varas in every sense, so that each vine has a surface of four square varas allotted to it. This large extent of surface is necessitated by the peculiar mode of turning and working the earth, to be described hereafter. The canes to be planted are a vara in length, and are sunk into the ground in three different methods. Either a hole a vara in depth is dug for each, and after insertion of the cane, filled up (*plantacion por hoyes*); or the vineyard is traversed by ditches, which, after the canes have been laid in, are filled up (*plantacion por cajones*). The last form is that which employs iron bars for making narrow holes in the ground, in which the canes are inserted (*plantacion por barras*). During the early years the young vines are kept surrounded by hollows so as to catch all available water. In the second and third year they receive a support in the shape of a caña or strong reed, and begin to show fruit. They are then cut in a manner to establish the permanent four-armed stocks, and in the eighth year they begin to bear rich harvests. But it is not until the 15th or 20th year of their growth that they produce the best wines. Up to that time these plantations are termed majuelos, only with the 18th to 20th year they reach their majority, and then are termed viñas.

The growth of young vines is very vigorous indeed, particularly in rainy seasons. The first shoots are very long and thick. In dry seasons they come to an early standstill, and many die. Such partial losses in young, and also in old vineyards, are mostly re-placed by layers, so-called *mugrones*.

A single layer is made in the ordinary manner, described on pp. 61 and 62 of Thudichum and Dupré's Treatise, if the object is to produce a single new vine from an old one. The burying is very deep, and the point of the cane projects in the bottom of a deep excavation, intended to collect as much water as possible, and to allow the new cane to be gradually covered up by earth, so that it may have a deep footing.

But when several layers are required from one vine, the latter is buried in a pyramidal hill of earth, termed "voga." Its four arms are allowed to project, and to grow from the four inclined sides of this hill, and all fruit is suppressed. The canes now grow much more vigorously, because they are fed by the stock itself, as well as by the numerous new roots which they develop in the voga. They may therefore be laid down in the winter following their growth, and in that case are only detached from the mother-stock in the winter following their growth; or they, or some of them, may be detached entirely in the first winter and used as rooted plants. After the largest have been detached, the vine is disinterred, and again puts out new branches.



Annual Labour in Vineyards.

The labours are all performed by men, and on no single occasion have I observed women or children to be employed, even in vintage time and for light work. The working day lasts from sun-rise to sun-set, but is interrupted by two periods allotted for meals and repose. For breakfast, one hour is given; and for dinner and siesta, two hours. The labourers are paid for the day, and I have not learned that there are any who work by piece and contract. They receive the wages mentioned below, and four or five cigarettes a-day. During the time of active labour, particularly poda, chata, cava bien, and vintage, the men stay in the vineyards; they mess together, and their food, consisting mainly of arranque, is prepared for them by the common cook or housekeeper (*casero*). In cold weather they sit, during the time of meals and repose, around a great bonfire of vine and reed canes, which is lighted in a pit of masonry specially arranged for that purpose in one of the sheds of the vineyard. The smoke escapes through a long slit in the highest part of the roof. The labours which are successively performed upon the vines and vineyards are the following:—

Poda.—The pruning, or cutting back of the vine, to maintain its shape and fertility, is performed during October, November, and December. Some viticulturists work the earth before, some after, the poda.

Alumbra, or Chata, consists in digging and dressing the land in such a manner that there is a large square basin round each vine, which may catch the rain-water. As the vines are from 1·5 to 1·8 metres apart, in every sense these basins are more than a square metre in width, and one-third of a metre deep. This work begins in October. When the digging is not so much a formation of basins, in case the rains were early and copious, as a stirring, it it is termed "chata."

Hechar Mugrones is the work of making layers.

Reposicion de Marras, to replace dead vines.

Deserpia is the removal of suckers projected by the roots.

Desbragar (desbarbar) is the taking off of the highest roots, day or dew roots, which, particularly in young plants, become exposed by the chata.

Cava bien is the great digging and refilling of the holes (cierra) made by the chata. This is performed in February, after the rains are over, and before the new growth starts.

Castra is the operation of taking off all superfluous shoots and buds previous to and immediately after blossom-time.

Golpe lleno is a digging of the ground after the grape is formed, and before the branches of the vines have become entangled with each other, sometimes even as early as the end of April or beginning of May.

Levantar varas is the operation of supporting branches after the grapes have begun to get heavy, by little forks made of canes or wood. These supports are not higher than the stocks of the vine, and, consequently, the branches are kept in a horizontal position.

Vina is a light digging of the surface of the land, performed in the latter part of June, to destroy the weeds.

Recastra is the second removal of superfluous shoots.

Revina is another hoeing at the end of July, to remove weeds (also termed *aschalado*).

In August the vineyards become covered with the correguela, or running weed, a kind of convolvulus, whose roots grow very deep in the ground, and run quickly through great distances, reproducing the plant at the surface with great rapidity. Another common weed is the castanuela, a kind of cyperus. The removal of these weeds in August is termed agostar.

The vineyard from this time is left to itself, protected by watchmen, until the vintage.

Vendimia, the vintage, begins on the 7th or 8th of September, mostly with great regularity, in the best situations. It lasts until the 18th or 20th when regular, when interrupted by rain it may last till the end of the month. Generally it is a most rapid operation.

The vintagers (vendimiadores) receive three pesetas a day in money, and have a sleeping room, and mats of rushes (enea) provided for them. The pressers (pisadores), receive also three pesetas per day, and, in addition, for each bota of mosto pressed one peseta and half a bottle of wine; once during the entire vendimia each pisador gets a basketful of grapes (*un capache de uvas*) or five reals instead.

The removal of the mosto, or wine, from the vineyard to the bodega in Jerez costs for each bota about thirty reals for all distances below and up to one league. Above one league the cost is forty reals per bota. When the removal is by mules the vehicles used are carros, when by oxen, carretas. I have also seen mules laden with a bota full of mosto each, and believe the practice to be cruel and dangerous, and happily rare.

The day's work of a man is called peonada. The price paid for the peonada of each kind varies according to years, weather, and the labour market. In bad years and during bad weather, the day's labour is less valuable, and therefore paid less highly than in good years and fine weather. I witnessed a strike for higher wages in a vineyard at an approaching rain. The capataz defied the men, and the rain passed off. In 1865 labour was so dear that the chata, which ordinarily costs 14 reals per day per man, actually had to be paid as high as 38 reals.

A proprietor of a large well-kept albariza vineyard calculated the cost of his labour per annum, including vintage, to be from £15 to £16 per aranzada, or on the whole one-twelfth of the amount of capital sunk in the vineyard. A generally-accepted estimate brings the cost of labour to one real per vine per year.

Manuring is never employed, partly because it is not frequently necessary, partly because the proprietors believe it to be injurious to the grapes. It is difficult to understand this, but the fact remains, that in albariza vineyards, which have been uninterruptedly planted with vines for 300 years, as shown by documents of tenure, no manure is ever employed. In such vineyards there are, however, barren and bald places, which baffle all attempts to replant the vine. They may possibly be chemically exhausted, and here manure should be tried. It is probable that the system of catching the rain-water may act as chemical manuring, for it cannot be doubted that the heavy rains of winter bring much of the constituents of sea-water from the near Atlantic, and in this a portion at least of the salts required by the vine.

Nowhere in this district have I seen vineyards cultivated by the plough, but all labours were done by the arms of men. On the whole, the labours upon the ground are the most serious of any which I have witnessed anywhere. But they seemed out of proportion to the more scientific care bestowed upon the vine, and the ripening grape in particular seemed to me mostly neglected in an unaccountable manner. The consideration occurred to me that the bounty of nature is here so great that man has no necessity for husbanding the produce, but if he loses a fourth or a third part of it he can, with the remainder, still make up a profitable account.

Productiveness of Vineyards.

Albariza legitima is believed to produce, on an average, from 1½ to 2 botas per arranzada. The dark and arenas soil produce much more, namely, four or five botas, but the must is coarse. This depends mainly upon the quality of the vines, which, for the lower lands, are chosen from the richest bearers. It was stated to me that the arenas grapes commanded a uniform low price, and that therefore an agriculturist would do better to grow quantity rather than to grow fine vines, unless indeed he did not sell his grapes but his wine. The best parts of a Balbaina vineyard give from 10 to 11 botas per aranzada, such as the slope which runs to the top of the hill. Other pieces at bottom give only a half to one butt, and some parts give nothing.

Competent estimates bring the average production of all kinds of soil to three botas per aranzada, or ninety arrobas for every 2,000 vines. If we assume the entire area of the vineyards of Jerez as 14,000 aranzadas, and of these 12,000 to be in bearing, there would be an average annual production of 36,000 botas, or 1,080,000 arrobas of mosto. The average price of mosto may be assumed as 75 pesos, or 1,100 reals per bota, and the value of all the vintages is therefore about 40 millions of reals. Now, as the 14,000 aranzadas all require labour at the rate above detailed (though only 12,000 return at the time), and as the wages for this labour, paid to a population of more than 10,000 men, amount to between 20 and 30 millions of reals, the interest and profit annually reaped by the proprietors of the Jerez vineyards amount to from 10 to 20 millions of reals.

Prices of Vineyards.

The usual price for average good vineyards per aranzada is from 15 to 18,000 reals—say 150 to 180 guineas. If the albariza were less absolute, and the vineyard were to enclose places with dark earth, its price would be less. Old vineyards fetch higher prices than young plantations. Young vineyards do not reach first-class value before the twentieth year. The grapes of young vineyards are mostly worked up into vino de color, or into dulce. Some vineyards increase so much in price, that an example which cost 7,000 reals per aranzada in 1833, in 1871 had a value of 37,000 reals.

But this is exceptional. A large vineyard of 80 aranzadas was a few years ago sold for about £16,000. It had been established only about twelve years, and is believed to have been sold at a loss, although by otherwise firm hands. Most vineyard property around Jerez some years ago had risen to very high prices, but the last few years have depressed all prices greatly. This is due to political circumstances, and also to the fact that proprietors have ceased to take personal interest in their vineyards. Consequently returns diminish, and the satisfaction of personal success disappears. While twenty or thirty years ago every proprietor (not always resident in his vineyard) would go to the vineyard during the entire vintage time; now-a-days none superintend their vintages, and the consequence is everywhere visible in dilapidation, deterioration, and neglect.

Second class vineyards are sold at 8,000 reals per aranzada. The total value of the vineyards of Jerez is estimated at 210 millions of reals.

In 1819, the barro-arena vineyards were held in greater value than the albarizas. An aranzada of vineyard in the pagos of Carrascal or Macharnudo, which have the greatest fame now-a-days, was then not much more than from 3,000 to 4,000 reals, while an aranzada of vineyard in Toleze, San Antonio, or Peliron, fetched 7,000 reals and more. It is not by any means impossible that the future may see similar relations restored. For a careful consideration of all the conditions of the Jerez districts will show that the barro-arenas soil is economically the most suitable for viticulture. The albarizas is being exhausted beyond redemption, unless the proprietors resolve to bring, at least, mineral manure into their vineyards. In fact, the albarizas are dear because fashionable; but if the barro-arenas were planted with the same select stock, they would produce the same quality, and much more quantity than the albarizas, and therefore obtain a ready market.

The pagos of the Corchuelo and Añina group are situated to the north-west of Jerez, beginning at a distance of about three kilometres, and extending for about five kilometres over the entire space between the old and new roads to San Lucar. They are conveniently reached by either of these roads, or by a field-road running between them direct from Jerez to Corchuelo (the Camino de las Viñas). By whichever of these roads the tourist leaves Jerez, he has to pass close to the town through the vineyard pagos of Picadueña and Miraflores, the latter remarkable for containing on its commanding height the splendid reservoir of the waterworks which supply Jerez with water from the distant mountains (*deposito de las Aguas de Tempul*). These pagos include about eighty aranzadas of barro-arena soil, and are planted with mollares, mantuos, and the uva calona, the fruit of which is mainly used in the shape of verdeo. Close to them is a third small pago, Serrana, on the right of the road del Calvario, which separates it from Miraflores; it belongs to the barro-arena class.

The pago las Salinillas is an albariza hill stocked with palomino, and surrounded by swampy territory impregnated with salt, furnishing the name to the pago, next to Maricuerda. The soil is partly albariza, partly bugeo; it vines mainly palomino. Its surface is from fifteen to twenty aranzadas. In the direction of Corchuelo is the pago of Rui Diaz, of one hundred aranzadas, with the noted vineyard La Lebrijana. To the south lies the pago of Cortadedo, bordering upon Obregon and Rui Diaz. Its extent is ninety aranzadas, with bugeo, albariza, and lustrillo soil, planted with palomino.

The pago, el Corchuelo, is circumscribed by the pagos of Rui Diaz, Cortadedo, Obregon, and Cantarranas, and the lane of Añina. It comprises three hundred aranzadas, and its soil is what is termed lustrillo, being rocky and lumpy albariza, bugeo, and barro-arena mixed, just the same as is found in the pagos of Cuartillo and Majada alta and some others. Prevailing vines are the palominos, with perruno, Pedro Jimenez, mantuo, cañocazo, and albillo. Its products vary in quality. Noted vineyards are la Recobera, los Desaboridos, and others. The name of the pago is sometimes connected with *corcho* (cork), and corchuelo may have signified a plantation of cork trees (*alcornóques*). The word also signifies blockhead.

Close to Corchuelo is the pago of Cantarranas, which borders to the west upon San Julian, and comprises two hundred aranzadas. Its higher parts have albariza, its lower ones bugeo soil. The predominating vine is palomino.

The principal vines which are most commonly cultivated in the albariza and bugeo districts are the following:—

Pedro Ximenes.—This vine gives mostos of all kinds, but is mainly reputed for the sweet liqueurs, falsely called wines, which are made by mixing the juice of its sun-dried grapes with spirit. This dulce is also used for sweetening the ordinary sherries. The stock is large; the canes are the most erect amongst all varieties of vines in the district. When weighted with a full harvest they sink to the ground, but after the vintage become again upright. The leaves are quite smooth, and not woolly or hairy; medium to small, lobed or irregularly incised, and possess reddish greenish yellow nerves. By the erect position of the canes, and the yellowish colour of the foliage, a stock or vineyard of this vine can be easily recognised at a distance. The grapes are not very large, greenish white, and bloomy, the sweetest of all grapes; the bunches not very large, but yet of southern dimensions. The mostos are from 12° to 15° B., without assoleo, but rise to 22° B. after about ten days' exposure to the sun.

The legend that this vine had been brought by one Pedro Ximenes from the Canary Islands and Madeira to the Rhine, and had thence been transplanted to Spain, was first published by the German author F. J. Sachs ("Ampelographia," Lipsiæ, 1661, 8vo.) It has since made the round of literature, and is an established, but nevertheless completely erroneous tradition. Odart says characteristically, that this story might flatter a German, but could make a Frenchman only smile. For if Pedro Ximenes had taken away any of this vine from the Rhine, he must have taken all. The vine is not found on the Rhine, as I can testify, since I have studied it in the South. It is a large-graped vine, which would never ripen in any German vineyard. The fallacy ought therefore to be discarded.

A less frequent variety of the foregoing vine is the *Pedro Ximenes Loco*—a name reminding us of the French *la folle blanche*. It is also termed *soplona*, the tale-bearer, informer; names for which the reasons are not assigned. Stock strong; canes horizontal; leaves not provided with reddish nerves; bunches and grapes large, and of slightly rough taste.

The most esteemed of all the vines of the Jerez district is the *Palomino*, also named *Palomino blanco*, *Listan commun*, *Tempranilla*, *Orgazuela*, *Alban*, and *Ojo de liebre*. The stock is strong, the canes are thin and long, and numerous, reddish grey, or whitish red; leaves medium-sized, equal, dark green on the upper, woolly on the lower face. The blossoms come early, and develope into large bunches. The grapes are of medium size, of a greenish waxy colour and bloomy appearance, becoming very much bronzed when struck by the sun, which spoils their quality; they give mostos of 14° and 15° B. The wine obtained from it developes mostly into fino, but not into oloroso. This vine is the most common on the albariza soil of the Jerez district.

A very delicate variety of the foreging vine is the *Palomino negro*, also termed *Centella*. Similar to foregoing, but with black grapes; very fine taste; little grown; used for *vino de color*.

Perruno.—Strong stock, with many erect, straight reddish grey canes, irregular shining leaves, many large bunches, with small, round, translucent grapes, of bronze yellow colour. They are very late and hard, not too sweet, and have astringent husks. The mostos have 12° B., and are good for olorosos of high flavour.

Perruno negro differs from the former mainly by its black grapes.

The Añina-road separates the pagos of Mariañez, Cerfate, Orbaneja, Añina, Cerro, del Marmol, and Montana on the northern, from Marihernandez, Montana, San Julian, and Zarzuelo on the southern side of the group.

Mariañez is a pago of twenty aranzadas, between Añina and Corchuelo, and bordering upon Cantarranas, Cerfate, and Marmol. Its heights are albariza, its lower parts bugeo. Cerfate is situated at the entrance of the pago of Añina, close to the Cerro de Orbaneja. It has fifty aranzadas, and its soil and plantations are like those of Añina. Close to the old San Lucar road, and separated from it by the opposite pago of Amarguillo, which I shall describe in connection with the Macharnudo group, is the Cerro de Orbaneja. The Cerro borders upon Añina, Cerfate, and Mariañez, is 150 aranzadas in extent, its soil is albariza and bugeo, and other earth in the lower parts, and its principal vine is palomino. On the right of my road lay Añina, stretching towards the San Lucar road, bordering upon Orbaneja, Cerfate, and Marihernandez in the west. Its territories are partly bugeo, partly albariza, and partly villares, that is to say, soil formed by the destruction of ancient habitations. Its area is one thousand aranzadas, on which the ubiquitous palomino predominates. Prominent vineyards are del Aljive, del Alamo, del Caribe. Close to Añina is the Cerro del Marmol, twenty to thirty aranzadas in extent, with a rocky subsoil, whence its name is derived.

The most north-western end of the Añina group is formed by the pago of Montana, two hundred and fifty aranzadas in extent, with soil varying between bugeo and albariza. In the south-west it borders upon the pago of Marihernandez, which in the east touches San Julian, and in the south abuts upon Balbaina. It has eighty aranzadas, and bugeo prevails on its surface, although the summits are albariza. I returned by the Hijuela de Candelero, keeping on my left the pagos of San Julian and Zarzuela. The latter lies between Candelero and Cantarranas, and has lustrillo, bugeo, and albariza soil. Its vines are palominos, mantuos, and albillos. San Julian has 300 aranzadas, and stretches from Zarzuela to the new road to San Lucar. Its soil is good albariza, its wines are mainly palominos, with interspersed perrunos, albillos, cañocazos, mantuos, and Pedro Jimenez. It yields wines of the first quality.

Passing out of the Candelero road into the old San Lucar road I passed the last pago of this group, completing the list, namely, the Cerro de Obregon, eighty-five aranzadas in extent, a young plantation on albariza and bugeo soil. Thence I returned to Jerez by the new San Lucar road. Along San Julian and Balbaina this road was just in course of being reconstructed, a circumstance which, though inconvenient for travelling, the traffic being deflected upon fields and field-roads, yet had the advantage of exhibiting to the eye some good long and deep sections of the albariza territory, the white hard rock, softer surface, and overlying white or coloured bugeo earth.

The Cerro de Santiago is a pago of more than two hundred aranzadas, bordered to the west by the old San Lucar road, and in the north passing directly into Macharnudo bajo. Its soil is albariza, and it contains the noted vineyards del Capitan and de la Trinidad. Continuing our way in a north-west direction we passed the pago of Doña Juana, bordering upon the bye-road del Alferez Tuerto, and came to the low arable, now stubble, lands between Macharnudo bajo and the pago of Amarguillo. The name of this latter is derived from a spring of bitter water in proximity to the pago. Its vineyards are divided into two patches, situated on the right or eastern side of the old road to San Lucar, which road separates them from the pagos of Añina and Orbaneja. In the north, Amarguillo passes into Valcargado, Pelado, and Tizon. Its soil is, for the greater part, bugeo, its vines are palominos and moscatels. From a height I saw the pago of Puerto escondido, isolated between Amarguillo and the Cerro del Pelado. Its extent is seventy aranzadas of lustrillo soil, its vines are palomino, perruno, Pedro Jimenez, moscatel, albillo, and mantuo. On the right of the San Lucar road, past Amarguillo and Puerto escondido, between Tocina, Tizon, and Valcargado, one sees the Cerro del Pelado, with albariza heights, bugeo in the lower parts, and palomino prevailing on its ninety aranzadas. Farther to the north-west, close to the Cerro del Pelado, is the pago of Tizon, with two hundred aranzadas of albariza and bugeo soil, and planted with palominos. Between Tizon and Amarguillo, close to the latter, is the pago of the Tocina, one hundred aranzadas in extent, with soil varying between lustrillo of albariza, bugeo and barro-arena. Its vines are palominos and mantuos, and of its vineyards the most noted is the one del Garrotal, also named del Canónigo. East of Tizon, north from our point of view, and stretching towards Macharnudo, we see the pago of Valcargado, with a surface of one hundred aranzadas, bugeo and albariza soil, and palomino vines. East of Valcargado and bordering upon Macharnudo bajo is the pago of Tabajete, of sixty aranzadas, with albariza and bugeo soil planted with palomino. We take the road which borders this pago to the east and divides it from Macharnudo bajo, termed Hijuela de Tabajete, and then turning towards the east take the Hijuela alta, which separates Macharnudo bajo in its entire length from the isonymous high pago. Thus we are in the midst of what is termed comprehensively Macharnudo, perhaps the greatest pago of Jerez, having more than fifteen hundred aranzadas of vineyards. In the east, it abuts for several kilometres upon the Trebujena road.

Its soil is mostly white plastic albariza, with interspersed low-lying bugeo districts. Its wines are palomino, perruno, Pedro Jimenez, albillo, moscatel, cañocazo, and mantuo; palomino forms half the set. It yields excellent wines. Noted vineyards are those de la Compania, and Domecq's, originally planted by Haurie, 400 aranzadas in extent.

(To be continued.)

ANNUAL INTERNATIONAL EXHIBITIONS.

The Council, having been informed that her Majesty's Commissioners do not intend to publish Reports on the different departments of the Exhibition of the present year, and looking to the great importance to Arts, Manufactures, and Commerce that these annual displays should not pass away without some record, have decided to undertake that duty, and for this purpose have engaged the services of gentlemen specially skilled in the subjects of the several sections, to prepare such Reports for publication in the Society's *Journal*. The Council, however, desire it to be understood that, in publishing these reports, they do not necessarily adopt all the views expressed in them, which must be taken as those of the writers only.

The following report is the tenth that has been issued. The remainder will appear as soon as they are complete.

REPORT ON STEEL.

By William Baker,
Associate of the Royal School of Mines.

If the strength and riches of England lie in her iron and coal mines, it is chiefly that from these sources are elaborated the countless forms which steel assumes in the arts, and which have made it a synonym for fidelity, brightness, inflexibility, and temper, and other excellent qualities. To any one cognisant of the great industries which precede alike the production of a massive crank-axle and the finest piece of cutlery, it will be a matter of regret that the Exhibition at Vienna has probably robbed us in London of a number of articles which would have more fairly represented our manufactures in steel. Nevertheless, in the Galleries of the Albert Hall there are very complete examples of the skill which has been attained in the production and manipulation of steel, in a great variety of forms.

The heavy steel goods are placed in No. 26 Room, West Machinery Galleries. The cutlery and small steel goods are in the four South Balcony Floor Rooms in the Royal Albert Hall. The most prominent feature in this exhibition is the "mild steel," produced by the modern process known as the Bessemer and the Siemens-Martin. Crucible steel can also be made as mild in temper, and is daily melted with a proportion of carbon no greater than is sometimes met with in certain kinds of wrought-iron. The application, however, of crucible steel to the production of large masses, must, of necessity, be less economical than the treatment of the metal in a single furnace. Krupp, of Essen, Vickers, of Sheffield, and others at previous exhibitions, have shown large masses of crucible cast steel, which were produced by organising a regular supply of melted steel from some hundred pots, so as to give a continuous flow into the mould. Great skill must, manifestly, be employed to keep so many melting holes, and the contents of the pots, at the proper temperature, as well as to ensure the presence of the necessary proportion of carbon in the casting. This older process may still claim greater exactness in producing a desired temper, and it is likely to be long employed for the finer qualities, which are used for cutting tools. A brief comparison of the methods now in use may be interesting, in view of the manufactures under consideration.

Crucible Steel.—If a proof were required that the demand for this kind of steel is undiminished, it might be found in the fact that converting furnaces are still being built in Sheffield. In these furnaces bar iron is heated in contact with charcoal in close chests, whereby a certain amount of carbon is absorbed by the iron, and the so-called "blister steel" produced. The proportion of carbon may be regulated by the length of time given to this cementation process. A control of the temper of the steel is also obtained upon breaking up the blister steel before melting. The appearance of the fracture indicates to some extent the amount of carbon, and this permits an assortment of pieces according to temper. Thousands of pots, however, are employed in melting steel direct from iron by the addition of the appropriate proportion of carbon, either in the form of charcoal or of carbon combined with iron, as in Spiegeleisen. It is worth recording that there are differences in the character of the steel made from the same iron, according to which method has been employed; even when the amount of carbon in the ingots, as found by analysis, is identical. A closer application of chemical analysis, and perhaps an examination of the occluded gases, might yield an explanation of this result. Messrs. Howell and Co. (No. 3,737) have been prominent as manufacturers of mild steel by this method, and they have illustrated the homogeneous character of their metal in a variety of ways.

Bessemer Steel.—In this magnificent metallurgical process air is forced through molten cast-iron until its carbon is reduced to a minimum. The silicon is, by this treatment, very completely eliminated, and only sulphur and phosphorus resist oxidation and remain in the charge—at least, as long as there is any carbon left in the metal. The "blow" may be arrested, and steel of different degrees of hardness obtained; but in this country it is the invariable practice, after the removal of the carbon, to restore it again in a known proportion by the addition of Spiegeleisen—a variety of pig iron which contains generally from 4 to 5 per cent. of carbon, and from 9 to 13 per cent. of manganese. The time occupied in the treatment of ten tons of metal varies from ten to fifteen minutes. After the addition of Spiegeleisen, the charge is transferred to a vessel, from which it is run into the ingot moulds. At the present time, there are in Europe 165 Bessemer converters, producing annually 700,000 tons of cast-steel. A section of a portion of a Bessemer ingot, when polished and etched for a microscopic object, discloses a structure admirably adapted for rigidity and toughness. Crystals of soft iron are seen filling up a network of harder or more carburised metal. Upon subsequent re-heating and working under the hammer, the etched surface approaches the grain or pattern exhibited by crucible steel, and is more homogeneous. Now, the control of this process obviously depends upon hitting the exact point of complete decarburisation, together with the addition of a proper proportion of Spiegeleisen of known quality. Steel of this kind made for

Fig. 1.

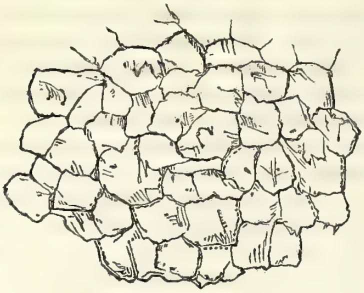


Fig. 1.—Section of a portion of a Bessemer ingot, etched and magnified.

Fig. 2.

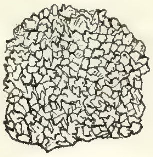


Fig. 2.—Section of crucible steel etched and magnified.

rails contains about 0·5 per cent. of carbon. Harder steel is of less common application when made by this process. The grey pig-iron most esteemed in England for making Bessemer steel is that known as hæmatite pig. Samples of this iron, together with the ore, limestone, and coke used for its production, are exhibited by F. W. Webb, Esq. (No. 3,789), from the Barrow Hæmatite Iron Company. This iron is made chiefly from the splendid ores of the Whitehaven and Ulverstone districts. Here are specimens showing the dark grey fracture of the iron, with the highly graphitic scales of No. 1 pig; also the limestone used as a flux, and the fine red ore itself, containing from 60 to 68 per cent. of metallic iron. In the same case an interesting series from the Ebbw Vale Company displays the fine crystalline faces of the Spiegeleisen and the ores employed for the production of this valuable adjunct to the Bessemer process.

The Ebbw Vale Company was the first in this country to attempt the manufacture of this variety of iron. Only two years ago we were entirely dependent upon Germany and Sweden for its supply. It was believed that spathic iron ore, containing a proportion of manganese, was essential to its production. The Ebbw Vale Company have at hand the spathic ore of the Brendon Hills. However, it is not too much to expect that, with the introduction of ores in which manganese and iron oxides are naturally blended, as in those now imported from Spain and Portugal, other successful attempts may be made for the production of Spiegeleisen.

The Siemens-Martin Process.—This process now counts in actual use, in Europe, sixty furnaces, and is becoming a rival to that of Bessemer. When pig iron, free from sulphur and phosphorus, is melted, wrought iron, previously brought to a welding heat, may be introduced into the bath of molten metal, and a quality of steel obtained similar in character to Bessemer steel. Here, again, Spiegeleisen is found to be a useful addition to the charge, inasmuch as its manganese appears to protect the carbon from oxidation, whilst oxidising itself; no gaseous compound is produced, and the ingots are consequently obtained of greater solidity and with fewer bubbles of enclosed gas. The striking difference in the conditions of this method and that of Bessemer is that, in the Siemens-Martin process the metal has longer time to become mixed and homogeneous; and also, that it is possible to take samples and adjust the charge until the desired temper is attained. This advantage is obtained by having at command the intense heat along with the neutral, or unoxidising flame of the Siemens' gas furnace. The latest application of this valuable invention of Dr. C. W. Siemens is exhibited in the form of a model (No. 3,774.) This furnace has a cylindrical body, which is caused to revolve whilst the flame from the regenerators both enters and returns at the same end, the other being reserved for the charging and for the withdrawal of the bloom. The ore is first heated until nearly softened, a certain proportion of limestone, for flux, being added. The coal, or reductive material, is then mixed with it, and reduction effected. If steel be desired, Spiegeleisen must be used. The important advantage claimed for this furnace is that ores containing phosphoric acid may be used; the iron oxide being more rapidly reduced than the acid, the latter remains in the slag.

Should this result be uniformly attained, the invention may be looked upon as the greatest advance in the metallurgy of iron since the Bessemer process. It will bring into the market a vast quantity of English iron ores, which contain such a proportion of phosphorus as to prohibit their use, except for ordinary cast iron. Adjoining the model may be seen a mass of iron in the state of a bloom, as it is taken out of the furnace. The necessity of an ore of high assay, in order to reduce the slag to a minimum quantity, seems the only limit to the economical working of such a furnace.

Turning to the special objects which illustrate these various methods of producing a mild steel, the exhibition of Mr. F. W. Webb, of the London and North-Western Railway Works, at Crewe, is remarkable for its completeness.

A large locomotive boiler and fire-box display the toughness and strength of the Bessemer steel, and its resistance to punching and forging into angular shapes. Very convincing proofs of the high quality of the metal are afforded on a smaller scale by a number of objects which have been submitted to severe tests. Plates and rods are bent and doubled again in the cold. Bolts are shown which have been slaked at red heat and bent cold. The steel boiler plates possess a tensile strenth of 65,790 to 73,310 lbs. on the square inch. A $\frac{5}{8}$ hole punched in a plate has been drifted to $2\frac{1}{2}$ inches. A steel rail is exhibited, over which 60 million tons have passed with a wear of table only amounting to $\frac{1}{32}$ inch. There is also a steel rail twisted cold into the form of a spiral column. Boiler plates are folded cold like pocket-handkerchiefs, without the slightest crack or separation of fibre. The boiler flue with expansion rings will commend itself to the notice of engineers.

Messrs. Vicker, Sons and Co., Limited, Sheffield, (No. 3,787), send a fine cast-steel screw propeller, railway axles and tyres. One of the latter is shown as tested by a falling weight. A railway axle is also shown, bent nearly double, as a test object. A splendid example of this firm's manufacture is a locomotive tyre, 7 feet $3\frac{5}{8}$ inches in diameter, as well as a crank-axle of a goods engine on the Lancashire and Yorkshire Railway, which has worn over 233,878 miles. A hydraulic cylinder for a cotton press, tested up to 4 tons on the square inch, and a cast-steel gun block for lining an Armstrong gun, are fine specimens of the metal. Sir J. Whitworth has, with considerable ingenuity, applied pressure to aid in the production of a solid casting. Enormous pressure is applied whilst the metal is solidifying. The lining for a marine engine cylinder and a hydraulic cylinder are the objects exhibited, and those in which density is eminently required. An interesting series of sections of steel rails, taken off the Furness Railway after use, is exhibited by Mr. Frank C. Stileman. The wear of the rail on levels and on gradients is exhibited by diagrams. These rails were rolled by the Barrow Hæmatite Company, and have been in use six or seven years.

Mr. W. Adams, locomotive superintendent on the North London Railway, and Mr. A. McDonnell, of the Great Southern and Western Railway, Inchicore, Dublin, contribute other examples of the use of steel in railway machinery. The former sends a cast-steel crank axle, by Krupp, which has been in use $10\frac{1}{2}$ years, and is consequently made from crucible steel; it has travelled over 396,262 miles. Mr. McDonnell exhibits steel plates for a locomotive firebox, wheels, and a tyre, by Vickers, which has run over 125,000 miles, having been once turned up again after 73,305 miles. Originally its thickness was $2\frac{5}{8}$ inch. The wear and turning required have only reduced it to $2\frac{3}{8}$. Messrs. Park, Brothers, and Co., of Pittsburgh, represent American skill in these manufactures. Their cast-steel boiler and firebox plates are worthy to be placed on the same platform as those mentioned above from Sheffield and from the works at Crewe. Other foreign exhibitors in heavy steel goods are the Central Swedish Iron and Steel Company, the Dannemora Cast-Steel Company, and the Fagersta Iron Company.

Mention must be made of a novelty in railway wheels, patented by Mr. Robert Hadfield, of Sheffield. In this wheel the steel tyre is cast on to the centre, which may be of cast or wrought iron. No separation of the tyre can take place other than by actual wear, or turning it off in a lathe. By this system lighter steel tyres may be used than would be safe if the tyre were shrunk on to the centre, as in wheels of the usual construction.

Turning to the collection of lighter goods in steel, we find the number and variety forbid a detailed description. In cutlery there are thirty-eight exhibitors; fourteen are from Sheffield, two only from France, and two from Sweden. The finest example of the skill of Sheffield artisans in forging and tempering steel is the magnificent circular saw, seven feet and a quarter in diameter, made by Messrs. Spear and Jackson. Messrs. Wheatman and Smith exhibit a circular saw, with a peculiarity of being furnished with a set of holes which guide the file in sharpening, and preserve the relative distances and proportion of the teeth.

The tools exhibited afford ample illustrations of the use of the finer qualities of steel. The finish of the domestic cutlery in the cases of Messrs. Mappin and Webb, Nowill and Sons, Unwin and Rodgers, and others, is unapproached by any foreign makers. Messrs. Wilkinson and Sons' swords are exquisite pieces of workmanship. Amongst them is placed a cimeter of black Khorassan steel. The workman's toil in the production of such a blade is indicated by the regular pattern which appears on the etched surface. The blending of hard and soft metal, welded, but not fused, affords, when the weapon is ground and whetted, the serrated edge so essential for cutting purposes. It is a matter for discussion and experiment whether the polish obtained by the use of cast-steel is not at some slight expense of real utility. Even now, by some makers, shear steel is preferred for a carving knife, and doubtless for the reason indicated above. For further illustration, comparisons may be made with antique pruning knives by Hofmann, of Nuremburg, exhibited by Mr. Henry Cole; the quaint old cutlery sent by Achille Juvinal and P. de St. Albin, as well as the ancient European and foreign weapons in the collection of Colonel Lane Fox. The modern difficulty in the art of working cast-steel for cutlery lies in obtaining hardness with toughness. According to the special purpose of the tool, a disturbance of a certain relation of these qualities causes brittleness or dulness of temper. Instructive examples of fractures are shown by Messrs. Wilkinson and Son, in a series of sword blades which have broken in testing.

The manufacture of needles and steel-pens demands a fine quality of steel, as the smallness of the object leaves no flaw undiscovered. The Redditch needles have been long celebrated, and four firms exhibit every variety for hand as well as machine-sewing. Messrs. Mitchell and Co., James Perry and Co., and Poure, Gillott, O'Kelly et Cie., Boulogne-sur-Mer, are rivals in the exhibition of steel pens. The sheet steel for pens is almost invariably rolled in Sheffield.

The application of steel gun and rifle barrels should be mentioned as affording lightness with security. Specimens are shown by Wilkinson and Son, and by the Husquarna Small Arms Manufacturing Co., of Sweden.

Steel Grates.—These articles afford considerable scope for the artistic use of steel in combination with other materials, such as ormolu bronze and ceramic tiles. The firm of Stuart and Smith, Roscoe Works, Sheffield, exhibits a handsome grate, with fender and fire-irons, which will all bear close examination. The ormolu ornamental work, with the moulded lions couchants, produce a pleasing contrast to the mirror polish of the steel grate. The whole is in excellent taste. H. E. Hoole, of Sheffield, and Messrs. Benham and Sons, London, are also exhibitors, the latter showing the effect of nickel-plating on steel. The slightly yellow polish of this metal might pass unnoticed, when not in immediate contrast with steel.

Amongst the miscellaneous articles should be mentioned the steel keys of Messrs. Hobbs, Hart, and Co., which recall the elaborate work of mediæval times. Messrs. Chubb and Son, London, and S. Chatwood, of Bolton, are exhibitors of locks and safes, and both display a finish and solidity of work peculiarly English. A most meritorious collection of clock and chronometer fusees, and tools used in their production, is sent by T. Schick, of Goswell-road, London. Finally, the ornamental uses of steel are very prettily shown in the steel jewellery of Jean Wunden, of Brussels, and Martha Farey, of Regent-street, London.

Since the foregoing was written, Messrs. John Brown and Co. (Limited), Sheffield, have succeeded in producing Spiegeleisen in their blast furnaces, from the Spanish ore. Two specimens which have been examined possessed all the physical character of the best iron from the Siegen district, and contained as follows:—

Carbon	4·41	4·62 per cent.
Manganese ..	13·17	12·89 „

The preparations shown by the Indestructible Paint Company (No. 4,847) do not form very attractive objects to the general public, but the important character of their inventions makes them deserving of considerable attention. It is now twelve years since Sir Charles Barry reported, in 1858, to the House of Commons on the decay of the stone used in the building of the Houses of Parliament, and the process of decay has since been proceeding unchecked. Numerous preservative solutions have been applied by way of experiment, but it is stated that the only one that has stood the test of trial is that prepared by the company above mentioned. In the Exhibition are shown several vases coated with the preservative solution, and side by side with these are other vases of untouched stone. The closest examination will not detect any difference between the two, so that the solution has no effect whatever on the appearance of the natural stone. As to its efficiency, that time only can prove. The stone at Westminster treated with it has been preserved for two years without any appearance of deterioration, and even decay already manifested has been arrested. Experiments show that the prepared stone will resist dilute muriatic acid, one of the most destructive agents of decomposition in stone, and there is every reason to believe that this property is permanent, and that stone to which the solution has been applied is practically indestructible.

The number of visitors admitted to the Exhibition during the week ending Saturday, August 16th, was as follows:—Season tickets, 644; on payment, 12,575; total, 13,219.

EXHIBITIONS.

AWARDS AT THE VIENNA EXHIBITION.

The following English, East Indian, and American exhibitors have received diplomas of honour at the Vienna Exhibition.

In the Mining Department—The Geological Survey Office, Calcutta.

In the Agricultural Department—Messrs. Fowler and Co., London; J. and F. Howard, Bedford; Ransomes, Sims, and Head, London; and Walter A. Wood, U.S. America.

In the Food Products Department—The Acclimatisation Society of Victoria.

In Textile Fabrics—Messrs. Brook Brothers, of Huddersfield; Christy and Co., London; Horrocks, Miller, and Co., London; Donald Nicoll and Co., London.

In the Metal Trade—Messrs. Henry Bessemer and Co.; the Broughton Copper Company, Manchester; Messrs. Brown and Co., and Cammel and Co., of Sheffield; Elkington, of Birmingham; and the Landore Seimens Steel Company.

In Furniture—Messrs. Jackson and Graham, London.

In Glass, China, and Stoneware—Messrs. Minton and Company, Stoke-upon-Trent; the Worcester Portland Company.

In the Paper Trade—Messrs. Cowan and Sons, of Penicuick, Scotland.

In Decorative Art—Mr. Owen Jones, of London.

In Machinery—Mr. Coplis, of the United States; Galloway and Sons, Manchester; Lawson and Sons, Leeds; Platt Brothers, Oldham; Sellers and Co., Philadelphia; Sharp, Steward, and Co., Manchester.

Scientific Instruments—V. Kullberg, London; S. White, Philadelphia.

War Material—Messrs. Armstrong, Newcastle-on-Tyne.

Naval Material—The Washington Lighthouse Department.

In Group 22—The South Kensington Museum, London.

Educational matters—The National Educational Bureau, Washington; Dr. Leitner, Lahore, India; the Government of Massachusetts; and the Smithsonian Institution, Boston, U.S.

VIENNA EXHIBITION ITEMS.

[From *Iron*.]

Algeria exhibits an important collection of ores, and especially iron ores; these latter represent important deposits which lie near the sea coast, and throughout nearly its whole length. The purity of these ores, that is to say their freedom from sulphur, arsenic and phosphorous, renders them especially valuable in the manufacture of fine iron and steel, and the presence of certain quantities of magnanese in many of these hæmatites adds to the value. Under such circumstances the rather high rate of transport presents no impediment, and these ores are in great demand, not only for France, but also for England, and even America.

Amongst the most noticeable examples at Vienna, are the oxydulated ores of Moktael-Hadid, the hæmatites of Soumah, and Temoulga, and of Oulossa-d'Oran. In 1872 Algeria exported 391,190 tons of iron ore, valued at 19½ milllions of francs.

Algeria also contributes many other ores, such as lead, grey copper ore and pyrites, found over the whole extent of the province of Tell; zinc, in the form of calamine and blende; antimonial ores; and mercury is found in Constantine. In the case of workings conducted with any amount of knowledge and care, considerable success has been achieved, but in more instances the attempts have failed from the miserable want of means employed.

To the present time the exports of copper ore, lead ore, and lead from Algeria have been very small, but the trade is increasing, and with the employment of sufficient capital and energy there is little doubt that the mining and metallurgical industries of the colony will attain a highly respectable figure.

Our neighbours, the French, exhibit their usual tact in availing themselves of this, as well as all other opportunities, of letting the world know what they are doing in science and art. The government and the city of Paris both exhibit largely and effectively. The most recent of the works thus exhibited are examples of the geological chart of France, the completion of several sheets of which was announced the other day to the Academy of Sciences, by the Minister of Public Works. These charts are the development of the general chart due to the labours of MM. Brochont de Villiers, Dufrenoy, and Elie de Beaumont. The new work is under the direction of M. Elie de Beaumont, and several eminent mining engineers and officials of the School of Mines.

The charts exhibited consist of twelve sheets, coloured geologically, of the chart of the staff, and comprise Rouen, Beauvais, Soissons, Evreux, Paris, Meaux, Chartres, Melun, Provins, Chateaudun, Fontainebleau, and Sens; two sheets of longitudinal sections, and three of vertical sections; three sheets of photographs of quarries, and two sheets of fossils, also photographed, which complete the accessory documents which will be attached to the whole series of charts.

The work is performed with great care, and it is impossible to exaggerate the value of such a series of charts to the mining, metallurgical, and agricultural interests of the country. The appearance of the first instalment of the charts has been hailed with much interest by scientific men, and the hope is expressed that the important work may be pushed forward with the activity which such a valuable practical undertaking deserves.

The offer of free lodging in the Rudolphinum during the Exhibition at Vienna has been responded to by no fewer than 2,412 teachers. Of these 418 have been selected, viz.:—207 Austrians, 99 Germans, 36 Italians, 20 Englishmen, 14 Dutchmen, 13 Swedes, 12 Danes, 10 Swiss, 7 Russians, 3 Belgians, and 2 Spaniards. There is to be, moreover, an ordinary in the building at 1s. 8d.

Testimonial to Mr. P. C. Owen.—Fifteen hundred pounds, in sums of from one to twenty pounds, have been subscribed by the British exhibitors as a testimonial to Mr. Philip Cunliffe Owen, Secretary of the British Commission, in recognition of his unwearied exertions and unvarying attention. The testimonial, consisting of candelabra and tazzas by Elkington, and jewellery for Mrs. Owen, the remainder in a purse, will be presented in London, on October the 1st.

Northampton Exhibition of Leather Work.—The Exhibition of Leather Work, opened last week at Northampton, has proved a complete success. The 2,000 exhibits are classed into five divisions, and not only illustrate the uses to which leather can be put, but the machines employed in manufacture. Besides shoes, boots, gloves, saddlery, portmanteaus, and book-binding, there are specimens of leather frames, card cases, and brackets. Some old English leather bottles, a South American lasso, a Kaffir shield, and one of rhinoceros hide taken from Magdala, and two Ashantee bridles excite general interest. One article has a peculiar interest of its own, "part of the show-board of Mr. Carey (Rev. Dr. Carey), written by himself when a shoemaker at Hackleton, in Northamptonshire." It is a matter of history how Carey became a pioneer of missions in Bengal, and an Oriental scholar, one whose "name will be remembered to the latest generation." Cobbett asserted that "the trade of a shoemaker numbers more men of sense, of public spirit, than any other in the kingdom." There is hardly any other science or art in which they have not distinguished themselves. Hans Sachs, of Nürnberg, was a shoemaker; and Jacob Böhn, whom Hegelians consider one of the founders of modern philosophy, followed the same humble craft.—*Globe.*

Oriental Congress and Exhibition.—The organisers of the congress which is to be held in Paris on the 1st of September to discuss various questions connected with Japanese literature and the best means of bringing the Japanese intellect into profitable conjunction with that of Europe, have added another feature to its programme which cannot fail to be an attraction, namely, an exhibition of the products of Chinese and Japanese art, for which purpose the Minister of Public Works has placed a portion of the Palais de l'Industrie at the service of the council. M. de Longpérier, of the Institute of France, is the organiser of the exhibition, and his name will at once give character to the undertaking and assure its being carried out with the sole view to the illustration of art and archæology. Taking into consideration the important nature of the exhibition, the Municipal Council of Paris has voted the sum of 1,200 francs towards expenses. A fine collection of objects, brought from China and Japan only a few months since by M. Henri Cermuschi, will form a feature in the exhibition. The congress itself, which originated with M. Léon de Rosy, professor of Japanese, and a few other eminent Orientalists, promises to be very attractive, and a considerable number of English names are on the list of its members; and it will be well to add that Mr. Robert K. Douglas, of the British Museum, is the honorary secretary in England. The congress will not be merely a scientific assembly, but also the opportunity for many pleasant and profitable social meetings of Orientalists from all parts of the world.

Exhibition at Philadelphia.—The Philadelphians are hard at work preparing for their Centennial Exhibition to be held in 1876. £200 each for the ten best designs for an appropriate building had been offered, and 40 plans have now been sent in.—*Graphic.*

Whitehaven Exhibition.—An Industrial Exhibition on a large scale was opened last week at Whitehaven, by Mr. G. Bentinck, M.P., in connection with the Working Men's Reading-room and Library.

THE INTERNATIONAL PATENT CONGRESS.

The labours of this congress at Vienna were brought to a close on Saturday, the 9th inst., after a week of discussion. The resolutious finally adopted were the following:—

"Resolution I.—The protection of inventions is to be guaranteed by the laws of all civilised nations under the condition of a complete publication of the same; because:—

"*a.* The sense of right of civilised nations demands the legal protection of intellectual work.

"*b.* This protection affords the only practical and effective means of introducing new technical ideas, without loss of time, and in a reliable manner to the general knowledge of the public.

"*c.* The protection of invention renders the labour of the inventor remunerative, and induces thereby competent men to devote time and means to the introduction and practical application of new and useful technical methods and improvements, or to attract capital from abroad, which, in the absence of patent protection, will find means of secure investment elsewhere.

"*d.* By the obligatory complete publication of the patented invention, the great sacrifices in time and of money, which the technical application would otherwise impose upon the industry of all countries, will be considerably lessened.

"*e.* By the protection of invention the secrecy of manufacture, which is one of the greatest enemies of industrial progress, will lose its chief support.

"*f.* Great injury will be inflicted upon the countries which have no rational patent laws, by the native inventive talent emigrating to more congenial countries, where their labour is legally protected.

"*g.* Experience shows that the holder of a patent will himself make the most effectual exertions for a speedy introduction of his invention."

"Resolution II.—An effective and useful patent must have the following principles:

"*a.* The inventor or his legal heir only can obtain a patent. A patent cannot be refused to a foreigner.

"*b.* In order to carry out the principle stated above (*a*), the introduction of the system of a preliminary examination is recommended.

"*c.* A patent for an invention should be granted for fifteen years, or the option should be to extend it to that period.

"*d.* The granting of a patent must be accompanied by a detailed and complete publication, which renders the practical application of the invention possible.

"*e.* The cost for the granting of a patent should be moderate, but in the interest of the inventor an increasing scale of fees should be fixed, so as to cancel a useless patent as soon as possible.

"*f.* It should be easy for any to obtain, through a well-organised patent office, the specifications of any patent, as well as to ascertain which patents are still in force.

"*g.* Laws should be passed by means of which a patentee may be compelled, in cases of public interest, to allow the use of his invention, for a suitable remuneration, to all *bona-fide* applicants."

"Resolution III.—In consideration of the great difference between the existing patent laws, and in consideration of the altered state of international communication, the necessity of reform becomes evident, and it is to be strongly recommended that the different governments should endeavour to arrange, as soon as possible, an international understanding on the patent laws.

"The not executing of a patent in a country is no reason for its becoming void in that country, as long as the invention has been carried out once, and the possibility is there that the right of using the invention can be obtained by any inhabitant of this country."

A requisition is being signed by Members of Parliament and others, requesting the Lord Mayor to call a meeting in the City of London, to consider the advisability of the State purchasing the railways. Mr. Bass, M.P. for Derby, is one of the promoters.

A company has been formed at Adelaide to work canal coalmines in Tasmania. A Victorian company has also opened a mine at Spring Bay.

Egypt is said to contain 113 navigable canals and 756 smaller ones, constructed for irrigation.

NATIONAL TRAINING SCHOOL FOR MUSIC.

At the recent Eisteddfodd of the Anglesey choir, Lord Clarence Paget, K.C.B., in the course of his presidential address, made the following remarks on the school:—

It so happens that my presidency of to-day will, I hope, be the means of introducing to my countrymen the knowledge of an institution which is about to be founded under the immediate presidency of the Prince of Wales. I think the Welsh people are worthy of the first intimation of this proposed scheme, because already they have in the principality given great attention to the important question of elevating the people and securing all the advantages which may accrue from the cultivation of the noble art of music and of the other branches of the fine arts. Therefore it is to Wales that the honour is accorded of being the first part of the United Kingdom to be informed of what I trust will prove to be a magnificent scheme for the cultivation of music amongst all classes. It is proposed that we should, under the presidency of his Royal Highness the Prince of Wales, have a great national training school for music, of which the central depot will be in London, but which hereafter, I trust, will spread through the whole of the country, exactly as the schools of art which are now established, and which were also originated by the Society of Arts, have done. A private individual, Mr. C. J. Freake, has munificently undertaken at his own cost and risk to erect the necessary buildings, containing class-rooms, lecture-rooms, and everything that is necessary for the school to be attached to the Albert Hall. The fundamental principle and primary object of the school is the cultivation of the highest musical aptitude in the country, in whatever station of society it may be found. In order to carry out this principle to the fullest extent, admission to the school will be obtained by competitive examination alone. The proposed scholarships will be 300 in number and will be of two kinds, the one to afford free instruction by paying the students' fees, the other to give free instruction with a maintenance allowance in addition. It will be open to any county, town, public body, or private individual to establish one or other of these kinds of scholarships for competition under given limitations. Should there be more accommodation in the school than is requisite for the instruction of these scholars, students paying their own fees will be admitted by competition to fill the vacancies, care being taken that they show sufficient aptitude. It is proposed that the school should provide in the first instance for the free instruction of about 300 scholars. The school fee without maintenance it is estimated will be between £35 and £40 pounds a year. The maintenance allowance for the support of a scholar will be in addition to this fee, and independent of the school. The council of the Royal Albert Hall are prepared to devote certain rooms, including two small lecture theatres, to the use of the school at a nominal rental, when proper arrangements shall have been made for its conduct. This assistance is estimated to be worth about £1,000 a year. The school is to be under a committee of management, consisting of two members appointed by the Royal Commissioners for the Exhibition of 1851, two members appointed by the council of the Royal Albert Hall, and three members appointed by the council of the Society of Arts, and the committee thus formed will consist of H R.H. the Duke of Edinburgh, H.R H. Prince Christian, Admiral the Right Hon. Lord Clarence Paget, K C.B., Major-General F. Eardley-Wilmot, R.A., F.R S., Mr. Henry Cole, C B., Major Donnelly, R.E., and Sir W. Anderson, K C B. Thus, you will see that we have the prospect at last of establishing in our own country the highest class of musical education, both instrumental and vocal. We shall no longer be dependent upon foreigners, but shall look to our own country, where there is as great talent as in any other country in the world, and as great an aptitude for the art of music, and I hope that in a few years we shall have our country properly represented with regard to musical education. In conclusion it gives me very sincere pleasure to be called upon to occupy the honourable post which I do on the present occasion, and to express my hope that all classes of society will use their best endeavours to promote the scheme which I have very inadequately put before you.

TECHNICAL EDUCATION.

The excellent action of some of the City Companies is doing more and more to draw attention to technical education. The Goldsmiths' Company, *e.g.*, annually award £250 in prizes for designs, models, execution, and workmanship, and have also decided that a travelling scholarship of £100 shall be awarded to a student who shall have shown exceptional talent and obtained a prize for design for three successive years. The members of the deputation to the Marquis of Ripon enunciated some very sound views on a subject which cannot be allowed to slumber much longer. The ancient practice of apprenticeship has—it was averred—almost broken down, and has not yet been replaced by any equally advantageous system. Workmen are no longer thoroughly taught, and, shifting from one trade to another, the artisan often acquires the unsatisfactory reputation of "Jack of all trades and master of none." South Kensington has done a great deal towards infusing true artistic feeling into those who can avail themselves of its advantages, but even there sound practical teaching is wanted. A lecturer is less required than a practical demonstrator—one who can not only tell the pupil what he should do, but show him how to do it by practical example. None but a skilled manipulator can do this, and there appears but little doubt of the desirability of employing thoroughly practised artisans as demonstrators. One of the deputation, however, appeared to be struggling against the inevitable when he denounced the present system of subdivision of labour. No doubt it is to be deplored, inasmuch as it has an unquestionable tendency to dwarf men into mere machines, or rather portions of machines, but we fear that the current is almost too strong to be resisted. Not only in trades, but in professions, is the tendency towards specialities becoming stronger every day. Lawyers not only devote themselves either to common law or equity, Parliamentary business or conveyancing, but to subdivisions of these great branches. Doctors devote their lives to the study of a single organ—the eye, the ear, the brain, the lungs, the heart, or the skin. The same tendency to focus the entire intelligence upon a single point is apparent in almost every walk of life; but in some trades it has been carried to a preposterous extent. A more thorough technical education would remove many of the objections to subdivision of labour, as, although it might ultimately pay the workman best to devote himself to one department of his craft, the artisan and the man could not fail to be improved by a knowledge of the "whole art and mystery" of his particular trade.—*Iron.*

THE ELECTRIC LIGHT.

It will be in the recollection of the readers of the *Journal*, that, in April last *, an analogy was pointed out between sunlight and the electric light, and that certain conditions were therein indicated as being most favourable to that particular development of light which would best bring out the separation of the power producing the light from the place of its manifestation. Those conditions were the employment of magneto-electricity, and the use of a closed incandescent conductor in an atmosphere which would not oxidise or otherwise affect the durability of the light-producing material. From the quotation from the Russian paper *Golos* which follows, it will be seen that the results anticipated are even now in the course of realisation, and all that practical men can do is, to wish the plan the success it seems to deserve, and to wait the result of the further exhibitions of its power in London and other places more accessible to the Western nations than St. Petersburgh:—

"On Tuesday the 8-20 of May, a most interesting trial was made for the first time in public at the Admiralty House, St. Petersburgh, under the auspices of Messrs. S. A. Kosloff and Co., the proprietors of the patent, of a new system of lighting by electricity, the invention of Mr. A. Ladiguin of that town.

"Owing to the restricted space in the hall made use of on this occasion, the number of spectators was necessarily limited, but still they consisted of more than a hundred specialists from different countries, representatives of science, honourable visitors, and many reporters, who were all deeply interested, and unanimously decided that the trial was really successful.

"Up to the present time, as is well known, the electric light has been used only for light-houses, as an electric sun illumination for signals, or on the stage, where a strong light may be required without regard to cost; but thus far it has been quite impossible to employ it for lighting streets or houses.

"By the old method the electric spark was passed between two points of charcoal, each attached to a copper wire connected with an electro-magnetic machine.

"The disadvantages attending this mode consisted in the facts, that, for each light a separate machine was required, and that the light so obtained, although very powerful, was impossible to be regulated, besides being non-continuous, owing to the rapid consumption of the charcoal points from exposure to air.

"All these difficulties Mr. A. Ladiguin has tried and apparently overcome most successfully.

"By his newly-invented method, only one piece of charcoal or other bad conductor is required, which being attached to a wire connected with an electro-magnetic machine is placed in a glass tube, from which the air is exhausted, and replaced by a gas which will not at a high temperature combine chemically with the charcoal. This tube is then hermetically sealed, and the machine being set in motion by means of a small steam-engine, the charcoal becomes gradually and equally heated, and emits a soft, steady, and continuous light, which, by a most simple contrivance can be strengthened or weakened at the option of those employing it; its duration being dependent solely on the electric current, which of course will last as long as the machine is kept in motion.

"Taking into consideration the fact that one machine, worked by a small three-horse power engine, is capable of lighting many hundreds of lanterns, it is evident what an enormous advantage and profit could be gained by the illumination of streets, private houses, public buildings, and mines with the new electric light. In the latter it must prove invaluable, as no explosion need ever be feared from it, and these lanterns will burn equally as well under water as in a room.

"Without mentioning the many advantages this mode of illumination has over gas, which by its unpleasant odour and evaporation is slowly poisoning thousands of human beings, and from which explosions are frequent, we can state that by calculations made, this electric light can be produced at a fifth of the cost of coal gas.

"We hope shortly to place before the public more complete particulars, as well as reports of further experiments which are proposed to take place in Vienna, Paris, and London."—See the Russian paper *Golos*, No. 129, of May 11—23, 1873.

NOTES ON BOOKS.

Scientific Handicraft. By J. J. Griffin, F.C.S., &c. (London: Griffin and Sons, 1873.)—This is a catalogue of apparatus suitable for the performance of elementary experiments in physics, comprising mechanics, hydrostatics, hydrodynamics, and pneumatics. The book is abundantly illustrated, and the descriptions are sufficiently full to be useful to the physical student.

What to do in Disinfection, &c. (*E. W. Allen*).—A pamphlet bearing this title is published by Mudie's Disinfectant Company, and though its principal aim is to bring before the public the disinfectant of that company, it also gives a good deal of general information upon the subject of disinfection, which at the present time is likely to be specially useful.

The Turkish authorities have given an order to Krupp, of Essen, for 500 heavy fortress guns. The cost of these guns will be £750,000.

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* See *Journal of the Society of Arts*, vol. xxi., p. 381; also p. 398.

GENERAL NOTES.

Discovery of Coal near Bagdad.—A coal mine has been discovered in the Bagdad district, between Yezireh and Zeto. According to the report of M. Mongel, engineer to the Viceroyalty, the formation extends over a length of more than seven kilometres, with a breadth of from 150 to 200 metres. Eighty-four tons were got out during the first three weeks of working.

Servian Railways.—The principal conditions proposed for the construction of a railway in Servia are as follows:—The concession is to be granted for a term of fifty years, but the Government is to have the option of purchasing the line at the expiration of 20 years. The undertaking is to be called "The Servian State Railway," and it is to have a double line of rails. The company constructing it is to be subject to the jurisdiction of the Servian Government, and it is to have its head office at Belgrade.

The Projected Canal through the Isthmus of Corinth.—According to the *Levant Herald* it appears that the concession for the canal through the Isthmus of Corinth has been granted by the Greek Government to a Greek banker of London. This concession includes a grant of 30 millions of square yards of land for building purposes, docks, &c., the mines and forests in the neighbourhood of the canal, the mineral springs of Zutraki, railroads and tramways, the Lake of Stymphalia for irrigation, the monopoly of the navigation, and numerous other privileges. This undertaking is said to be looked upon favourably in the Levant.

Preservation of Food.—In a recent number of the *Revue Hebdomadaire de Chimie Scientifique et Industrielle*, M. Lanjorrois proposes to preserve animal substances from decay by adding to them 1 per cent. of magenta! The process has been applied to slices of beef, which, after being kept for several months, yielded, after being washed and boiled, very good soup. The *Chemical News* suggests that, should this method of preserving food become general, it is to be hoped that the magenta employed will be free from arsenic.

Asphalte Paper.—Asphalte paper is likely to become of great use in many ways. In thin sheets it is useful for wrapping silks or other fabrics that need protection from moisture, for lining cases, or packing boxes for pianos, &c., or rolled up into pipes for conveying water. Asphalte tubes are only one-fifth the weight of iron, will not rust, and are quite tough and strong. The tubes are simply sheets of paper, of a peculiar quality, dipped in melted asphalte, and then rolled upon a cylinder. A machine for preparing the asphalte wrapping paper consists of a hollow cylinder, heated by steam, and a wedge-shaped box, containing the hot asphalte. The box has a narrow slit, the width of the paper, and as the paper passes, a thin layer of asphalte is distributed on the paper just before it passes the cylinder.

New Pavements.—Wood, macadam, granite, and asphalte (especially the latter) find ardent friends and irreconcileable enemies. Much praise has been lavished upon asphalte; it is clean, smooth, and noiseless; but the memorial presented to the Commissioners of Sewers by the owners of fifteen thousand horses shows that there are at least two sides to the asphalte question. The slipperiness of asphalte when slightly wet is a serious drawback in a country where dampness is the normal condition of things. Messrs. Pickford and Co., and the London General Omnibus Company make the startling statement that accidents to their horses have not only increased fifty per cent. since the introduction of asphalte, but have become more severe in their character. On the other hand, Captain Shaw records his opinion in favour of asphalte. If the use of locomotives on roads develop with the rapidity predicted by many, the durability of pavements is likely to be subjected to much severer tests than it has hitherto endured. A fifteen or twenty ton locomotive, travelling at three miles an hour, the maximum pace proposed for "heavy" engines "in towns" by the Select Committee of the House of Commons, will be very likely to find out the "soft places," both in asphalte and its rival pavements.—*Iron.*

The St. Gothard Railway.—The seventh report of the progress of the St. Gothard Tunnel has just been published by the Federal Council. From this it appears that the length of gallery driven up to 30th of June was 427·40 metres; length of tunnel completely excavated, 296·20; length of arch, 145.00; length of side walls (east), 101·90; ditto west, 141 60; length of drain built, 99·50 metres. The average number of workmen employed during the month of June was 1,036; the greatest number employed in one day was 1,205. At Goeschenen, 19 metres of the tunnel in curve have been driven, and 13·80 of arch built. Towards the end of the month trial will be made of two new boring machines (Mackeau). At Airolo the tunnelling by machinery was commenced on the 21st of June with the machines of Dubois and François.

Central Asia.—The completion of the Northern Bengal Railway to Darjeeling will do much towards opening the markets of Tibet to English produce. Through Sikkim transit is attended with few difficulties, and this route possesses the advantage of leading to the richest provinces of Tibet. A little to the east of the two loftiest mountains in the world—Mount Everest and Kunchin-jinga—is the Jelep pass, only 13,000 feet above the level of the sea, thus affording a practical gateway to Lhassa. Trade with Eastern Central Asia has hitherto taken a circuitous route through Ladakh and over the Karakorum range to Yarkund and Kashgar. Despite the difficulties, dangers, and length of this route, trade has been steadily increasing, and affords great encouragement to those who regard Central Asia as an important future outlet for our manufactures. The Northern Railway will also afford important help to the tea-planters of the Terai. Meanwhile it is gratifying to hear that the mission dispatched with the Queen's letter from Rangoon to Mandalay, in Upper Burmah, has been graciously received by the golden-footed monarch. The route through Upper Burmah, along the line of the Irrawaddy, to Western China, has long attracted the attention of railway projectors, and, if carried out, would have the effect of pouring the whole export trade of Yunan and Upper Burmah through Rangoon.—*Iron.*

NOTICES.

SUBSCRIPTIONS.

The Midsummer subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

THE LIBRARY.

The following works have been presented to the Library:—

Report of the Commissioner of Agriculture for the year 1871, and the Monthly Reports of the Department of Agriculture for the year 1872. Presented by the Department of Agriculture of the United States of America.

Smithsonian Contributions to Knowledge, Vol. XVIII. Presented by the Smithsonian Institution, Washington, United States.

Hydraulic and other Tables, with Rules, and a variety of Useful Information. By J. M. Blackbourne, M. Inst. C.E. Presented by the Author.

Practical Hydropathy. By John Smedley. Presented by the Author.

Traité Pratique du Chauffage, de la Ventilation. Par Ch. Joly. Presented by the Author.

Scientific Handicraft. By J. J. Griffin, F.C.S. Presented by the Author.

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FRIDAY, AUGUST 29, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

GENERAL EXAMINATIONS.

The Programme of Examinations for 1874 is now ready, and may be had gratis, on application to the Secretary.

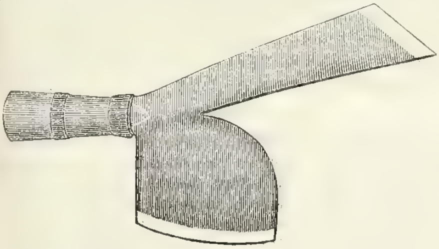
PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The first lecture of the third course of Cantor Lectures for the Session, "On Wines; their Production, Treatment, and Use," was delivered by J. L. W. Thudichum, Esq., M.D., on Monday evening, April 21st, 1873, as follows:—

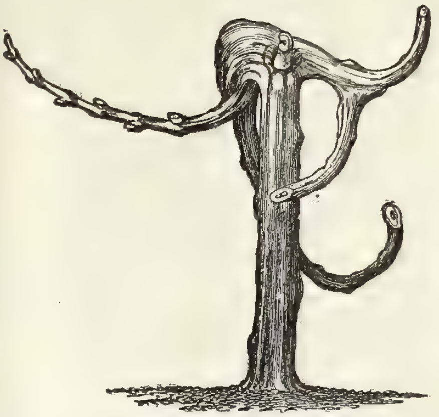
Lecture I.—(*Continued from page* 772.)

Pruning of the Vines.



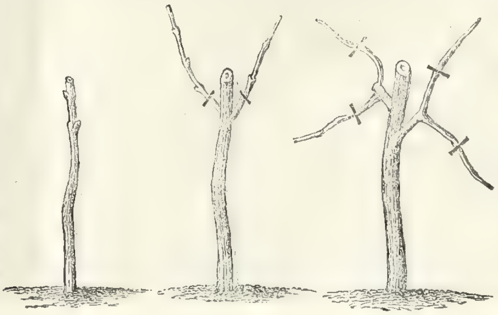
After a long ride, interrupted by frequent local inspections and frequent questions on my part, we arrived at the vineyard, named the "A. B.," from Andres Botaina, its former owner. I requested to have the pruning of the vines explained to me, and the capataz fetched his cutting instrument. This is termed "hoz de poda." The long part, "boca," bears the oblique cutting edge with which the canes are cut downwards. The "peto" is a kind of light hatchet, and used as such upon trunks and dry old wood. In cold weather this hoz not rarely breaks the branches, particularly of young vines, therefore upon such advanced viticulturists now perform the poda by means of the secateur. Each established vine is generally so trained that it carries four arms on a low trunk. Ideally these arms should be at right angles to each other, but as the vines have no supports, and the branches are heavily dragged down by the fruit, they are mostly wonderfully contorted. Long fruit branches may bear from ten to twelve eyes. The three remaining arms are mere stumps of old wood, which, if any, have but one or two eyes left to them. There is here a curious mode of cutting through the node of the cane without considering the eye close by. When the fruit branch has been borne by one arm during one year, it is in the following established on the next arm to the left, and the arm with the obsolete fruit-branch is cut down to a stump. In this manner the fruit-branch travels round the vine like a game of cards, from right to left, once in four years. This cycle is observed in the whole land of Sherry.

After the pruning, the vines look so mutilated and stumpy, compared to their former richness in branches, that the uninitiated can scarcely comprehend the manner of their recovering the autumnal appearance. This was strongly felt by an English visitor, who expressed his fear of what might happen if the pruned vines should take it into their heads not to grow again, and caused him to exclaim, anxiously:—"Y si no mete?"



The pruning is always effected with the intention of causing the branches to grow towards the ground; therefore, stumps which are directed towards the earth are preferred to those which are turned upwards. When old wood is so situated that its cutting off might endanger the fruit branch, it is left. This is the result of the use of the coarse instrument, the hoz, above described. I have not heard of the use of saws, which in the Gironde now everywhere accompany the use of the secateurs.

In old vineyards young vines are practically all produced by layers. In new plantations the vines are produced by canes, or by rooted plants trained in a plantera, or nursery. The new stocks are always planted in a deep hollow, which is gradually filled up. When the plant has obtained a good size, and consists of a good strong cane, it is cut for establishing the foot, that is to say, whereas before it was cut close to the ground, now it is cut at a height of one foot from the ground. Two eyes only are left to it at the top, from which two canes grow. These two canes are in the next autumn cut so as to leave two spurs of two eyes each. Out of each eye



a new cane is produced, and these four canes furnish the four permanent arms of the vine. At the top of the primary stem a little dead wood is left to indicate the spot at which the primary cane was cut from the establishment of the foot. This little stump is, curiously enough, never removed by the vine-dresser. Here I also observed some striking cases of the diseases affecting the vine in Xeres; the most remarkable of them is the ageña—the insolation, or sun-stroke of the leaves, which causes them to die in part or entirely. Many leaves in 1871 showed this effect in the shape of black or brown patches of dead tissue. This ageña also affected the grapes, and gave to many of them a nice golden brown face, a feature considered a prime quality in the chasselas of France, and termed *doré* (gilt). But the grapes so affected at Jerez are always inferior, and never attain either the sweetness or aroma of pale greenish grapes which have ripened in complete shade. The ageña affects young vines more than old ones, and causes great havoc in nurseries (planteras). This A. B. vineyard is mainly planted with palominos, few mantuos, perrunos, and cañocazos; but it also contained stocks of the following rarer varieties of vines:—

Abejera derives its name from the preference shown to it by the bees (*abejas*). It has a thick foot, with many canes, of silver-grey, yellowish colour, partly hanging, partly standing erect. The canes have many laterals. The leaves are entire, or nearly so, somewhat rugose, and of a pale green colour on their surface, and woolly on the underside. The branches are pyramidal, the grapes green, juicy, and sweet, less cloying than those of the albillo castellano, which, in other respects, it much resembles. It occurs in Espera as the exclusive stock of vineyards or patches.

Agracera, distinguished by the *agraz*, or acid taste of its grapes, which is said to make it useless for the production of wine. It is a late-ripening vine, forms flowers until the end of the spring, and ripens some of its fruit only in November. Its grapes are very large, black or violet; the bunches are mostly small, and poorly provided with grapes. Sometimes, however, when the vine is planted in good soil, they become large and close-grained. It is almost exclusively grown in espaliers. The stock is slight, the canes are numerous, and have many branches; their colour is greenish-white, and sometimes reddish. The leaves are small, shining, dark green, and almost smooth. They remain long on the vine.

The *Agracera de soto* is a variation of the foregoing. Its grapes are less black and less acid, and ripen earlier than those of the ordinary agracera. It also resembles a little the melonera. It is more suitable for wine (say the Jerezanos) than the other two varieties, because it is less acid.

The pago el Almocaden lies along the right side of the Trebujena road, opposite high Macharnudo. The road is here also termed the cross road or thoroughfare of Almocaden, as if this pago were situated on both sides of the road. Its soil is albariza, with palomino mainly, mixed with some mantuos, moscatels, and others. The principal vineyard is that of Matamoros. The name of Almocaden is Moorish, and signifies captain or chief of troops guarding the fields. To the right is the pago of Cuadros, fifteen to twenty aranzadas of vineyards upon the rivulet of the same name, abutting on the road to Trebujena, between it and that of Carrascal. The soil is bugeo, with some albariza, mainly planted with palomino. We now entered Carrascal, a pago of seven hundred aranzadas, enjoying great reputation. Carrascal means a forest or plantation of evergreen oaks; it may, therefore, be assumed that these preceded the vines in this pago. The soil on the heights is albariza, in the lower parts bugeo. Its predominant vine is palomino, with some cañocazo, Pedro Jimenez, and albillo. It yields fine mostos and superior dulces. It forms the centre of the group of pagos which lie between the road to Trebujena and that to Lebrija. It contains large vineyards, and amongst them that of Amorosa and that of the Corregidor.

Amorosa lies on a lower hill, surrounded by a circle of higher ones, and therefore well protected from inclement winds, particularly the dreaded levante. It produces the amoroso sherry, which is well known and frequently imitated. Only a short time ago, I saw a naive advertisement of a London wine merchant, stating that he had fine amoroso, that he did not know why it should be called so, but it was much liked, and therefore, etc. He and his customers will perhaps thank me for the information, that Amoroso was the name of the original proprietor and planter of this vineyard, who lived at the beginning of this century, and is remembered as a contributor to the work of Clemente. But for this reason the name might be considered objectionable, particularly as the Italians play much with the root of amor in the names which they give to many of their productions, such as amorino, amoroso, amoretto, and others, all of which I have seen on labels. However that may be, the wine which grows in this vineyard is termed amoroso, because it grows in the vineyard of Amorosa (*i.e.* viña), and not on account of any other real or imaginary properties of the wine.

The vineyard contains some palomino negro, which is generally used for dulce, or vino de color. Having completed our inspection, we rode to the vineyard of Romano. Behind the house of the capataz was a great growth of Marvels of Peru (Suspiros), with white, red, yellow, and violet flowers. Some yellow flowers were piebald, one-eighth of their entire petal being red. The vines and mode of making wine were here the same as everywhere, but I took the opportunity of inspecting the latter a little closer.

VINTAGE.

The gatherers, or vintagers, all men, were busily engaged in selecting the best grapes for dulce, to be dried on the platform. Each had a box (tineta), with a strap of esparto fixed on one side, which hung the box over arm or shoulder.

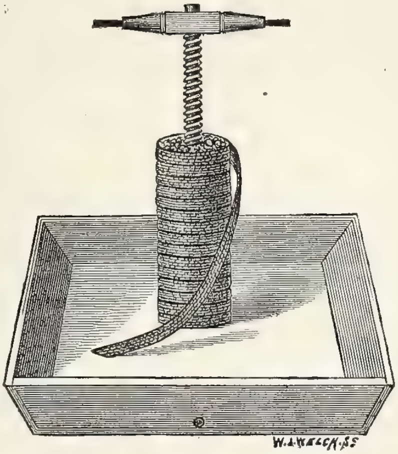
The full tinetas were taken to the platform, and their contents emptied on mats. The next operation was the removal of the main stalks, which was effected by cutting the side-branches of the bunches away from the stalks by means of knives. I was told that this was done for dulce only, and not for other wine. I then inspected the building, which struck me by its size and convenience for vino-poetic purposes. In a large hall were the sleeping mats of the labourers, the pit for their nightly bonfire, and the copper for boiling the must. In a large shed behind this were the lagares, to the number of eight, and an hydraulic press. All these were in active operation.

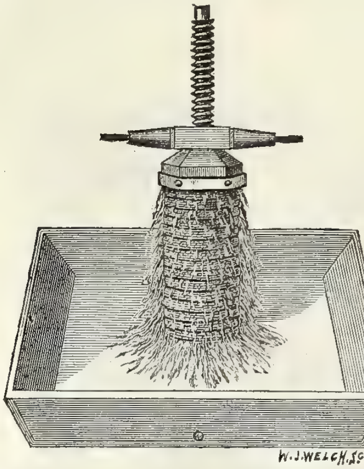
THE LAGAR.

The lagar used in Andalusia is a large square wooden trough, in which the grapes are trodden and pressed, but never fermented. It differs, therefore, greatly from the Portuguese lagar, which is mostly of stone, and serves for treading and pressing as well as fermenting the mosto. The platform or even bottom of the Jerez lagar is a square of about three yards on each side. The sides of the trough are from eighteen inches to two feet high, and slope inwards towards the bottom. The top of the trough measures, therefore, about three and a-half yards in each direction. In the centre of the platform a wooden or iron screw is fixed perpendicularly. This is about seven feet long; it carries a heavy nut, to which strong levers are attached, this entire piece from end to end being about two yards in length. The necessity of getting this piece out of the way of the workmen, when they are treading and manipulating the grapes, causes the enormous length of the screw—for while only the lower half or third of the screw is actually used for pressing grapes, the upper half or two-thirds serves to screw up the nut and leavers to a height above the heads of the workmen. The lagar is raised above the ground about a yard or more and slightly inclined in the direction of the side, where there is a spout for the juice to flow off. Sometimes the lagar is raised sufficiently high to allow a bota to be placed under the spout and receive the juice directly. But more commonly the spout delivers the juice into a tub, even when the lagar is high enough to allow the bota to be placed directly under its spout. Of such lagares there are generally a number kept ready in the building attached to each vineyard. In some vineyards, of which I knew the dimensions, I counted that one lagar was kept for every eight or ten aranzadas of vineyard, so that on each lagar there would be made from thirty to forty botas of mosto during each vintage.

Pressing the Grapes.—Pisa.

The grapes are spread on the lagar, and immediately dusted over with burned plaster of Paris (Yeso). Perhaps from twenty to thirty pounds of plaster are thus employed, enough in any case to precipitate all tartaric acid and leave a large excess of sulphate. Two men (pisadores), lightly clad in short breeches, wearing leather shoes, the entire soles of which are covered with heavy iron nails, now tread the grapes in the lagar, keeping time with each other. The treading proceeds first in one direction, and then at right angles to it, over the entire lagar. The juice does not run from the lagar while the trodden grapes are lying spread, but begins to flow when they are heaped up in one corner and patted with the shovel. New grapes are now spread over the lagar, and trodden, and shovelled aside; and this is repeated until a sufficient quantity has been treated to give a bota of mosto and a quantity of murk sufficient for a pressing, and for leaving a dry cake of sufficient size. The trodden murk is now heaped up around the screw, which stands in the centre of the lagar, and is with great labour and difficulty worked up into a high conical heap. The lagar is swept, and all is carefully collected. To see the pisadores building this "pie" with the shovel, and ever and anon patting it with the hands, cutting, bending, and adjusting it, and then see the murk bulge out here and yonder, and require a new effort on the part of the pisadores, reminded me greatly of the efforts of boys to construct a snow man in thawy weather. At last, however, the column stands, and is now ready for being bandaged. A long band, made of esparto grass, three to four inches broad, is wound round the cone of murk from below upwards in a spiral direction; both ends are fastened by being clenched between two rounds of the band itself. Frequently the windings are not uniform, so that no spiral result is obtained. When well built, the structure resembles much the representation of the tower of Babel in Merian's picture Bible. About fifteen rounds of the band are required to cover a cone about a yard in height. The top of the murk is covered with a plate, over this passes the nut of the screw to which the levers are fastened, and the murk is now compressed by turning the nut downwards. As this proceeds the murk gives out juice, and the spiral circles of the esparto bands are pressed, the upper ones behind or inwards of the lower ones. At last the labour of turning the screw becomes severe. To overcome the friction of the plate, the men have to jerk their bodies violently, and as they might thereby lose the grasp of the levers and fall, they tie their hands to the levers. When the murk is compressed so that the two men jerking simultaneously at the levers can no longer move the screw, the pressing is complete. The cake is allowed to remain in this compressed state for a time and is then removed.



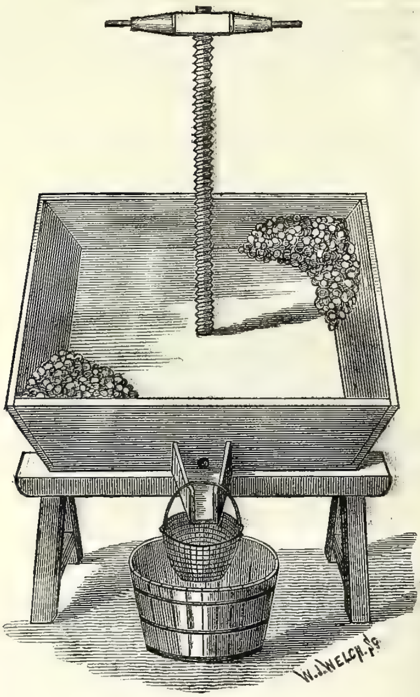


Some now subject the entire murk, distributed on mats, to a second compression in hydraulic presses; others remove the stalks by working the murk on sieves, treat the murk with water and then compress between mats, others, again, simply pour water on the murk and press it between mats. Whenever I have seen any of these processes adopted I have been always informed that the product was not put with the wine or used for wine, but was kept and fermented by itself and ultimately taken to the distillery.

The juice which runs from the most inclined part of the lagar through a spout passes through an iron-wire sieve (see woodcut, page 784), of the shape of an oval basin, hung over the end of the spout to retain pips and husks, and then flows into a tub (tina), whence it is ladled by flat spoons resembling bankers' money shovels, into jugs, and from them poured through a finer sieve, placed inside a wide funnel (embudo), into the butts.

This mode of pressing is highly laborious, and yet does not yield a dry cake of murk. Its only advantage is that it is not strong enough to press juice out of the stalks; but, as no care is taken to exclude the last portions of juice from the husks, which are always harsh, from the mosto, this feebleness is only a partial protection against the coarse elements of the murk. We can judge of this process better by comparing it with the method of pressing used in the Champagne. Here the must is collected in four or five different stages and mixed consciously only, with the distinct object of obtaining the finest and purest juice and excluding acerbity. (See Thudichum and Dupré, Treatise on Wine, &c., p. 459). Compare also with the Jerez mode of pressing, that which is used in Styria and Dalmatia (see ibid., page

604), and the description of good wine-presses as used in the Gironde (ibid., p. 102, *et seq.*)



The pago nearest to Jerez reaching from the Lebrija road to the Sevilla chaussée is the Cruz de las Caballeras. Thirty aranzadas of barro-arena are here planted with mantuos and mollares. United to this is the Pié de Rey, a pago of eight or ten aranzadas. Farther N.N.E. lies Bogar (or Bogas), a barro-arena pago of ninety aranzadas, extending from the Ducha to the Sevilla road.

About one and a half kilometres from Bogar, in the direction toward Ducha, on both sides of the Ducha road, and looking towards Carascal on the west, and Val de Pajuela on the east, is the pago of Doña Rosa, barro-arena with some albariza, about thirty aranzadas in extent. Its vines are mantuos and mollares. The most extreme pago in this section on the Sevilla-road, and stretching on its eastern side to the railway, bordered on the N.E. by the cañada ancha is Val de Pajuela, a barro-arena pago of one hundred aranzadas. On it mantuo predominates.

The second section of the north-east district lies between the Sevilla-road and the Arcos-road. The pagos nearest to Jerez are Jarreta, pago of barro-arena near cemetery, between the road de la Zanja and the carriage road to Arcos. Here also lies Membrillar, close to the rivulet of the same name; its extent is about forty aranzadas. Laguna del Jabonero is a pago which may have been a swamp in which soda-plants, yielding ash fit for soap-making, grew. A part is occupied by the cemetery. Close to it and the cemetery is the Peral del Cangrejo, a pago of barro-arena, and close to this, bordering upon Jarreta, is Peliron, barro-arena, forty aranzadas in extent. Close to the Peral del Cangrejo is the pago of Cuatro Novias, barro-arena, thirty aranzadas. It borders upon the suburbs of Jerez.

On the right side of the Sevilla road, between this and the road De la Zanja, below Valdepajuela, lies the la Zanja, and a side-road called of Largálo, lies the barro-pago of Santa Fé, barro-arena, twenty aranzadas in extent. Between the long narrow lane which runs almost parallel with the Sevilla road, called Callejon de arena pago of Largálo, with a surface of 200 aranzadas. Close to this, and in the direction of Las Abiertas, is Pelona, a barro-arena pago. Here also is Percebá, a barro-arena pago of twenty aranzadas, planted with mantuos and mollares.

The most eastern pago, situated close to the high-road to Arcos, between the olive-groves of Alcántara and land belonging to the Cortijo de la Peñuela, is the pago of Alcántara. It gave its name to the Marquisate of that name, which was bestowed in the seventeenth century upon the Jerezano D. Agustin Villavicencio. Its soil is albariza, its surface one hundred aranzadas—the palomino predominates upon it. Its most notable vineyard is that called of the Cartuja, formerly the property of the monastery of that name on the Guadalete. The last pagos of this group to be described are the Abiertas de Caulina vineyards, in the plain of Caulina, forming the extreme E.N.E. end of the group, and bordering upon the Llanos de Caulina. They extend from the Arcos road to the Callejon de la Zanja, and are traversed by the railway. On the north they are bounded by Santa Fé, on the south by El Pinar. Their soil is barro-arena, their vines are mantuos and mollares, and their surface is one hundred and forty aranzadas.

The vines most commonly grown in this and the following district are the mantuos, mollares, the ferral and beba. I subjoin a short description of them and of their subordinate varieties:—

Mantuo Castellano.—This vine occupies one-half of the Jerez vineyards. Its stock is strong; its canes are numerous and large; at the thick end they are greyish red, towards the point whitish red; the leaves are yellowish green, and reddish when they are shed; they are of medium size, entire, and woolly on the lower face. The numerous bunches are large; the grapes large, equal, of good taste, and ripen a fortnight later than those of the palomino; they rot easily in rainy weather. They are peculiarly consistent, without being hard, as if the juice was shut up in many small receptacles. Many dark stones make the grape disagreeable to eat. Its mosto is very heavy, ranging from 9·7° to 14° B, and developes into wines termed finos.

Mantuo de Pila.—The canes are somewhat irregular; the grapes hard; sweet, but late; this lateness necessitates that they should hang on the vines beyond the time of the general vintage, which causes them to be inconvenient grapes for wine-making, if not kept by themselves Its name is derived from Pila, the town in the province of Seville.

Mantuo morado.—Similar to the other mantuos, but differing by the violet colour of its grapes.

Mantuo Cordovi.—Whitish strong canes; leaves yellowish green; grapes large, bronzed, and translucent.

Mantuo lacren, ladrenado, or layren.—Name derived from the Arabic, of problematical meaning. Similar to the former; its grapes are less translucent and later ripe; its bunches more pyramidal.

Canocazo.—Arabic name, signifying soft mild grape. Is also termed *mollar blanco.* The stock is strong, its canes are numerous and straggling, some being upright, others on the ground, hanging in all directions; they are thick, and of a greyish red colour, with some yellow admixed. The large leaves are almost entire, yellowish green; the branches are large, with many grapes, and giving a mosto of from 11° to 12° B, which produces high-flavoured olorosos. When well dried in the sun it may be advantageously combined with Pedro Jimenez for dulce.

Mollar negro, also termed *Sevillano.*—Stock middling; canes numerous, hanging, greyish red; with large and almost round leaves of yellowish green colour, which become red before the fall. The bunches are large and numerous, the grapes black. Very commonly grown in Jerez, and used for verdeo. Mosto weighs from 9° to 14° B.

Ferrar, also *ferral.*—Stock strong, with few short, thick, erect canes, of a greyish red colour. Leaves yellowish green; bunches large; grapes nearly black, large and very late. In unfavourable years and conditions the husks remain violet, even green, though the contents are quite sweet. It should be grown on espaliers in protected places, upon the so-called extension system, with many branches, like the so-called Hambro' vine of English conservatories, the Tyrol grape, to which it has much resemblance. It is supposed that from the richness in branches (when it is grown on espaliers) the Arabic name *ferrar* is derived. Its mosto is not very heavy, Clemente finding it 8·5° B. I have observed it at 14° B, from very ripe ferrars. Clemente says that its must was not good for wine, as it was too acid. This has been so often repeated, that it is now generally believed; but it is a great error. I have made excellent wine from ferrar. It must not be forgotten that what in Andalusia is acidulous, would be very sweet indeed even in the Gironde.

The last of the favourite vines in this district is the Beba. Its stock is of middling size, with canes which are red, and have the silver-grey hue; they sink to the ground. The leaves are large, and appear whitish, owing to a downy covering; in shape irregular, palmate, lobed, and of uneven surface. The bunches are pyramidal, and dense, and the grapes are large and hard, and frequently bronzed. They are late, and therefore are suitable for being hung up for later use, or for being transformed into raisins. Large quantities are sold as verdeo. As I have repeatedly used, and shall have again to use this expression, I give some explanation of its meaning. Verdear is the selling of fruit for the purpose of its being eaten fresh, or transformed into other products. Thus it is said that the inhabitants of Velez transport to Malaga, in the month of July, "para verdear," or "para verdeo," 250 mule loads of sugarcane. The grapes which are sold as such at Jerez are termed "verdea," but it does not follow that they are all eaten. A portion, no doubt, is made into wine, although produced and sold, in the first instance, as verdeo. (See Clemente, p. 136, footnote 1.)

Calona.—This vine has a medium-sized stock, and few straight and erect canes. The leaves are almost entire, unequally punctured, and of a yellowish green colour. The bunches are large, the grapes large and white, tasty, but sour; this is indeed indicated by its name, which is Arabic and indicates acid or vinegar. It is an early grape and used for eating. Its black brother, the *Calona negra,* also termed *Carchuna,* has yellower leaves than the former, and large thick black grapes. They are sweeter and earlier than the white ones, and liked for eating.

The *Uva de Loja* belongs to the class of datileras, has numerous straggling canes, and small and light yellowish leaves. The grapes are large and frequently two-winged; when single they are conical; the berries have thin husks, and are good for raisins and for eating. The name is derived from the town of Loja.

A kind of vine, not frequently grown here, and possibly identical with the Malvasia of Greece, is the *Malvasia.* Canes erect, short, whitish red. Leaves large, irregularly lobed or palmate; grapes transparent, white, very delicate to eat, sweet, and early, but with a thick skin. Comes from Cataluña. Another interesting vine is the *Vigiriega commun.* Middling-sized stock, many canes, and yellowish leaves, of middling size, almost entire and round. Bunches few; grapes almost round, greenish white, and very sweet, being good for mosto and for eating. A variety of it is the still more rare *Vigiriega negra,* black, and much less sweet than the former.

On this occasion I obtained a classification of grapes, in the order of their quality for making wine:—

Pedro Jimenez—the finest grape, little grown in Jerez, mostly used for dulce; sweetest grape.

Palomino—the dominating vine; produces finos and amontillados; made pure.

Perruno—produces high-flavoured olorosos.

Mantuo castellano—solid fleshy grape.

Mantuo de Pila—late grape.

The foregoing alone form sets in vineyards.

The following never form sets, and are not prized for wine:—

Beba—esteemed for eating.

Cañocazo—scarce; produces high-flavoured olorosos.

Ferral, Mollard, and Palomino Negro—are used by proprietors for making vino de color, as if from white grapes, not red. The ferral and mollar are rejected by the purchasers of partidos.

Almuñecar and Albillo—the most jucy or fluid of grapes.

The proportion in which any of these vines are reared in vineyards may be seen under the description of each district. For common vineyards no proportiou can be stated. I inspected some crops while they were being emptied on the lagares (September 15, 1871), and found them to consist of a mixture of the following grapes, enumerated in the order of their apparent frequency:—Beba, Mantuo Castellano, Palomino, Albillo, and Mollar.

The eastern group comprises the section between the Arcos road and the Hijuela de Pedro Diaz. The first pago which the tourist comes to when leaving Jerez by the Arcos road is that of San Antonio, situated close to the town, upon the drain or sewer de los Alunados, between the carriage-road to Arcos, or footpath del Badelejo on the one and the footpath of the Canaleja on the other side. Its extent is thirty to forty aranzadas; its soil is barro-arena, its vines are mantuos and mollares. On the south-east of, and close to the former pago, is that of the Pozo de Ramos, twelve aranzadas in extent. It is close to Jerez, and approached by the long narrow lane La Manga del Toril. Its soil is barro-arena; its vines are mantuos and mollares. East of San Antonio, and bordering upon the road of Badalejo, is the mantuo-bearing pago of Barbadillo. Between this, the Arcos-road and the pago El Pinar, is that of Cabrestera, forty aranzadas in extent. In this group also lies Garrido, a pago of about twenty aranzadas, and Piedra del Mirabel, of thirty aranzadas. Continuing by the Badalejo road, we meet on the left the large pago of el Pinar, which bears its name from a plantation of pines contained in it, and includes one hundred aranzadas. On its north side this pago is bordered in its whole length by the Arcos road, in the east it borders upon the Caulina plain and Badalejo. South of el Pinar, and on the right of the Badalejo road, is situated the long pago of Canalejo, confined on its south side by the road of the same name, with fifty aranzadas of vineyard. The name is probably derived from criadero de cañas, cañaveral, or more probably from canaléja, a drinking trough. The soil of all the foregoing pagos, when not differently characterised, may be assumed to be barro-arena, and to be planted with mantuos and mollares.

East of the Canaleja is the small barro-arena pago of Catalana, forming a compact mass of vineyards, with the larger pago of Badalejo. This is situated where the Canaleja and Badalejo roads join, and, branching off from the road to Cuartillos, make a semicircular loop towards the Arcos road, winding round the eastern end of el Pinar, already described. The pago lies close to the rivulet of the same name, which flows in a southern direction towards the Guadalete, and joins its waters, profuse in the rainy season, almost nil in dry summertime, with those of the Guadalete, at a point between the Cartuja and the bridge close by. The name of pago and river is spelt by Suter in his map "Albaladejo," sc that we have here an Arabic article prefixed, and some letters transposed. The spelling which I adopt seems justified by the probable derivation from the Arabic guadalec or guadalejo, derived itself from guada, river.

The soil of this pago is barro-arena, with much chalk, containing great numbers of fossil marine shells of the tertiary period. The mantuos prevail, and their products are esteemed. The total area of the vineyards amounts to forty aranzadas. To the south-east of the pago and rivulet of Badalejo is the isolated pago of Culebra, with 25 aranzadas of barro-arena soil, planted with mantuos and mollares.

Due east of Jerez, and about ten kilometers distant, is Cuartillos, forming, with Majada, an isolated group of important vineyards. It comprises about four hundred aranzadas of lustrillo soil. Its vines are palominos, perrunos, albillos, mantuos, and bebas. The most noted vineyard is that de las Animas. Majada, also termed M. Alta, measures twenty aranzadas, and resembles Cuartillos in soil and plantation.

Returning to Jerez from a visit to the plain round Culebras, I passed the pago, which from a neighbouring flowing spring is called Fuente de la Teja. It is situated at the eastern end of the group of vineyards which are enclosed between the road of the Canaleja and that of Pedro Diaz. It passes westwards into the pago of Pedro Diaz, thirty aranzadas of barro-areno soil, and is also blessed with a living spring of the same name. From this pago all the way to Jerez the vineyards lying along the Hijuela de Pedro Diaz, over which I rode, belong to the pago of San José, barro-arena vineyards of forty aranzadas surface, with the mantuos and mollares usual in this district.

The plains all round this eastern district are, if not barren, at least mainly uncultivated. Their soil is clay and sand, and suffers from stagnation of water in winter and drought in the summer. They are covered by groups of palmitos, and were adorned, when I first saw them, with numberless squills in full bloom. Herds of cattle were roaming over them. I was informed that before the Revolution of 1833 these lands were the property of the commune of Jerez. In consequence of the revolution a plan was started in Jerez to cure the poverty of the labouring population by giving them lands. The public lands were divided, and somehow distributed amongst the citizens. The plots were large enough for separate settlements, or the establishment of small farms. But not a single one of the new proprietors was found to settle on, or even work, the newly acquired land. Some sold it on the evening of the day on which they had received the boon, for more or less of wine or money, an arrobe of wine being no uncommon price for an entire lot of several aranzadas. A few monied persons and landowners in the neighbourhood acquired the whole of what had been the common land, for a ridiculously inadequate price; and thus the community was not only cheated of its property, but the mass of its poor inhabitants were deprived of the greater part of the common land on which their animals had, during a great part of each year, found their subsistence.

On leaving Jerez by the southernmost of the eastern gates, one passes the railway station on the right, and soon after under the viaduct of the railroad itself. On the other side of the railroad the way divides into three branches, of which that at right-angles to the railway is the Camino de la Canaleja; another, about thirty-five degrees more to the south, is the Hijuela de Pedro Diaz; and a third, turning immediately southwards, and running close to and parallel with the railroad, is the Camino de la Cartuja.

The first pago close to the south side of Jerez, bordering upon the plain of San Telmo, is that of Mancebia, a small vineyard, of one aranzada, in bugeo soil. Where the road to Monte Allegre branches off that to the Cartuja there is situated the pago of Pozillos, fourteen aranzadas in extent, with barro-arena soil, and planted with mantuos and mollares. In the angle formed by the Monte Allegre and Cartuja road is situated the barro-arena pago of Barrial. Not far off is the farm of Vallesequillo, on barro-arena soil, with orchards and vineyards. In this part the soil is remarkably red when freshly worked, paler when long exposed; some parts are almost reddish brown, and the colour changes frequently with the situation. To the east of the pagos just mentioned, between the Hijuela de Monte Alegre and that of Pedro Diaz, lies the pago of Manjon, or Majon, twenty aranzadas in extent, with barro-arena soil, and the vines appropriate to it. Contiguous to this is the Llano del Moral, a barro-arena pago, of from fifteen to twenty aranzadas. To the south-east of these pagos, and occupying almost the entire space between the road to the Cartuja and that of Pedro Diaz, is the important pago of Monte Allegre, of about four hundred aranzadas. It is divided in its middle by a road bearing its name. Its soil is in one part barro-arena, in another portion plastic albariza. The dominant vines are mantuos with interposed bebas, mollares, and palominos. The point of Monte Alegre close to the Cartuja is termed Cabeza de la Azeña, and contains twenty aranzadas of barro-arena soil.

To the south of the road to the Cartuja, between it and that to the Granja, lies the pago of Buena Vista, which derives it name from certain high hills in its midst, whence a fine view of the old monastery, and of the valley of the Guadalete is obtained. It comprises about sixty aranzadas; its soil is barro-arena, with some chalky under-ground; the prevailing vines are mantuos. More towards Jerez, and to the west of Buena Vista, we see the ten aranzadas of the pago of Flamenco, traversed by the three roads of the Cartuja, la Granja and Solete. The Cartuja road separates it from the Moral, and the Granja road from the pago of Geraldino. This pago is, in its turn, circumscribed by the road to the Granja and that to the Solete. It contains twenty aranzadas of barro-arena, and is planted with mantuos. The name is said to have been selected in honour of a Jerez naval man, who fought with unsuccessful glory at the naval battle of Cape St. Vincent. At the southern extremity of Buena Vista, and close to the Guadalete, we find the pago of la Granja, with a farm of the same name, to which its main vineyard belongs. The road which leads to it bears the name of Camino de la Granja. It is thirty aranzadas in extent; its soil is barro-arena, and its vines are mantuos, mollares, and others.

West of la Granja, and between it and Solete, is the barro-areno pago of Lazo. It is a long strip of land, with twenty aranzadas of vineyards, abutting in the north upon the Granja-road, in the south upon that of del Rio viejo. The last of the large pagos of this district which I inspected is that of Solete, due south of Jerez. It borders in the west upon the Carretera del Puerto, in the east upon the pagos of Lazo and Geraldino, and is traversed by a road which bears its name, and farther west by the railway to Cadiz, running parallel with the road. Its soil is barro-arena, and its vines are mantuos and mollares.

On the outskirts of the district above described are yet a few small pagos, which may be conveniently here enumerated. S.S.E. of Jerez, and at three leagues' distance from it, is the newly-planted pago Torre de la Cera, of forty-two aranzas, with albariza soil. In the same direction from Jerez, but a distance of five leagues, near the ex-convent del Valle, is the pago of Parrilla, of forty aranzadas, also recently planted.

The road to the Cartuja is a quagmire of sand and dust, with here and there a fragment of macadamised road, a remnant of a better past. We traversed it on horseback; but although it was the end of September, the heat was something fearful to feel, particularly when the road was sunk in the ground and bordered by dense hedges of cactus on the top of the banks. It is a great relief and surprise to the tourist, when, at the end of the vineyards of Buena Vista, he suddenly has before him the open valley of the Guadalete, with the Cartuja in the foreground, and is greeted by the fresh air from the distant hills. It is a spot to make a pause at to take in both fresh air and a great sight.

The Torrox group of vineyards, sometimes also called group of las Anaferas, is situated S.S.W. of Jerez, in a pentagonal space, bordered to the N.N.W. by the Trocha de Jerez al Puerto, on the W.S.W. by the Cañada del Carillo, and the northern slopes of the Sierra de San Cristobal. On the N.E. it is skirted by the carretera del Puerto a Jerez, the railroad from Cadiz to Sevilla and the Rio Guadelete, three roads which run close together at the former port of Jerez, el Portal. The entire group is within five kilometres from Jerez, and is easily reached by the Puerto roads mentioned, or by either of two field-roads, the Hijuela of Torrox or that of las Anaferas.

The pago of Torrox is S.S.W. from Jerez, in the place where formerly was a laguna of that name, abutting upon Gibalcon, and giving its Moorish name to the entire group. Its extent is two hundred aranzadas, its soil albariza, with bugeo in the lower parts. The vines are palomino, mantuo, Pedro Jimenez. To the east of this, and due south of Jerez, lies Gibalcon, a pago with an Arabic name, and fronting towards the cerro del Fruto and San Telmo. Extent, ninety aranzadas; soil, albariza; vines, palomino and mantuo. Next to the former two pagos, and almost in the centre of the group, lies the pago of Cibullo, being albariza with some bugeo, fifty aranzadas in extent, and mainly planted with palomino.

The pago nearest the river and railway is that of Parpalana, one hundred and sixty aranzadas in extent. Its soil is white plastic earth, with bugeo in the lower parts. Vines: palomino and Pedro Jimenez intermixed with peruno, cañocazo, albillo, and mantuo. Noted vineyards: Nuestra Senra de la Merced, Perla de Parpalana, borders upon la Calderera and Bonaina. The former is an albariza pago, with sixty aranzadas of palomino, but Bonaina has more bugeo soil, fifty aranzadas in extent, and is also stocked with palomino. To this district also belongs the pago de Galera, a strip of land lying between the river Guadalete and the carriage-road to Puerto, extending from the Portal to the olive-grove del Duque. Its soil, of which only half an aranzada is as yet planted with vines, is exclusively bugeo.

The pago of this group, which is third in importance and most distant from Jerez, is las Anaferas. It borders upon the Cañada (brook lined with reeds) del Carillo, and the pagos of Cibullo and Torrox. Its soil is white albariza, of so plastic a nature that it can be carved with a knife, like soap, and is in that state worked into portable little stoves for charcoal, over which the common people cook their dinners. From these stoves the pago derives its name. The palomino predominates on its ninety aranzadas.

Bordering upon las Anaferas is the pago termed after the brook Cañada del Carrillo, fifty aranzadas, with albariza in the high and bugeo in the low portions. On the outskirts of the group we have yet to notice the pago of Colores, situated on the right of the bridle-road from Jerez to Puerto. It measures twenty aranzadas, with bugeo soil and some albariza. Its stock consists of mantuos and palominos. Close to it, on the left or south-side of the same road, is the pago of Matacardillo, about fifty aranzadas in extent.

South of las Anaferas and of the Cañada del Carrillo, is the pago of the Sierra de San Cristobal. The vineyard is situated on the northern slope of this mountain. Its soil is bugeo, some albariza, and arena, products of the disintegration of the sand and chalk-rock which forms the mass of the hill. The soil on the whole is therefore lustrillo. Extent, fifty aranzadas; vines, mantuos and palominos.

Close to el Portal is the Vega del Moscatel. It forms about six aranzadas of vineyards in bugeo soil, on which choice varities of moscatels are cultivated, amongst them the following:—

Moscatel gordo blanco, also termed romano and flamenco. The stock is strong, the canes are yellowish, like those of reeds, the leaves small and entire, or almost so, and the grapes are large, and have the peculiar flavour.

Moscatel gordo morado, similar to foregoing in shape, but its grape is violet, and the canes somewhat greyish-red.

Moscatel menudo blanco, also termed morisco and fino, is a more delicate plant than the former; its canes are intensely greyish-red. The grapes are small and very sweet, and give the best moscatel wine, or rather sweet liqueur.

Moscatels require dark territory; even in this warm climate their flowers set very imperfectly, but the grapes which become developed at all attain a high degree of perfection.

Farther towards Jerez, to the east of Gibalcon, bordering upon the side-road of las Coles, and the carriage-road to Puerto, are yet two small pagos, the Cerro de Paez, a single vineyard of from six to seven aranzadas, with barro-arena soil, and pago de Palmosa, a small vineyard with bugeo soil.

ANNUAL INTERNATIONAL EXHIBITIONS.

The Council, having been informed that her Majesty's Commissioners do not intend to publish Reports on the different departments of the Exhibition of the present year, and looking to the great importance to Arts, Manufactures, and Commerce that these annual displays should not pass away without some record, have decided to undertake that duty, and for this purpose have engaged the services of gentlemen specially skilled in the subjects of the several sections, to prepare such Reports for publication in the Society's *Journal*. The Council, however, desire it to be understood that, in publishing these reports, they do not necessarily adopt all the views expressed in them, which must be taken as those of the writers only.

The following report is the eleventh that has been issued. The remainder will appear as soon as they are complete.

REPORT ON COOKING APPARATUS.

By G. W. Yapp.

This class occupies considerable space in the Exhibition, there being 52 exhibitors, all of whom, with the exception of two, belong to the United Kingdom.

Economical and efficient cooking apparatus always possessed considerable interest in the eyes of the social reformer, the physicist, and the doctor, for badly-constructed stoves bring in their train waste of fuel, ill-dressed dishes, hot kitchens, and a vitiated atmosphere. Count Rumford, Dr. Kitchener, whose name will go down to posterity in connection with the stoves which bear his name, and other scientific and benevolent men, have bestowed much attention upon the improvement of our cooking stoves, which were in their time, as they are too frequently even in the present day, among the most glaring examples of the neglect of the simplest rules of science and economy. An enormous grate, three or even more feet wide, with nothing but a thin, shifting check to limit the extent of the roaring, smoking fire, with a great gaping chimney to carry off wastefully as much of the heat and gases as possible, with no cooking accommodation but the fire itself, a couple of small hobs, and a pair of smaller trivets, nearly all distant from the heart of the fire, with no arrangement for preventing the radiation of three times more heat into the kitchen than reached the saucepans; such was the kitchen range of the last generation, and such, as we have already stated, is in too many instances that in use in the present day. In no country in the world, but one in which the supply of fuel was abundant, and consequently cheap, would such a wasteful, dirty, and unwholesome apparatus have been tolerated so long as it has been by the inhabitants of the United Kingdom.

The old range has certainly long disappeared from well-regulated houses. Public and other large establishments, clubs, &c., now make use of much improved stoves, but it is well known that in many, the majority of cases, in fact—perfect combustion and economy of fuel have not been reached; chimneys and ranges are, as a rule, far too large; too much is attempted to be obtained from one fire, and consequently the cost of cooking apparatus deters landlords, and actually prevents tenants of small means from adopting superior cooking ranges, while the misguided calculations of manufacturers cause them to produce apparatus unnecessarily large, complicated, and, in many cases, rendered too costly by showy fittings.

The collection of cooking apparatus at the Exhibition well represents that in use all over the country, and may be classed under a few heads—economical stoves for simple cooking for large numbers, such as those used in the army and navy, in hospitals, workhouses, &c.; cooking-stoves for private houses; gas-cooking apparatus; and sundry small adaptations for the camp, the kitchen, &c.

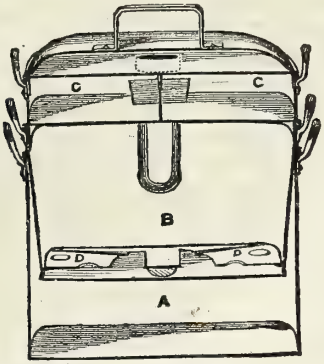
It will be convenient to consider these several classes of apparatus apart from each other, pointing out, at the same time, any features in one class which may be applicable to others.

Messrs. Adams and Son, of London, exhibit cooking apparatus on Captain Warren's system for workhouses, hospitals, barracks, and for domestic use, in several forms (catalogue No. 4,701). In one instance a small steam boiler is used to heat four or more large soup-boilers arranged against the sides of the former; in others the fireplace is at the base of a quadrangular iron case, the upper portion of which forms a large oven, while a number of tin cooking vessels are arranged somewhat in the manner of a pack on a mule's back, so that the heat is well economised.

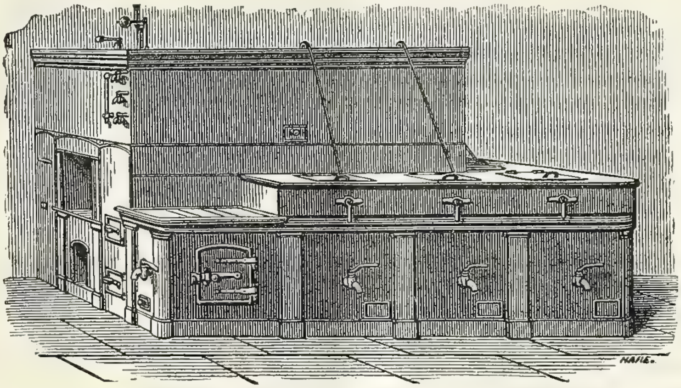
Capt. Warren's apparatus is stated on the authority of official reports to cook for 120 men with a consumption of 28 lbs. of coal per day, or 4 oz. of fuel per man. This is not, however, by far the whole advantage of the system in question. The loss incurred in cooking meat, except in the case of dishes like the French *pot-au-feu*, in which the juices make the soup, but the meat is left in a flavourless condition, is known to be from 3½ to more than 5 oz. in the pound, that is to say a leg of mutton weighing nine pounds uncooked will, if roasted, be reduced to about six pounds; if boiled, to a little over six and a half pounds; and, if baked, to about seven pounds; in careless cooking this loss of 2 to 3 lbs. in seven is absolute; the grease pot alone benefits. Capt. Warren, besides saving 50 per cent. in fuel, has succeeded in reducing the loss in amount by about fifteen per cent., and his apparatus has been adopted largely. Trials were made with it at Portsmouth which prove the truth of these figures. It was found that fifteen pounds of meat cooked in the ordinary way at the Cambridge barracks were reduced to 10 lbs. 12 oz., while by the Warren apparatus the same weight of meat was only reduced to 12 lbs. 1 oz, showing a gain of 1 lb. 5 oz. in fifteen pounds, or nearly 1⅓ ozs in each pound of meat. The success of the plan is beyond question; and its application may be in a certain degree general. It deserves special notice, as being based on a principle which is applicable to all kitchens and has been adopted in many, namely, cooking the meat in its own juices, and thus to a great extent making it supply its own sauce. The saucepan, boiler, box, or whatever form may be adopted, consists of a double vessel, or rather of one vessel within another, with a space of an inch or more between them for water. The meat is placed in the inner vessel, without any water, unless it be salted meat, which requires just water enough to cover it, the water is kept at the boiling point in the outer vessel, the meat is entirely cooked in the vapours arising from its own juices, retains all its proper flavour, and is rendered extremely tender and easy of digestion; the plan applies to fish as well as to butchers' meat.

The sketch (p. 789) of the interior of one of the cooking vessels in question will explain the principle of the whole of them at a glance.

The water is contained in the lower portion, A, which is just filled; B contains the meat, fish, &c., to be cooked; C is a vegetable steamer, of the usual form, the steam rising into it from the lower vessel, A, by means of a pipe; lastly, and this is a highly important feature, of general application, the lid is made double, to prevent loss of heat by radiation, the stratum of air between the top and the lining being an excellent non-conductor. The Warren cooking pot is used with any kind of stove.



Messrs. Benham and Sons, of London (Cat. No. 4,713) exhibit a cooking apparatus of admirable construction, which is in use in a great number of schools, colleges, hospitals, asylums, workhouses, and commercial establishments, represented in the following engraving:—



The apparatus is of the most solid construction and general application; it comprises a brick bread and roasting oven, a pastry oven, hot plate, boilers for steaming, &c., and a hot-water boiler for supplying baths for large numbers with a single fire. The manufacturers give a list of public establishments in which these apparatus are used, and state the consumption of fuel to range, according to circumstances, from 1 cwt. of coals a day for 400 persons to 2 cwt. for 300. The same firm also exhibits an admirably contrived circular apparatus for passenger ships, adapted to cook for about 300 persons, used on board the new ships of the Royal Mail Steam Packet Company. This apparatus is fitted with every means of cooking, bain-maries, &c. They also exhibit a plain, compact apparatus, made as strong and simple as possible, used in the navy and on board the vessels of the Peninsula and Oriental Company, for cooking for the crew.

Messrs. Bowser and Son, of Glasgow (4,714a), also exhibit a well-known ships' cooking apparatus, designed by Mr. James Blake, of the Royal Dockyard, Portsmouth, and employed in the Royal Navy.

Messrs. Jones and Rowe, of Worcester (4,725), exhibit a range which they make expressly for use in workhouses, hospitals, &c., and which, with some modifications, is applied to private kitchens. In the former, a large supply of hot-water is added to the cooking powers of the stove, the system of double steam linings is wisely adopted, and, as in all the best kitcheners, the flues are composed entirely of iron, so that the setting is reduced to the mere fixing of the parts in place. These ranges have been largely adopted, and the certificates of the directors of many public institutions speak of the moderate amount of fuel they consume. The roasting oven seems to be well ventilated, and the fire may also be used for the same purpose.

Captain A. S. Tomkins (4,753) exhibits military cooking utensils carried on pack-saddles; and Sergeant Mayell (4,744), of the 9th Lancers, army cooking apparatus packed in the smallest possible compass for transport.

In the case of stoves for ordinary kitchen service, their great similarity becomes a source of embarrassment, and it is evident that no really satisfactory result can be obtained, except by a series of carefully-conducted trials. It is perfectly well-known, however, to stove makers and others, that the most economical modes of cooking are not adopted, because they require an amount of knowledge which few cooks possess, and more trouble than they like to take. The adoption of apparatus with one fireplace, having of necessity a very keen draught, for all the operations of boiling, baking, roasting, &c., when so much is required of the stove only during very short periods, and the fire is maintained all the rest of the day merely to perform small operations, cannot be declared economical, except in comparison with the old kitchen ranges of which we have already spoken. Certainly a kitchen requires a fire to warm it in cold weather, but the use of a large kitchener for that purpose, even with all its dampers closed, is a costly arrangement. One great recommendation to the kitchener, however, is the abundant supply of hot water, so dear in more senses than one to an English family.

Mr. Addis (4,703), the Industrial Dwelling Company of London (4,704b), and Messrs. Benham and Sons (4,713), exhibit the simplest forms of cooking ranges that can well be conceived; those of the two first exhibitors are small open fire-ranges of the cheapest construction, with oven and boiler; that of Messrs. Benham has been arranged for the use of married soldiers, and is largely employed in barracks, and consists of a block of fire clay forming the fire-place, a small open fire, and an oven; the parts are put together with about four screws, and are strong and simple in the extreme. Messrs. Benham also exhibit a grill stove, one of those highly-finished apparatus adopted in chophouses, a fine piece of work, in which the gridiron is fitted with chains and winch to bring it at the proper height from the fire, and with a wheel and ratchet that alter the angle at which it rests.

Messrs. Bailey, of High Holborn (4,712), exhibit a simple, solidly-constructed, well-finished close fire-range. It is fitted with a moveable bottom grate, so that the fire may be enlarged or contracted at pleasure; the oven is large, and may be ventilated by means of a tube which passes from the front to the back, where the air is admitted through a perforated box, while the steam and burnt air are carried off by the draught of the flue through an opening made for that purpose at the top of the oven; the boiler is made of wrought iron, well riveted together, and the whole apparatus is plain and durable. The same firm also show a compact cottager's or emigrant's stove, suited also for a summer cooking-stove to be placed in a back-kitchen, or an ironing-stove. With a view to emigrants' use the fire-hole is constructed with moveable bars and back, so that wood or turf may be burned in it. For the sake of simplicity all the space is given to the oven, the boiler being replaced by a very large flat kettle; the saucepans drop into the hole above the fire, so as to bring them close to the flame, and a hood is supplied which converts a portion of the hot-plate into a Dutch oven. In the absence of a lining of iron or fire-clay a screen is introduced into the oven to prevent scorching on the side next the fire.

Stoves similar to the above are exhibited by Messrs. Brown and Green, of Bishopsgate-street (4,717); Mr. Constantine, of Kingsland (4,719); and Mr. Murdock, of Cannon-street (4,728). They will be found of all sizes, from that of a hat-box to three or four feet in length. These stoves work well enough in practice under certain conditions, but not otherwise; their greatest fault is excessive fierceness of fire, and they too often burn themselves to pieces in a comparatively short time. They are, however, such a boon to small families, cottagers, and others, that they deserve special attention. Buyers should consider several points; first, whether it is not better to dispense with the boiler in these small stoves, making use of a large, flat kettle on the hot-plate instead, and thus secure a good-sized oven; secondly, whether the iron work is tolerably thick; and, thirdly—a most important point—whether there is anything, either an iron casing or fire-clay, to prevent the side of the oven being burnt out. The writer knows by long experience the necessity for these hints.

Mr. Murdoch, besides well-made cottage stoves, exhibits another class of American stoves well suited to the habits of the people of this country. These are small, ornamental, open fire-grates, bearing the elegant names of "Queen," "Sylph," and "Magnolia," with the fire protected by fire-clay linings, suitable for offices, small sitting-rooms, shops, &c., but which, upon removing an ornamental top, disclose two holes for saucepans or kettles, and are capable of roasting small joints or toasting in front. The moderate prices of these little stoves form a strong recommendation.

Messrs. Poore and Co., of London (4,729a), also exhibit strong, well-made portable stoves of the American type, closely resembling the preceding.

The show of kitcheners, that is to say, of cooking apparatus for ordinary kitchen chimneys, is large.

Mr. Badger, of Worcester (4,711), shows a neatly-made stove, in which the open and close fires are carefully combined, and in which the arrangement for increasing or decreasing the size of the fire is peculiar, the back and bars of the fire-place being simply supported by a series of notches in front. The back of the stove is occupied either by a fire-clay lump or a boilers, as desired.

Messrs. Benham (4,713) exhibit an excellent kitchener for use in a moderate-sized house; and a somewhat similar one, by the same makers, has been adopted in the School of Cookery in the Exhibition. These stoves are very strongly made with thick solid plates of iron, side fire-bricks, and boilers at back. Messrs. Benham have made no point of an open fire, but they have done better, they have taken great care to ventilate their oven thoroughly; the air is let in through a pipe, and being conducted from the bottom to the top of the oven becomes sufficiently warmed before it enters it; the flues are independent of the bricklayer, and the apparatus altogether is of excellent construction.

Messrs. Brown and Green, of Bishopsgate-street, London (4,717), and Luton, whose small or portable stoves have already been noticed, exhibit specimens of the kitchen-ranges which they have made for many years, and in which the facility of roasting by an open fire while all the other parts of the apparatus are in full action, is made a special point. In their kitcheners the upper front of the fire is enclosed by a moveable plate, which, coming in contact with the fuel, becomes very hot, with a large fire it would be red-hot, so that the joint is exposed to as much heat above as below. The apparent intention of this front-plate is to secure full heat on the top of the stove and in the ovens. It is perforated with a line of holes, which admit air over the fire, thus effecting the burning of the smoke. When roasting is not going on, and a moderate heat only is required in the ovens and hot-plate, this front-plate may be turned down, and then serves as a trivet with a low fire. Among the points of these stoves are good arrangements of flues to carry off unpleasant smells, moderate depth with good width of the fire, and a sliding-plate over the fire which allows fuel to be added without the trouble of lifting a heavy cover. In their larger stoves steam boilers are included, but in the smaller Messrs. Brown and Green place their boilers on the hot-plate, and in cases in which only an ordinary amount of cooking is required, this is probably the more economical method. According to the report of a trial with one of the large stoves, it appears that the consumption in three hours was only 86 lbs. of inferior coal, or three-fifths of an ounce of coal per head per man; but in this case all the capacities of the stove were called into action at once, and the cooking was only of the ordinary kind employed in the army.

Messrs. Edwards and Son, of Great Marlborough-street, London, are well known as manufacturers of warming and cooking apparatus; they manufactured some twenty years ago stoves in which the fuel is burnt from the top downwards, a true principle set forth by Mr. Cutler about half a century since, and warmly pressed upon the public in 1854 by Dr. Neil Arnott. These stoves burn admirably well, and the chimneys in which they are used scarcely ever require sweeping, but the fire is not so lively as in a common stove, and consequently they have not become popular; perhaps at the present price of coal they may obtain more favour. Messrs. Edwards and Sons' cooking stoves (4,720) present the peculiarity, since adopted by other makers, of a large use of white tiles, which give them a very light and agreeable appearance, but this is not all—white tiles are light, clean, and do not conduct heat so readily as iron; they aid in keeping the heat within the apparatus and out of the kitchen; they are applied not only to the back and sides of the stoves, but also to the doors of all ovens and hot closets where they are specially useful. The fire in these stoves is recessed, so that the cook may be able to stand nearer to the hot plate than with a fire flush with the front of the grate. In ship stoves the fire has generally a sliding iron guard, or apron, to prevent accidents, and there is no reason why the same arrangement should not be adopted in kitchens. In the case of large apparatus, Messrs. Edwards raise their ovens above the hot-plate, and there is great economy in so doing, but it narrows the hot-plate, the great size of which, by the way, is one of the causes of the comparatively large consumption of fuel often alleged against kitcheners. Messrs. Edwards have rising bottoms to their fires, and the usual arrangements for open-fire-roasting, but they very properly declare in their publications that until the open fire is got rid of, positive economy in fuel must not be expected. In connection with this subject, it is right to state that with thoroughly well ventilated ovens, meat can be roasted in such a way that none but the most fastidious epicure, and in the best cases, not even he, can tell the difference between it and that which has been cooked at an open fire. The flues in these kitcheners are well studied and effective, and the roasting ovens are well ventilated without the clumsy expedient of letting cold air in at the oven door being resorted to.

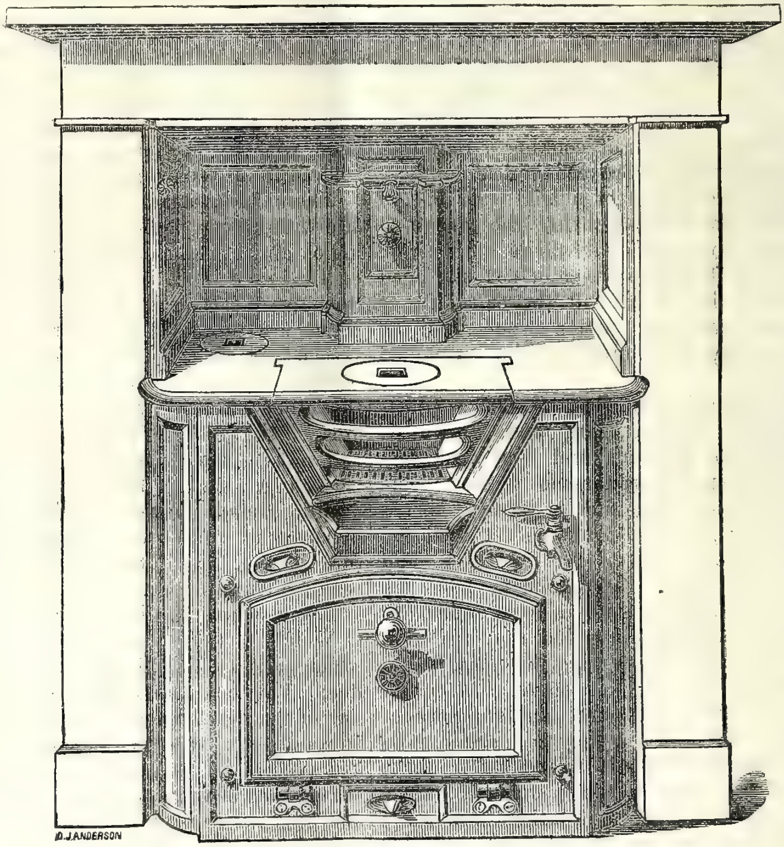
Messrs. Flavel, of Leamington (4,721), are also well-known makers of cooking ranges, having obtained medals at the two great exhibitions of 1851 and 1862, and they have introduced some modifications in the arrangement of parts, which are protected by patents. Amongst the special features is the substitution of two loose bottom grates, one flat, for a high roasting fire, the other on legs which greatly diminish the area of the grate. This is certainly a cheaper and more simple plan than that of a bottom worked by a rack. The ventilation of a roasting oven in Messrs. Flavels' kitcheners is managed by means of a cast-iron box placed over an aperture in the top of the oven, close against the back; a constant current of air passes through this box, when, and in proportion to the extent to which, a valve which works in it is open, which carries off all the steam and fumes into the flue. This box also forms the back of the top flue of the oven, beneath the hot-plate. In the larger-sized stoves, the boiler is strongly made and placed at the back of the fire. Messrs. Flavel take advantage of fire-clay to retain heat and preserve the side of their ovens. They have a very neat form of latch to their oven doors, and, in common with some other makers, they adopt the very useful arrangement of a bracket-piece, set level with the floor of the oven, upon which the cook may easily draw out a dish to see how the cooking is progressing. In the case of heavy joints, this is a great boon to cooks, and may prevent many accidents.

Mr. Gray, of Torquay (4,722), exhibits a kitchener which presents little difference in appearance from others around, with the exception of the adoption of bracket-rests for both ovens. These Devon-tor ranges, as they are called, have been for some years before the public, and are said to consume a very moderate amount of fuel. Like others already mentioned the fire may be either closed or open, and when open may be reduced by simple contrivances to a very small one. The arrangement of the flues and the equalisation of the top and bottom heat of the ovens have evidently been carefully studied, and the iron-work of the ovens is carried up to the hot plate, in order to avoid the common accident of displacement of bricks, mortar, or cement. These stoves are strong and well put together.

Messrs. Hassall and Singleton (4,724) show a close and open fire-range which calls for no special remark. The model is of an ordinary kind, with no peculiar features as a cooking stove. The sides of the stove are formed into hot-air chambers for heating apartments.

Mr. Nock, of Birmingham (4,729) shows another open and close fire-range, the characteristics of which are very large ovens, and a novel form of fender, which is just level with the bottom of the ovens, and supplies firm support for drawing out dishes, or for the foot of the cook, besides answering the ordinary purposes of a fender. Mr. Nock uses a fire-clay grate-back, and causes the fire and heated air to pass down behind the back and under the bottom of the ovens first, and lastly over the top and into the main flue. The bottom of the grate is worked upwards or downwards, to increase or diminish the size of the fire, by means of a vertical screw. The front of the stove is octagonal in form, so that the cook in working at the hot-plate is less exposed to the fire than in a straight-fronted stove.

Messrs. Wright and Co., of London and Rotherham (4734), exhibit two "economic cookers," of smaller dimensions than usual, only two feet wide, which deserve attention from their compactness and moderate prices. In these stoves a large oven is placed beneath the fire, and the boiler across the back; the fire-place is lined with fire-brick, and the stove, like many others,



can be converted in a moment into an open grate. The maker claims for it great economy in the consumption of fuel.

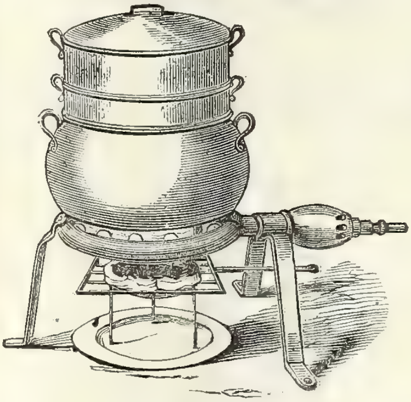
Gas cooking apparatus presents more novelty than that which is fed by ordinary fuel, and its cleanliness and convenience, the portability of the stoves, their comparative independence of positive flues, &c., are highly attractive characteristics; still the fact remains that under ordinary conditions cooking by gas is not an economical process, and as the cost of gas follows, of necessity, the price of coal, their relative advantages in this respect must always maintain the same ratio. The original form of gas stove, a ring of gas pipe pierced with a number of holes, unprotected by any heat-preserving arrangement, although a very simple and cheap apparatus, is as extravagant a form of cooking stove as could be imagined, though it has this special advantage, that the gas is always ready at any moment, where there is day service, and the fire can be extinguished the moment the cooking is done. Its disadvantages were many, the holes in the pipes wore away rapidly, and the jet thus became irregular; every breath of air caused flickering and loss of heat, and the product of combustion often filled the place with disagreeable smells, while the meat in broiling was liable to be contaminated with them.

One of the grand faults of the original gas stoves was corrected by the introduction of the atmospheric jet, or Bunsen burner, which consists simply of a gas pipe placed within a pipe of larger dimensions, and fitted with holes to admit air; the pressure of the gas causes the air to enter the outer tube at a proportionate rate, and the gas and air are then burnt together in the proportion which the inlets of the two bear to each other. The effects of this arrangement are great economy in the amount of gas consumed, small steadily burning jets, with great heating and but little luminous power, and lastly, the absence of sooty deposit on the cooking utensils, in consequence of the more perfect combustion caused by the oxygen of the air. A gas cooking apparatus without an atmospheric burner ought to be regarded as a monstrosity, only equalled by the burning of a candle in the open air without protection. But even with the use of the Bunsen burner, the ordinary gas stove is a wasteful apparatus, and the amount of heat lost is out of all proportion to the work done by its means. Fortunately this fact has been recognised, and the most approved gas apparatus presents many arrangements well deserving of attention.

First in order, as in importance, is the show of gas apparatus made Messrs. Leoni and Co., of London (4,705). In the collection exhibited by this firm is almost every form of cooking apparatus, from the simple ring of gas to that for the preparation of food for a large household, and even for public establishments. Mr. Leoni has evidently studied his subject carefully, and has produced admirable results.

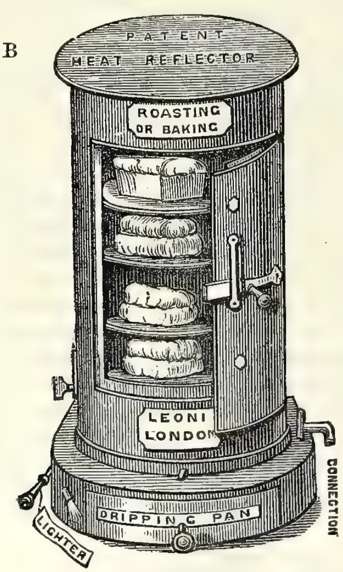
In the first place he has adapted a patented composition, called "adamas," to the formation of gas-burners. These are placed in holes in the gas rings and tubes, and, while they produce well-formed jets, wear infinitely less than the holes in an iron pipe, which soon lose their regularity of form from the heat. Secondly, he has introduced a fireproof material in many ingenious ways, as linings to large cooking apparatus, as reflectors and diffusers, and as small ovens, and has thus given to gas apparatus new and improved forms. The simplest form of cooking-stove, as supplied by all makers of such apparatus, is a ring of gas-jets set within an iron frame, which serves as support for kettle, saucepan, and fryingpan. The next step is the adoption of the principal of reflection which is shown in a simple form in the accompanying figure A. In this case a boiler, with stewpan and steamer, is placed over the gas, while a portion of the heat reflected by the bottom of the boiler is made to grill a chop below. In place of the boiler a pair of Mr. Leoni's heat-reflectors may be used. These are simple circular vessels, made, as already stated, of fireproof ware two or more inches deep, and about half-an-inch in thickness. Two of these placed together, the upper one bottom upwards, form an excellent oven for potatoes or any small pieces of meat, &c., and the heat on the top is sufficient for gentle simmering, or keeping anything hot.

A

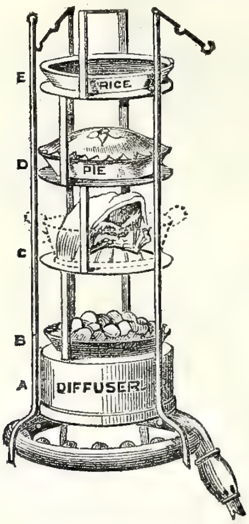


The complete application of the principles of reflection, diffusion, &c., is well illustrated in the two figures B and C (p. 794), the former representing an apparatus three feet high, and about sixteen inches in diameter, capable of roasting a joint of meat up to 14 lbs., baking four loaves of bread, or cooking an entire dinner. A description of the parts of this apparatus will explain the principles adopted by Mr. Leoni. The ring of gas is near the bottom of the apparatus, above the dripping-pan; on one side is the gas-pipe connection, and in the other a neat arrangement for lighting and extinguishing the gas. The outer case of the stove is of iron-plate, but within this is a jacket of heat-reflecting composition, an inch thick, shown by the broad white line to the left of the door. Between the iron case and the composition lining is a space all round, which greatly economises the heat, and allows of complete ventilation when required. The top of the stove is simply covered by one of the heat reflectors already mentioned, on which anything may be kept hot, or which may be replaced by a gas ring for broiling. The interior of the stove may be arranged according to the requirements of the day, being built up of circular stands made of thin iron-plate. Figure C exhibits an arrangement for general cooking purposes, while B contains four loaves of bread. At the bottom of C is a heat-diffuser—a mere circular plate of the fire-clay composition; this is used to disseminate the heat equally, and is necessary in all cases except roasting when a fierce central heat answers best. When a large piece of meat or poultry is to be roasted, it is simply hung from the centre of the frame, the divisions being removed.

B



C



The above description will apply generally to nearly the whole of the cooking stoves made by Mr. Leoni, whether large or small, round or square. For hotels and other large establishments Mr. Leoni makes roasting apparatus to cook from 100 to 200 lbs. of meat or poultry at once. In these cases the cover is lifted by means of a lever, the body of the machine is drawn from beneath on rails, and the iron cage of two stages containing the meat lifted out by means of a light crane. The principle has been still further carried out by the same firm at the London Hospital, in the Whitechapel-road, where a large apparatus has been at work for a considerable time. This stove is, for convenience, fitted beneath the floor line; the roof or reflector of the apparatus is attached to an iron trap-door, which fills up the opening, and thus completes the level of the floor. By means of cogged wheels, the winding up or down of this trap is easily done in two or three minutes; a light crane by a similar process works up and down an iron lift which holds the meat, and in this manner eight minutes are sufficient time for one man to fill the apparatus with about 300 lbs. of meat, and the same time to empty it. The dripping is carried off as soon as produced into a pail at some distance from the gas apparatus, where it cools at once; products, fumes, steam, &c., are carried off underground into the flue; gas is lit, turned on or off by means of a special apparatus, from the floor above ground, and according to the quantity of meat the heat is regulated, by turning on either one, two, or more supplies. The whole quantity of meat is roasted in exactly two hours' time. During the roasting the meat requires no basting, turning, or any attention whatever.

This apparatus was set up in 1870, and its results are thus summed up in a letter by Mr. J. Nixon, house-governor and secretary of the hospital:—"In the six months ended 31st December last (1870), the large roaster was in use 125 days, being about six days short of a full half-year's work. The waste of meat during this period averaged about 14⅓ per cent., as against 33⅓ under the old systems of roasting, while the consumption of gas was also reduced from a daily average of 610 to 250 cubic feet. The actual saving to the hospital in 125 days was, in meat, 4,579 lbs., and in gas 44,525 cubic feet, or for a full year's working of 261 roasting days very nearly 10,000 lbs. of meat, worth at present prices £296, and about 88,000 cubic feet of gas, costing £17 12s., and representing together an annual saving in money of £313 12s."

The following is Messrs. Leoni's statement of a practical experiment made with one of their family gas apparatus:—

"Breakfast for five adults and three children—two pints of coffee, one pint of tea, half-pound of bacon, half-pound of oatmeal for porridge, six rounds of toast; time, twenty minutes; consumption of gas, twelve feet; cost, under three-farthings. Dinner for twelve adults and three children—6 lbs. leg of lamb (loss, 1¼ lb.), 4 lbs. sirloin of beef (loss, 10 oz.), 5 lbs. of potatoes, six large cauliflowers, two large fruit pies; time, one hour and a half; consumption of gas, 48 feet; cost, 2¼d."

Messrs. Leoni have also applied gas to the production of steam and baking. They exhibit a high-pressure steam boiler, worked with 36 gas jets, which produces 100 feet of steam per hour, with a pressure of ten to fifteen pounds per inch A pipe connects this boiler with a steam-cooking chest, having a metallic lining throughout, cover included, the space between the metal ceasing and the wood lining filled, like the Norwegian boxes, with felt.

Messrs. Billing and Co., of London (4,714), have in their stoves, which are good specimens of work, relied almost entirely on the principle of reflection for the operation of roasting. The mode adopted is one which has been in use for some years for gas-heating stoves, and originated, we believe, in France. The gas pipe is above the meat to be roasted, and thus all fear of the latter deriving any unpleasant smell from the process of combustion of the gas is entirely obviated. In small apparatus the heat is reflected downwards direct upon the meat, while in larger stoves the reflector is placed at an angle of about 45 deg. behind the meat, and a tin reflector placed in front of the joint, as in the case of an ordinary coal fire. Above the gas is the hot-plate, and thus one series of jets is made to perform two sets of operations, as in the small gas cooker described above; this looks, at first sight like a very economical arrangement, and so, under certain conditions, it is. If a good deal of cooking is to be done at the top of the stove and a small amount below, the economic conditions are fulfilled, but if these be reversed there must be a great loss of heat, for a given number of feet of gas can only give a certain number of degrees of caloric; and, moreover, the reflected heat is not equal to direct heat. To roast below the gas must require a large quantity, and, as already stated, unless the top heat is actually required, there must be loss. A chop, or any small article cooks admirably under reflected heat, but the system can only be regarded as supplementary.

Messrs. Billings have adopted the good arrangement of double sides to their ovens, and thus obtain great regularity and economy of heat, but the latter would be much increased by the addition of fire-clay linings. The almost unavoidable spilling which occurs in cooking causes extremely unpleasant vapours to arise; this is in some cases partially prevented by the use of sand on the hot plate, and Messrs. Billings have adopted an ingenious mode of cleaning the plates; in small stoves the top rails or other supports for the saucepans, lift up to allow of the plate below being cleaned, and in the large stoves this plate is made to draw out, like the wooden tray of a bird cage. Messrs. Billings make use of the Bunsen burner in various sizes, and their pipes and fittings are well arranged. The following is their own statement of the capabilities of one of their Family Cooking stoves, about three feet high by 18 inches square:—"A joint weighing nine pounds, a large family pie, a couple of ducks, two sorts of vegetables, fish and soup, were all cooked at one time in the space of two hours, consuming about 40 feet of gas."

Messrs. John Wright and Co., of Birmingham (4,735), are well known manufacturers of gas cooking and other stoves, and the articles which they exhibit are neatly got up, in some cases remarkably so; the white tiles, set in neat iron frames, present a bright and extremely clean appearance. Their ovens and general apparatus for cooking bread, meat, and all other kinds of food, have, we are informed, been for some time in use at the Crystal Palace, Sydenham, and many other establishments. These makers do not seem to adopt either double iron walls or fire-clay linings, and this must be regarded as a serious oversight; the escape of heat which has done no cooking, must always be one of the tests of the economy or otherwise of such apparatus, and their white tiles, although good reflectors, are very far indeed from perfect reflectors and anti-radiators. Messrs. Wright, however, make use of certain earthen reflectors and heat distributors, similar, if not identical, with those of Messrs. Leoni. They declare that their ordinary domestic cooking stoves do not consume more than a pennyworth of gas per hour.

Gas stoves are also exhibited by Messrs. Davis and Son, of Westminster; Mr. Hall, of Battersea; Mr. Mitchel, Mr. Southby, and Messrs. Chavasse and Co., of London; Messrs. Scott and Butler, of Birmingham; Messrs. Verity

Brothers, of Paddington, and one or two other firms, but present no features calling for special notice. The last-named firm makes use of large fire-clay burners, and white porcelain slabs beneath the hot-plate.

A word should be said by way of recommendation of the excellent French fire-proof dishes and pans introduced by more than one exhibitor of gas apparatus.

Cooking by means of petroleum or other hydrocarbons is illustrated by two exhibits, that of Messrs. Odhner and Co., of Stockholm (4,707), which is a small portable apparatus, with two lamps, with long, flat wicks; and the apparatus of Messrs. Randall and Co. (4,730), who apply the vaporisation of hydro-carbons to large and small cooking apparatus as well as to heating purposes. These "vapour stoves," as they are called, are but recently introduced, and require a few words of explanation. The fire-place in which the mineral oil is burnt is circular, having in the centre a small hollow iron cone truncated, a taper ring. Behind the stove a small vessel containing the oil is mounted on a tall tube, so as to be out of the way of danger from the fire; and from the upright tube a small horizontal one passes over the top of the conical ring already mentioned; the supply being regulated by a stop-cock, the oil is allowed to drop very slowly from the tube into the ring. The oil being lighted burns at first in yellow flames, but when the cone and fire-place have become hot, which they soon do, the oil is vapourised at once, and burns in the form of gas with a blue flame. The apparatus seems to answer its intended purpose well, but its economy must be ascertained by practical experiment. The invention is American.

A few small apparatus remain to be mentioned. Messrs. Chavasse and Co., of London (4,704) show a family coffee-roaster, in the form of a frying-pan, with cover and interior stirrer; and a useful portable "hot-air oven," which consists of a close-fitting double iron pan with handles, which may be put on or in any kind of fire, the potatoes, chestnuts, or other contents being protected from burning by an inner lining with holes.

Messrs. Silver and Co., of London (4,732), exhibit that valuable invention, the Norwegian apparatus, that is to say, a close-fitting box, with a thick lining of felt, or hair, which is equally valuable as an ice-box or as a cooking apparatus. It is only in the latter form, however, that it comes within the scope of this report. The Norwegian box is pretty well known; those who are unacquainted with it will be hardly prepared for the fact that food contained in a tin saucepan, of which the water has only boiled for a few minutes, when shut up in the Norwegian box will be as thoroughly cooked as if it had been kept for the usual time over a fire; and, further, that it will remain hot and unspoiled for from eight to thirty hours, according to the size of the box For campaigning, travelling, boating, &c., such a companion is invaluable; and, in addition to this, it must be mentioned that cooking in such a manner causes the smallest possible amount of loss.

Mr. Smartt, of Buckhurst-hill (4,733), shows a small machine, called a sub-fire oven, consisting of a tin vessel with one rather smaller inside, and between which a small amount of space is maintained, which is partly filled with water, as in the Warren kettles; a cover overlaps both vessels, and the whole is easily managed by means of a simple moveable handle. For keeping anything hot, for warming up, and for cooking small things on the ashes, or beneath a fire, a better or more simple arrangement could scarcely be imagined.

Messrs. Needham and Kite, of London (4,738). Mr. Duff, of Leicester (4,739), and Mr. S. Jones, of London (4,742), exhibit self-acting and basting roasting machines. These, and most of the other small apparatus mentioned above, are in the Food Class, in the upper east quadrant, where the Atmospheric Churn Company (4,129), show an ingenious portable cooking dish, which, when closed, looks like a gigantic silver hunting watch. It contains a small stand for one of the two tin dishes of which it is composed, and a little tin grate. One dish is placed on a table, the grate within it, and the other dish on its stand over the grate. The lower dish acts as a reflector, and in ten minutes or so a chop, egg, or other small viand is cooked by means of waste paper only.

In the annexe opposite the door of the School of Cookery will be found a very neat apparatus, called the "Flying Column Portable Stove," the invention of Captain Lecky (4,751). It consists of a small cooking stove, with canteen for three persons, all packed into a stout iron bucket, which will hold six gallons of water, and the weight of the whole is 22 lbs. It was used at the last autumn manœuvres in several regiments and battalions and volunteer contingents; and is stated as boiling a kettle or saucepan with eight ounces of wood in eight minutes. In the same place, Mr. D. Tallerman (4,752), of London, exhibits one of the great catères used in the French army for making coffee.

The collection of cooking apparatus does not present anything new in principle—it was scarcely possible that it should—but it exhibits an amount of improved workmanship and many economical adaptations the value of which cannot be overlooked at a time when the price of fuel is one of the most serious questions of the day.

The number of visitors admitted to the Exhibition during the week ending Saturday, August 23rd, was as follows:—Season tickets, 732; on payment, 15,286; total, 16,018.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,085. Vol. XXI.

FRIDAY, SEPTEMBER 5, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

TECHNOLOGICAL EXAMINATIONS.

The subjects in which examinations were held this year, namely, Cotton Manufacture, Paper Manufacture, Silk Manufacture, Steel Manufacture, and Carriage-building, will be retained in the Examinations of next year, with the addition of Cloth Manufacture, Glass-making, Pottery and Porcelain, and the Manufacture of Gas.

The Programme is in preparation, and will be published as soon as possible.

In the report of the Educational Officer read at the Conference, held on the 27th June, it was stated that six candidates had been examined at the Technological Examinations held on the 17th May. The reports of the examiners relative to the papers worked were favourable, but at the date above referred to the returns of the examiners of the Department of Science and Art, relative to the science subjects, had not been sent in. These have now been received, and the results are as follows:—

E, means Elementary Stage; A, Advanced Stage; and H, Honours Stage.

Carriage Building.

Name.	Address.	Age.	Occupation.	Science Subjects.*						
				Obligatory.			Optional.			
				I.	VI.	VII.	II.	V.		Freehand Drawing.
								stage.	class.	
Heywood, J. J. ..	19, Parker-st., Preston	22	Carrriage Builder	A 1	E 1	A 2	H 2	2	1	Passed.
Mullins, T. F. ..	42, Naylor-st., Cork..	26	Do.	E 2	E 2	E 2	..	..		Passed.
Mullins, M.	42, Naylor-st., Cork..	19	Do.	E 2	E 2	E 2	..	..		Excellent.

The above have all complied with the conditions, and have obtained first-class certificates in the elementary stage of carriage building.

T. F. Mullins has been awarded the Society of Arts' prize of £5. The studentship of £50, given by Her Majesty's Commissioners, will be offered to him on the conditions stated below.†

M. Mullins obtains the prize of £3, offered by G. N. Hooper, Esq.

J. J. Heywood obtains the prize of £2, offered by G. N. Hooper, Esq.

Cotton Manufacture.

Name.	Address.	Age.	Occupation.	Science Subjects.							
				Obligatory.			Optional.				
				I.	VI. or VII.		II.	III.	V.	XVI.	XXII.
Mills, Thomas G.	200, South-st., Longsight, near Manchester....	22	Cotton Manufacture....	E 2	..	E 1	A 1	..	..	..	A 2

The above candidate has complied with the conditions, and has obtained a first-class certificate in the elementary stage, cotton manufacture, with the Society of Arts prize of £5.

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* The following is a list of the science subjects referred to:—

Subject I. Practical, Plane, and Solid Geometry.
„ II. Machine Construction and Drawing.
„ III. Building Construction.
„ V. Pure Mathematics.
„ VI. Theoretical Mechanics.
„ VII. Applied Mechanics.
„ VIII. Acoustics, Light, and Heat.
„ X. Inorganic Chemistry.
„ XXI. Vegetable Anatomy and Physiology.
„ XXII. Steam.

† Her Majesty's Commissioners for the Exhibition, in a letter to Major Donnelly, say that, "with the view of encouraging persons to present themselves for the examinations in technology, which have been established by the Society of Arts, they have resolved to offer to grant three studentships, of fifty pounds each, to be awarded to the persons who shall distinguish themselves the most in the subjects of steel, silk and carriages respectively, at the examinations in the present year. These scholarships are to be awarded on condition that the recipients go for a year to some place of scientific instruction, such as the Royal School of Mines, the Royal College of Science in Dublin, Owens College, Manchester, or the English, Scotch, or Irish Universities, or other school approved by her Majesty's Commissioners, or travel abroad for the purpose of improving themselves in their trades."

Steel Manufacture.

Name.	Address.	Age.	Occupation.	Science Subjects.								
				Obligatory.					Optional.			
				VI.	VII.	VIII.	X.	XIX.	I.	II.	V.	
											stage.	class.
Warren, W. H. ..	2, Upper Cross-rd., Kingsland-park, Dublin ..	21	Engineer.	A 2	A 2	H 2	A 2	A 2	H fail.	H 2	3 5 6	2 2 2
Jamieson, A.	7, Little Heath, Old Charlton, S.E.	23	Mechanical do.	A 2	A 2	..	E 1	Fail.	E 1	H 2	2	1

W. H. Warren has complied with the conditions, and has obtained a first-class certificate in the honours stage, Steel Manufacture, with the Society of Arts prize of £10. The studentship of £50, given by Her Majesty's Commissioners, will be offered to him on the conditions stated in the previous page.

A. Jamieson failed in subject XIX., and has not been examined in subject VIII.; he does not therefore comply with the conditions, but he may do so in a future year, and will then be entitled to a certificate.

GENERAL EXAMINATIONS, 1874.

The Programme of Examinations for 1874 is now ready, and may be had gratis, on application to the Secretary.

These Examinations, in 1874, will be held on the evenings of the 21st, 22nd, 23rd, and 24th April. The Time-table has been arranged as follows:—

TUESDAY, April 21, From 7 to 10 p.m.	WEDNESDAY, April 22, From 7 to 10 p.m.	THURSDAY, April 23, From 7 to 10 p.m.	FRIDAY, April 24, From 7 to 10 p.m.
Arithmetic. Logic. Floriculture.	Theory of Music English History. German. Spanish.	Political Economy. French. Fruit and Vegetable Culture.	Book-keeping. English Language. Italian.

Friday, April 24, 6 to 7 p.m.—Dictation.

The rule which formerly prevented a candidate who had once obtained a first-class certificate in a subject from being again examined in that subject with a view to gaining a prize, has, in accordance with the wish expressed at the Conference, held on the 27th June, 1873, been rescinded. In future, therefore, a candidate who has obtained a first-class certificate in a subject may be again examined in that subject, but not more than one first-class certificate in any subject will be counted for the Prince Consort's Prize, or for the Council Prize to Females. A candidate having taken the first prize in any subject cannot again take a prize in that subject, nor can a candidate take a prize of the same grade twice in any subject.

The Elementary Examinations, held by the District Unions and Local Boards, for which papers are furnished by the Society, are fixed for the 10th, 11th, and 12th March.

Full details in reference to the Examinations are given in the Programme, copies of which should be applied for to the Secretary of the Society of Arts, by all intending to come forward as candidates, or otherwise interested in the Examinations.

A copy of the Programme accompanies this *Journal* to each Institution in Union, and additional copies will be forwarded on application.

ECONOMICAL USE OF COAL FOR DOMESTIC PURPOSES.

With regard to these prizes it has been decided that testing rooms will be provided, in which the various competing articles may be tested in succession, each competitor having allotted to him in turn a room and chimney, for a limited period, where he may fix his apparatus for the purpose of its being tested by the judges appointed by the Society of Arts, the same to be removed when directed by the judges; such fixing and removal to be at the cost of the competitor.

The competing articles must be delivered at the London International Exhibition Building, South Kensington, on the 1st December, 1873, with a view to their being tested, and subsequently shown in the Exhibition of 1874.

The *Engineer* has intelligence of preliminary arrangements of much significance for developing the submerged minerals in a portion of the South Staffordshire district, that will result in the bringing to market of several millions of tons of good coal, besides much valuable ironstone.

An immense quarry of lithographic stone has just been discovered near the small town of Volbrom, in Russia. A merchant in Berlin is said to have purchased it for 100,000 francs.

It is stated that coal has been found in Westmoreland, and that some Middlesbrough capitalists are interested in the discovery, which they intend to turn to practical account without delay.

The annual consumption of tin in America and Europe was, in 1868 and 1869, about 22,000 tons; in 1870, 24,000 tons; in 1871, 27,000 tons.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The second lecture of the third course of Cantor Lectures for the Session, "On Wines; their Production, Treatment, and Use," was delivered by J. L. W. Thudichum, Esq., M.D., on Monday evening, April 28th, 1873, as follows:—

Lecture II.

The Varieties of Wines Produced at Jerez—Mostos, Anadas, Firos, Palos-cortados, Amontillados, Rayas, Bastos, &c.—Physical and Chemical Observations on the Causes of these Different Results.—Brandying, Plastering, Sulphuring, Mixing, and Counterfeiting of Jerez Wines.—Neglect of Scientific Guidance in Vinification diminishes the Certainty and Success of otherwise highly-developed Viticulture and Commercial Operations.—Other Spanish Vineyards and Wines.

Density of Jerez Mostos.

Many a sherry-drinker has heard the oft-repeated tale, that in the south the grapes are so sweet, so highly charged with sugar, that the mosto made from them is unable to consume the whole of it, and remains sweet, to some extent, even after fermentation has produced the ordinary quantity of alcohol. This tale is often made to justify or explain the sweet taste of sherry, and the large amount of distilled spirits which is added to it. For, say those who spread this tale, if spirits were not added to this sweet liquorous wine, it would not keep, but, during transit and the vicissitudes of its being kept in private houses, it would again ferment and spoil.

In the "Treatise on Wine," of Thudichum and Dupré, p. 638 *et seq.*, a special chapter is devoted to the comparison of the density of Jerez must with the specific gravity of must produced from different wines in various countries and years. This comparison led us to the conclusion that sherry is not naturally stronger than the principal wines of France and Germany; that it is able to consume the whole of its saccharine matter by natural fermentation, and become natural wine, and, if properly treated, does not require either plastering, or the addition of brandy, spirits, or boiled must.

I have been able to confirm this conclusion by many observations made at Jerez upon mostos as they came from the lagars, and subsequently fermented in the bodegas.

Out of 103 mostos, at the average temperature of 70° Fahr.:—

1	showed	specific	gravity	10·75	Baumé.
3	”	”		11·00	”
1	”	”		11·25	”
1	”	”		11·33	”
6	”	”		11·50	”
1	”	”		11·70	”
24	”	”		12·00	”
3	”	”		12·10	”
16	”	”		12·25	”
12	”	”		12·50	”
4	”	”		12·75	”
14	”	”		13·00	”
6	”	”		13·25	”
4	”	”		13·50	”
7	”	”		14·00	”

All these mostos came from the mantuo castellano grapes (grown in barro-arena soil) and transported to the bodegas on mules' backs during the time from September 20th to October 2nd, that is to say, very late in a very hot Jerez season. The grapes had, indeed, been subjected to such a heat that many were shrivelled, and others transformed into dry raisins. These latter do not influence the specific gravity of mostos made on the lagar, but are mostly lost to the wine-makers. When the dry murk is subsequently cast into the roads, or carried to the dung-heaps or fields, one can see numbers of poor children rummaging it, and picking out these raisins. I state this in order to show that the mostos above described were really highly concentrated liquids, which is indeed also shown by the specific gravities themselves, to all those who know that Spanish musts fluctuate between specific gravity 9 and 14 as extremes, and are more frequently near the lower than the higher figure.

I next observed eight mostos which were made from assoleated grapes, and showed specific gravity 13·3; 13·5; four = 14°; two = 14·25. Each bota received six arrobas of brandy of 40° Cartier, whereby the specific gravity was depressed by six or seven degrees. Of mostos made on October 2nd, from long-dried mantuo de pila, two showed 15°, one 16°, and one 17° Baumé. The heaviest mosto I observed at all at Jerez had 22° B., and came from Pedro Jimenez grapes exposed to the sun during ten days, from September 5th to 15th. All these heavy mostos were expressly prepared for dulce, and were not allowed to ferment at all, but had their fermentation arrested by the addition of one-fifth of their volume of alcohol.

I found the best palomino mosto from albariza soil, on many samples, weighed between September 11th and 30th, to have a specific gravity of 13° B. All these mostos, as well as the mostos of mantuo castellano from barro-arena soil, fermented readily and rapidly, and in the space of ten days or so, had completely lost all sugar, and were new, dry, thoroughly fermented wines. Thus it is shown, by overwhelming evidence, that the assertion so frequently made to screen the true nature of sugared and brandied wines is untrue. Sherry wine is never sweet except when it is expressly and intentionally sweetened by makers and exporters. Sherry is so sweetened, and coloured, and brandied, in order to cover the natural defects of the taste; and no sherry of any claim to quality is ever sugared or coloured, because the makers know very well that pale, dry wine, with the least possible amount of alcohol, is far more valuable than the cooked and drugged, coloured, sweet and hot liquids.

Sulphuring—Azufrado.

The wines in Jerez are all plastered. But the common wines are not only plastered, but sulphured in addition. For this purpose a complicated apparatus is employed, consisting of the following parts. A vat, closed on all sides, of the size of a bota, is raised upon a stand, so that its bottom is about breast-high; to the side of this is attached a little furnace in which the sulphur matches are burned. The fumes of the sulphurous acid are conducted by a tube to the top of the vat, and then diffuse in its cavity. The mosto is kept in a reservoir under the vat, mostly buried in the ground, and is repeatedly raised to the top of the vat by means of a pump. It is spread out in the vat in the form of a fine shower by means of a rose, or sievelike distributor, and in falling becomes impregnated with the sulphurous acid. The matches which are burned are made of broad cotton bands, and the products of the imperfect combustion of these bands are, of course, also admixed with the must. The quantity of sulphur thus burned to impregnate each bota amounts to one-third of a pound, or more than five ounces, and this will yield more than ten ounces of the sulphurous acid gas, and ultimately nearly a pound of sulphuric acid. As the plastering introduces several pounds of sulphuric acid into each bota, it is now explained why some descriptions of sherry contain from three to five pounds of sulphuric acid. The acid introduced with the plaster is in a combined state, but that introduced by sulphuring is ultimately contained in the free state.

The sulphuring process has the effect of somewhat retarding fermentation, in warm weather one, in cooler weather two days. The process also lasts a little longer than in must not sulphured. The freshly fermented wine has an awful smell and taste of brimstone and rotten eggs, and contains considerable quantities of sulphuretted hydrogen and other products of the reduction of sulphurous acid.

The object of sulphuring is said to be to prevent the wine from running into the acetous fermentation. Incidentally the free acid of the wine is increased in quantity, and thus approaches more to the condition of unplastered mosto. It seems also that sulphured wine becomes clear more quickly than unsulphured. In return for this advantage, the sulphured wine remains in the objectionable state of contamination with sulphuretted hydrogen for a very long time; and after oxydation of this remains turbid from finely-divided sulphur, which is removed with difficulty only. There can also be no doubt that the sulphuring deteriorates the taste of the wine, even after complete oxidation of the sulphur to sulphuric acid. This is so well known to the producers and extractors, that they never sulphur the better classes of wine, but only the low common qualities. If the Jerezanos had cellars to keep their musts at about 70° F. during fermentation, and if they did not allow their wines to lie with a great vacuum in their casks at temperatures approaching the fever heat of the human blood—a temperature well known to be the most suitable for the manufacture of vinegar—they might easily dispense with this practice of sulphuring, and save themselves an amount of trouble in the clarification of their wines, which only those can appreciate who have investigated the question. If sulphuring saves the wine from becoming acetified, it on the other hand entails its being heavily brandied. For the bodega-holders of Jerez cannot clarify their wines without raising their alcoholic strength to forty degrees of proof spirit.

Temperatures of Fermenting Musts.

On September 21st, when the temperature of the outer air was 76·5° Fahr., I ascertained the temperature of fermenting palomino mostos to be 90° Fahr. When the casks lay in a warmer place, their temperature rose to 92 and 93°; when in a cooler, it fell to 85°. Thoroughly fermented mostos about twelve days old showed 74·5°. When the casks were laid up in rows three high, called andanas, I found that the lower rows quickly assumed an even temperature of about 75°, while the temperatures of the middle rows was about 80°. The third or top rows varied between 81° and 92°. The highest temperatures were found near open windows. I have no doubt that, although these botas completed their noisy fermentation on the even ground, they carried a portion of the heat acquired by fermentation up to the andana, and that the entire heat cannot be placed to the account of position. But a certain portion of the heat is, no doubt, communicated by the hotter air in the upper strata, which in the day-time rose to 97°, and at night fell to 74°. Now, here is the easy explanation of the observation, that so much wine at Jerez and in other parts of the south passes immediately from the vinous fermentation into the acetous. The temperatures of the casks of one of the top rows observed were the following:—87°, 90°, 87·5°, 88°, 90°, 88°, 90°, 92°, 91°3, 76°. All these casks had just completed their fermentation, and were turbid, but beginning to deposit their yeast. They were lying in warm places, and following in a certain measure the lead of external changes of temperature, and kept near their actual temperature by the heat of the air in the day-time, which at this period (the middle of September) was excessive, that is to say, much higher than in ordinary years. All the casks were with vacua, that is to say, not filled by at least one-sixth of their capacity. Under these circumstances, it is, in my opinion, impossible that they should not directly pass into acetous fermentation; indeed, the wonder is, not that they form vinegar, but rather that any escape from this contamination, and remain sound wine. This stage is, indeed, the most dangerous one for Jerez wines, namely, the time from the cessation of the fermentation, at which the wine has a temperature of 90° to 96° Fahr., and is turbid, to that time at which the wine has reached 75° and less, and, not being disturbed by external fluctuation of temperature, has deposited its yeast and become clear. Until the Jerezanos have underground cellars in which to secure their wines, they must take care to fill up the vacua immediately after the tumultuous fermentation is over, and bung the casks with safety bungs, which will allow exit to the little carbonic acid evolved, and prevent the air from acetifying the hot wine; and they must not admit air until the wine is pretty clear, and its temperature has sunk to at least 75°. In a similar manner they must proceed with all young and all unbrandied wines during summer time. The clearer and the older these wines become, the more spirit they contain, the more independent they are of heat and air. But it is well known that much spirit hinders the development of wines, and has, therefore, to be avoided. Now, if by the exclusion of air in hot seasons the acetification of wine can be prevented (which it most certainly can), then a great part of the necessity for adding so much spirit to wine is done away with. Consequently, the wine is in a position to become more quickly developed, and, being developed, it may be either left in its natural state or brandied for the taste of palates accustomed to burning liquids.

The fermented wine remains stacked in the andanas of the bodega until it is pretty clear of floating yeast, which is mostly in January or February. It is then racked (desliado), and some brandy is added to it. Finos receive half an arrobe per bota. Common wines receive from one to one and a-half arrobes, of 40° Cartier. On the whole it may be said that the better the wine, the less brandy is added to it. Those botas which have become bad are sent to the still, and those which are retained are marked, if they have developed any specific qualities, or left unmarked if they remain doubtful and on trial. If a wine goes wrong in any of several ways, the only remedy applied to it is brandy, never any change in its other chemical or in its physical conditions.

Stages of Wine, and Qualities.

Mosto is not only the freshly pressed juice of the grapes, but the name is retained for all fermented wine up to the time of the first spring racking. Vino d'un anno is wine which approaches or has passed the age of one year. Quantities of wine of this quality are generally termed añadas. A regular heavy Jerez wine from albariza soil remains, as a rule, in an unripe state for several years, and then gradually becomes fino. It remains so from the 5th to the 8th year, and then passes into amontillado; when continued in open cask, and allowed to develop, it remains in this state from the 9th to the 14th year, and then passes into oloroso; this condition lasts from the 15th to the 20th year, whereupon the wine becomes secco; this is, properly speaking a passed wine, all its qualities are exhausted and gone: it is more properly termed passado. In other parts of Spain very old secco is sometimes called rancio, but in Jerez this word is not used in the same sense, but signifies a rancid, bad, sour, and mousy wine. From stout fino all subsequent qualities may be obained directly by accidental development. The wine, as it were, skips a stage or two, and becomes either oloroso or secco, without having been in the amontillado stage at all.

In the bodega of a distinguished Jerez house there is an interesting collection of wines, arranged so as to represent all these stages from year to year, 17 in number.

When distinguished according to quality simply, wines give rise to the following names:—

Palma.—The fine, dry, wines in the second and third year are thus called. They yield amontillado by time. Some extractors say that the amontillado obtainable from palma is thin, and never becomes oloroso. Others mark the amontillado by the sign of the palma.

Double palma signifies the same general qualities as the former, but more general and ripe.

Treble palma is the highest intensity of this modification, essence of amontillado.

Palo cortado, the broken stick, or cut stick, the mysterious sign for oloroso.

Double palo cortado, a better wine than the former.

Treble palo, the highest perfection of oloroso, "Oloroso muy vièjo," rising in price to £120 per butt.

Some place the oloroso before the palma as to quality. Probably the palma speaks more to the taste, the palo cortado to the nose.

Out of a large number of butts of wine from the same vintage and vineyard, only a small number develope into any of the above qualities. The largest quantity remains

Raya, or *rayea*, the third quality of wine. This in its natural state is sound and dry, but without prominent qualities. Perhaps three-quarters of all albariza sherry is raya. It is the bulk of the sherries exported to and drunk in England. This quality (raya primera) resembles in colour and dryness, but does not equal in merit, secco of 20 years.

Dos rayas is a common wine, not clean, but affected with some fault or other.

Tres rayas signify wine which nobody will buy—refuse. Thus it will be seen that with raya the multiplication of the sign goes along with the increase of badness, while with palma and palo cortado the multiplication signifies increase of good qualities.

Vinagre, wine which is more or less affected by acetous fermentation.

The sign of a grating signifies wine destined for the distillery.

The foregoing distinctions yield nine different qualities of wine. Of all wine produced in Jerez only a small proportion reaches the highest quality, and it was the opinion of one of the first extractors that there were not 200 butts of treble palo in Jerez at the time of my visit. These signs and distinctions are mainly used by the extractors for their guidance in buying, and during maturing, and are not generally applied to wines as shipped.

The Criadera.

This name signifies a kind of nursery, in which wines are placed which have already arrived at a certain quality in the partido. The partido is the entire "parcel;" that is to say, the total number of casks of one vintage from one particular vineyard. When this partido has been dissolved into its separate qualities, either by the proprietor or purchaser, these qualities are now added to other quantities of similar quality, or are simply laid by their side to undergo their probation. We will assume a hundred botas of palma to have been selected from ten different partidos. The hundred casks may all develop equally, or all unequally, or only a number may take the normal development; the others may go back before having their character permanently determined. This result is attained and observed in the criadera. The name is derived from the idea that the vine while thus situated grows. The extractors say that they grow the wine, which has to be interpreted, that they stand by while the wine undergoes its changes for better or for worse, and observe and register these changes from time to time. If the wine shows signs of an unfavourable kind it is treated with some spirits, but no other application or regimen is applied to it. When wine in the criadera has attained certain desired qualities it is either arrested in its career and prevented from changing any further by receiving its full complement of spirits, or it is taken to the soleras.

The Solera.

A number of botas, which are kept together, and as far as possible supplied with wine of similar character, are termed a solera. This institution has for its object to enable the extractor to supply constantly good wine of the same general quality, or, at all events, wine which differs no more in the variation of years and seasons than can be disguised by careful mixing. If, therefore, a solera, say of amontillado, consists of sixty butts, and the sales of the extractor have diminished their contents to one-half, then he has to supply thirty butts to make up his solera. These he must obtain either from his own criadera or from that of others.

Now suppose that in the criadera of a hundred butts of palma assumed in the previous paragraph, thirty had turned into amontillado, then the extractor would probably distribute these thirty butts over his solera of sixty butts, and have it complete; but if he obtained only ten butts of amontillado in his criadera he would distribute these ten over his entire solera, and the butts of the solera would contain a void of one-third of their capacity. On the contrary, if the extractor were to sell thirty botas of his solera, consisting of sixty, he would not sell half the number of his casks; but he would draw from each of the casks half a bota, arrobe by arrobe, and distribute them equally over the botas about to be sold. The criadera, therefore, and, still more, the solera, in one sense, destroys all individuality of wine as to origin and year. When large soleras have to be made up from numerous small partidos, they represent, of course, a mixture of an infinite variety of wines; and old soleras represent a mixture of small residues from a great number of years, the latest addition being probably the largest in quantity. All the deposits which the wine forms while in the soleras are left in the butts. I was informed by an extractor that he once bought the entire and only solera, consisting of 1,000 butts, of an old Cadiz house, who made only one quality of wine. Each cask contained about four gallons of black deposit, which was carefully moved with the wine when it was taken to Jerez. These deposits must not be of yeast, or they will be injurious. Later deposits improve the wine, and the storing up of old deposits in soleras, *e.g.*, during the addition of wine from the criadera, has a tendency to clear the wine. So say some extractors. Others have no belief in these deposits; they mostly consist of drowned mycoderma vini, and their significance stands and falls with that of the fresh or active mycoderma.

Colours of Sherries.

All young sherry wines which are produced from sound grapes are very slightly coloured greenish yellow. With advancing age they get a little more yellow, but the finos and amontillados are on the whole pale, and it is only the olorosos which become as dark as amber. The seccos are amber to brownish. I assume all such wines to be genuine, dry, free from sugar and boiled mosto. Now, as colour in good wine is an undoubted sign of age (colour in young wine indicates that there were rotten grapes employed amongst others), and as many people believe that age is the highest quality to be desired in wine, the greater part of the occupation of the Jerez wine trade consists in imparting to young common wines a sham colour, by means of which it may pass as aged. But as, happily, the finos, amontillados, and olorosos are highly valued in the pure state, they are scarcely ever coloured by extractors who understand their business. The Englishman of position and purse drinks raya, of ten or twelve years of age, and it is to the imitation of this that all efforts are directed. In this process the following agents are employed.

Arrope.

The plastered must, as it runs from the press, is boiled in a large copper, which is mostly fixed in a building in the vineyard. While boiling it is constantly skimmed, and the impurities and syrup adhering are thrown with the refuse, to be fermented and distilled. Seventy-six arrobas of mosto, fresh from the press, yield ultimately, by evaporation, seven and a-half arrobas of skimmings and 15 arrobas of arrope. When five butts have been reduced to one, which takes from 14 to 18 hours, the mass is constantly kept stirred to prevent burning at the bottom of the copper, and promote evaporation. It is now a dark-brown or reddish syrup, in thin layers. The colour is due to caramel, produced by the united action of heat and acid. Its taste is partially aromatic, partially bitter and nasty, owing to the concentrated mass of sulphate of potash which it contains. It is sometimes so acrid as to blister the tongue of delicate persons who taste it. The arrope is not used by itself without preparation, but it always transformed into—

Color, or Vino de Color.

To one bota of common wine about eleven gallons of arrope and a quantity of spirit are added and dissolved by agitation. By adding varying quantities of this color to other wine the shades are produced. Brown sherry receives about 25 gallons of this vino de color to the bota. The pale brown (sometimes also termed pale) receives about 20 gallons. A butt of golden sherry requires 15 to 17 gallons of vino de color; and the least coloured, called pale (*i. e.*, golden), receives 7 gallons of color. It is perhaps due to this large addition of brown and of boiled matter in the shape of vino de color, that this "golden" sherry can be shipped with about 34 per cent. of proof spirits, while "pale" sherry, with the smallest amount of color, requires 40 per cent. to 42 per cent. proof spirit.

In exceptional cases vino de color is made by boiling mosto down to one-third, and adding spirit to the coloured liquid.

All vino de color, and wine made with its aid, fluoresces green. This is easily observed when the wine is exposed to the direct rays of the sun in an otherwise dark place. Natural wine never fluoresces in this manner, but requires a cone of concentrated sunlight for showing fluorescence; then it is pale green, nearly white, whereas that of color is green.

Dulce.

Natural good wine has a mild sweetish taste, without containing sugar. But common wines have no such taste, and are therefore mixed with sugar. The most genuine sweetening material is mosto preserved in spirit, termed dulce. To produce the best dulce, either Pedro Ximenes, the sweetest grapes, or palomino, is selected. The grapes are exposed to the sun until they begin to shrivel, and then they are trodden and pressed. I examined a mosto made from palomino assoleadas, that is grapes which had been strongly passulated in the sun, and found its specific gravity to be 22° Baumé. The first and later runnings, when the grapes had been more crushed, had the same specific gravity, although the men working the press believed that the many raisins contained in the grapes would make the mostos heavier. The sugar of true raisins is never extracted by mosto in the short time during which this is in contact with them. Therefore, unless raisins are picked out from amongst the plump grapes, and treated separately, they are lost in the murk. Murk from which mosto for dulce has been pressed, is treated with water and pressed in an hydraulic press, and then yields a mosto of full 15° B. But this is not of good taste, and goes to the refuse vats to be distilled after fermentation. The sweet thick mosto to be made into dulce is mixed with one-fifth of its bulk of spirit of 40° Cartier strength, so that a bota of dulce consists of 24 arrobas of mosto and 6 arrobas of spirit. According to my observation it has then from 8·5° to 9° B. specific gravity. It is not subject to fermentation, but forms a deposit; and when decanted from this becomes clear, amalgamated, and a little darker by age. Old dulce (dulce muy viejo) is frequently drunk as a liqueur, and the working men take a glass of it the first thing in the morning, a practice which they call, "Tomar la mañana."

By the addition of such dulce, the various kinds of mixed sherry receive their sweetness. No sherry of any kind contains a sufficient amount of sugar to have a sweet taste of itself. In fact, all wine in Jerez which has fermented is perfectly dry and free from sugary taste. Grapes not passulated by assolation yield always a mosto, which ferments perfectly, and never any sweet wine. Mostos of as much as 22° B. require twenty per cent. of strongest alcohol to be protected from fermentation. The ordinary sherries receive of such dulce as much as may be required by the taste of the customer. It is found by chemical analysis that the sugar thus imparted to wine amounts to from one to four per cent. of the total weight of the wine. In some bodegas the common dulces are kept in the open air, in order to let them be heated by the sun. Much colouring and sweetening material is now made from cane-sugar. This is in so far preferable to the arrope, as it is not saturated with sulphate of potash. The sugar, when mixed with wine, is quickly transformed into grape-sugar, and the caramel is identical with that of the arrope.

I here summarise once more what I have already partly discussed in connection with mosto, namely, the observation on the vacua in botas as affecting wines. The casks containing the wine are at no time filled up to their bunghole, but there is always an empty space left, to which the air has free access. This space is called "vacio." The wine is allowed to ferment in seasoned botas, of from 37 to 38 arrobes, and in these a vacio of from 5 to 6 arrobes is customary, so that after two gallons of lees are abstracted and a little brandy added, a full bota of clear wine may be obtained after the first racking. In butts of 30 arrobes the vacio amounts to from 3 to 4½ arrobes. This empty space causes the wine to offer a great surface to the action of the air; the surface favours all kind of change, the best and the worst, according to the external temperature. In warm weather, the mycoderma vini is quickly developed, also the mycoderma aceti, and the wine changes with great rapidity from fino to vinegar, to mousetaste, to basto, or amontillado. All these varieties are observed side by side, or one above the other, in the same lot of originally identical qualities of wine. This vacio, together with the changeable temperature of the bodegas, is the ruin of Jerez wines. No doubt by its means these wines mature quicker in a low temperature, though even here it is dangerous, as we know, from the Arbois vaults. But in hot weather the wines go quickly to their ruin if not suffocated by and pickled in brandy. I am, therefore, decidedly of opinion that the practice of the vacio, at least in summer time, should be abolished, and only be adopted during the time from October to March.

Evaporation of Wine from Casks.

All wines kept in wooden casks diminish in quantity by evaporation, partly through the wood, partly through the corks and the bunghole. Young wines lose less than old ones. The former are estimated to diminish by 2½ per cent., the latter by 3 per cent. per annum. Some extractors maintain that all wines become stronger in alcohol by keeping, but I am not aware that this has been proved by reliable experiment.

Hydraulic Bungs.

This instrument is intended to prevent the access of air to fermenting wine, while allowing exit to the carbonic acid gas. This latter has to press its way through a column of water. Of course the instrument, in order to act, must be fixed air-tight into the bunghole. In a bodega I was shown such bungs, and the extractor said he had perceived admirable effects from them, although he had not applied them to what they were intended for, namely, fermenting wine, but to old wine. On examining the first bung handed to me, by blowing in at the lower aperture, where the carbonic acid should enter, I expelled a quantity of water, showing that the hollow of the bung had been unduly filled with water. The next bung I found quite dry, and containing no water at all. The fact is, these hollow cones, made of tin and varnished red, are silly playthings. They cannot be hermetically fixed, just because they are made of tin. In the above case they were a mere delusion, as the extractor did not even know their internal construction or mode of action.

FLOR.

With the expression *Flor* the extractors signalise the whitish fungus which grows on the surface of wine; the Germans' term is *Kahn*; botanists give it the name of *Mycoderma vini.* In November, 1871, all the wine of that year which I examined (and I examined many hundreds of botas) was covered with this mould. On expressing my astonishment to the extractors that they allowed their wines to lie with a vacio and to be covered with this mould, they admitted that it was an unfavourable feature if the flor appeared on mosto or young wine yet on the first lees; but they said they liked the flor on wine after the first racking, or on the añadas, or wine in criaderas and soleras. They said that wine, otherwise sound and growing flor, developed best. It is not easy to understand why, or how the fungus should be unfavourable at one and advantageous at another time. On the same grounds it is impossible to believe that the fungus takes any part in the development of the wine—for if it caused any favourable process, then the first flor ought to cause the greatest improvement, as it is the largest in amount. Flor is most commonly associated with the amontillado development, rarely with the oloroso stage. But I have also seen it together with mouse and other nasty tastes, and spoiled wine, and do not believe in its specific action. The German wine-makers consider kahn their greatest enemy, and carefully prevent its formation. All countries producing red wines avoid its formation on these wines, as it completely spoils their purity and high taste. Only at Arbois, in the Jura, is wine allowed to be covered with mycoderma vini, as we know from Pasteur's description. This chemist also made it probable that the flor absorbed oxygen from the air, and gave it to the wine, but not so as to form vinegar. This latter function he attributes to the vinegar plant, or mycoderma aceti, which he found frequently mixed with the wine-plant, and observed also that it displaced and drowned the wine-fungus. At Arbois the wine is kept in cold, deep cellars, with vacios in the casks, which are never filled up. The moulds are never removed. many casks of wine perish by becoming vinegar; some, however, assume an admirable development. This quality is said to stand in a direct proportion to the development of flor. But here the proof of the flor causing the good development is also wanting. If flor were the cause of good development of wine, nothing would be easier than to keep wine always covered with it. A mixture of red wine and water will grow true wine-mycoderma in a very few days, and many crops may be obtained from the same surface. The flor thus grown might be easily placed on the surface of wine required to be developed. This would soon decide the question whether or not flor causes any favourable change in wine at a certain stage. The cause of its unfavourable influence at the earlier stages would then require explanation, and certainly its development at these early stages should be prevented.

SCUDDINESS.

A white pertinacious turbidity of wine is called scuddiness, and the matter causing the appearance, scud. It is not necessary that the matter should be in the shape of clouds (nube) when the liquid is moved in a glass; but this kind of scud is the most unfavourable. Most of these turbid conditions of sherry cannot be removed except after the addition of large quantities of brandy. Indeed, scud is the main cause of the brandying of wine. No other wines being subject to such pertinacious turbidity as sherry, I made a special study of this matter, and soon found that the extractors confound under the one name scud a considerable variety of conditions. I distinguished the following varieties:—

The albuminous scud.—This is due to suspended albuminous matter in a fine state of division.

The Bacteria and vibriones scud.—This arises in new wine of feeble alcoholicity, and is counteracted by sulphuring.

The tartrate of calcium scud.—This is the whitest scud, and deposits gradually as a white deposit, but a cask of wine affected with it would perhaps not become entirely clear before six or seven years.

The sulphide of potassium scud.—This is caused by the sulphate becoming reduced in the wine in the absence of oxygen, and the production of peculiar sulphur compounds.

The reduced sulphur scud.—This is caused by the reduction of sulphurous acid in sulphured wines. Sulphuretted hydrogen is first formed, and causes the wine to stink horribly; then this gas is gradually oxidised and deposits finely-divided sulphur, which is one of the most difficult turbidities to remove, particularly from organic liquids. This scud is regularly found in all Portuguese white (and not rarely red) wines during their first year, and sometimes does not disappear until the third year, or some time after all the sulphuretted hydrogen has been oxidised, and all sulphurous acid has been oxidised or otherwise decomposed.

While the albuminous and vibrionic scuddiness are natural events, and are easily removed by ordinary reasonable treatment and fining, the tartrate of calcium and sulphate of potassium scuds are the result of plastering, and most difficult to remove without brandy. The reduced sulphur scud, and the stinking qualities of wines, are the causes of the sulphuring which some wine-makers adopt who do not know how to protect their wine from acetification, or to give it more acidity, if that should be required. All the principal difficulties, therefore, are artificial, and not inherent in the nature of things. If the Jerez wine-makers had proper subterranean cellars, they would not require these practices of sulphuring, and would, I am sure, be quite able to remove any turbidity from their wines by technical means without that destroyer of good wines, distilled spirit.

FININGS.

Animal Charcoal.—Much turbid and putrid evil smelling wine is treated at Jerez with animal charcoal. There are, indeed, extractors who use charcoal as the sovereign remedy for all evils, and leave the consequences to others to fight out. Putrid and evil smells can be removed from spoiled wines by charcoal, but the clearing such wines is only a temporary success. The wine dissolves phosphate of calcium out of the charcoal, and this is deposited from the wine subsequently in minute quantities and reproduces the turbidity.

Much wine is fined with blood, which is put warm into the bota. The albumen precipitated by the alcohol causes the turbidity to be enveloped, and drags it to the ground. Jullien's powder consists of dried blood, and is not rarely putrid. Blood mostly leaves a little hematin in the wine, and makes it darker. It also leaves some acid albumen and the salts in the wine, not rarely also the particular smell which is peculiar to the blood of all animals.

Meat is also used for fining wines; slices of steak are merely hung up in the wine, and their albumen is extracted, and causes a precipitate.

Most commonly albumen from eggs is used for fining the brandied wines. Fifteen to twenty whites, together with a quantity of common salt, are put into a bota and stirred. After that a quantity of Spanish earth, in the condition of a smooth thin paste, is added and stirred. The mixture is allowed to stand, and the wine becomes clear. In this case, also, the formation of a heavier and copious precipitate drags down the lighter slight impurity called scud. Milk, so frequently used in this country for clarifying sherry, is not used at Jerez.

In general, the difficulty of clarifying Jerez wines permanently is very great, and is said to be the principal reason for the addition of so much brandy to wine as we observe in it.

Tinajas.

The wines of all southern provinces of Spain, particularly those of Montilla, used formerly to be made and kept in tinajas, buried in the ground of the bodega. The tinajas were either large earthenware vessels, containing about a hogshead each, or they were constructed of bricks and cement. I have seen both forms in the Jerez district, and believe them to have been here also the general receptacles. In a vineyard I saw a large tinaja used as a dog-kennel; and in a shed at San Lucar I saw several tinajas of brick and cement, holding six botas each, in a disused but hardly dilapidated state. The dangers of these vessels are well represented in the legend about Don — —'s Sheep. Don — — was a celebrated producer or extractor of wine, at Montilla. His reputation grew, it is said, out of one particular tinaja, and the beginning of the rise was marked by the disappearance of a family sheep, a merino ram. After the lapse of years the celebrated tinaja which had made the fortune of the house, had at last to be cleared out, and in its muddy deposit were found the fleece and skeleton of the unlucky carnero. It is said that, in imitation of this remarkable event (a discovery without intention), the montillanos to this day are in the habit of putting the entrails of sheep into their wine. But whether this is true or not I cannot say from my own experience; I know, however, that sheep's blood, and that in a warm state, is often put into these wines.

We are now in a position to appreciate why botas and bodegas do not fit one another. In olden times wines were kept in tinajas, underground, which, in a covered space, is virtually in a cellar. When tinajas were discarded and botas adopted, burying was discontinued. The necessity of providing for export and transport antiquated tinajas; but the bota exposed wine more to the influence of heat and air. It is curious to speculate what anxiety this change must have given to the producers. But the enormous convenience of the wooden cask conquered the tinajas and their security. Now, the necessity for security must send the botas underground, and they will therefore have to go, not into the bare earth, where the tinajas go, but into vaults, to remain accessible and moveable.

Notes on Casks.—They are mostly made of Memel oak staves, and of Canadian oak staves. One bota now costs 9 dolls., equal to 36s.; but in productive years the price sometimes rises to 15 dols. and 16 dols.

½ cask	5 dols. =	20s.
¼ "	3 " =	12s.
⅛ "	2 " =	8s.
barille (4 arrobas)		8s.
2 arrobas		5s.
1 arroba		3s.

The practice as regards the treatment of new casks differs greatly. Some cause the casks to be burned inside when the staves are being bent, but do not steam the casks. I have heard that some contractors, possessed of steam-boilers and every necessary apparatus, have abandoned the practice of steaming casks, as either unnecessary or hurtful to the wood. Other extractors do not burn, but steam the casks, and are very proud of their pipe-arrangements for this steaming. A third series of houses both burn and steam their casks. All these gentlemen, however, agree in soaking the inside of their casks with water for a very long time, and frequently renewing this water, while it remains both colourless and tasteless.

The new wine, of good quality, is here mostly fermented in old casks, which are retained in the bodega and never sold. But the rich proprietors lend new casks to less fortunate producers, to ferment their wine in; after the spring racking and sale the seasoned casks go back to the proprietors.

Bodegas and Want of Cellars in Jerez.—A cellar is an apartment underground, so constructed as to withdraw its atmosphere from the fluctuation of temperature of the external air. The necessity for such apartments is felt more by the inhabitants of rigorous climates, with severe winter frosts, than by those of southern countries with mild winters. Accordingly the knowledge and practice of building cellars is more developed in the north than in the south of Europe. Cellars have been most developed in their application to beer and effervescent wines, so that the best are met with in Bavaria and the Champagne. In Bavaria they fulfil a twofold purpose. The beer is fermented as well as preserved in them after fermentation. Owing to the low temperature the fermentation is slow; it need not be quick, as exposure to the air does not injure the beer at that low temperature. But the exposure to air has the advantage of ripening the beer by oxidising and precipitating the dissolved albuminous matters. For these reasons the thin or light Bavarian beer keeps better than stronger beer prepared by ordinary hot fermentation, when both are similarly exposed to air and heat. The cellars of the Champagne are not so much used for fermenting the must, as for fermenting the wine a second time after it is drawn into bottles to give it the mousse. This fermentation might take place in any apartment above ground, and for it the cellar is not absolutely requisite. But the equable temperature of the cellar is required for the deposition of the yeast formed in the bottles; in other words for the perfect clearing of the effervescent wine.

In Jerez, and generally in the south of Spain and Portugal, there are no cellars such as I have defined above. The wines are always made, fermented, and kept in buildings above ground constructed for the purpose, and termed *bodegas*—in Portuguese, *adegas*. These structures are frequently of very large size and rather lofty, but they have many windows and doors, and their roofs are made of two layers of tiles, resting upon wooden rafters. The tiles next to the wood are flat, like large bricks; the tiles facing the sky, however, are corrugated, and so laid as to form parallel ridges and furrows. The two layers are fixed upon each other with mortar. Now, this roof conducts the heat of the sun with great facility, and radiates it easily into the space of the bodega. The bodegas, therefore, are very hot indeed; during the daytime their oppressive condition is only mitigated a little by draughts of air. In the night they become cool again. The wines in the botas follow all these changes within certain limits. They become cool at night, warm in the day—though they never reach the extremes of the air. The botas which lie highest on the andana which may form the third or fourth tier from the ground, are the most affected; those in the second tier less, and so on to those on the ground, which are the steadiest in their temperature. Those botas also which lie near apertures and windows are liable to great changes of temperature. Accordingly, it is often found that the upper tiers contain the greatest and the lower tiers the smallest proportion of spoiled wine. Botas near windows are frequently spoiled, and all this is just as it ought to be. Scud, mousetaste, and vinegar threaten constantly every bota. With anxious mien the capataz tastes the wines and marks the changes. This basto of to-day was new amontillado a week ago; these finos are all in danger of becoming vinegar. He shakes his head while observing all, and cannot alter it; he does not know the reasons for these ruinous changes; he consoles himself with the few palmas which he can inscribe here and there, puts brandy over the heads of the naughty children, and condems the worst of them to the still. But he has no power over the changes of his wines, either for good or evil, simply because he cannot regulate their relation to air and temperature, and such regulation he cannot possibly effect because he has no cellar. It is unquestionable that the great mass of Jerez wines is greatly deteriorated, or ruined, owing to the absence of cellars. I need hardly include in this category of ruined wines those which require and receive brandy for being preserved from acetification and fermentation, in order to prove my proposition, but everybody admits that brandy deteriorates wines, more particularly those of good quality, and therefore the fact of wine having been brandied is suppressed and disguised by every possible means.

How different would be the case if the Jerezanos were possessed of proper underground cellars, where their products might be maintained at the average temperature of the earth in that region. I ascertained what that temperature is in the usual manner, by taking on October 3rd the temperature of three deep wells:—

Pozo in a cooperage..............	64°73 F.
Ditto en casa de Don —— —— ..	64°33 F.
Ditto en casa de Don —— —— ..	64°33 F.

Consequently a good underground cellar in Jerez ought to have the average temperature of 64°5, with a very light increase in summer, owing to the heat radiated into it by windows and doors. But never would the temperature reach 70, or fluctuate between 70 and 85, as I have observed it to fluctuate in bodegas in September. I fear to think what the temperature in those buildings must be in the height of summer. No one at Jerez knew it, and after my actual observation it is not necessary to speculate about it.

In such cellars the Jerez wine would undergo a perfectly normal development. It would be perfectly safe in every respect. It would ferment thoroughly, would not be liable to the acetous or mousy change, and would become clean in a short time. It might be left to develop with the vacio, for at the low temperature the contact with air would be hardly dangerous, probably beneficial. It would probably be always beneficial, for as all botas would be under identical conditions, they could not fail of producing identical results. In any case, I am convinced that with cellars the Jerezanos would produce 90 per cent. of good wine, where now they produce 10 per cent. To this some of the extractors have objected by questions which exhibit more their anxiety than their discernment. They said, "Suppose we change our style of growing the vine ('growing' is here used as an active verb by the extractors, who also speak of 'rearing' and 'educating,' whereas their only action consists in standing by and seeing the wine behave and misbehave, 'kick,' and mark the result with chalk upon the barrel), should we produce any of those very fine qualities which constitute our reputation and main profit? Should we not depress our wines to one common low level?" To this I always replied that the mass of their wines was at a very low level indeed, that half their wine had to be exported at £15 per bota, and that £30 per bota was a high average to assume for the total export, and that of fine wine at £100, about which so much boast was made, not two hundred botas were annually produced and exported from Jerez. That the loss of these very high wines, if it were a necessary consequence, which I by no means admitted, of a change of vinification would be very small compared to the loss—the enormous loss—inflicted upon the average wines by the faulty condition of the bodegas; for I said that it was notorious that in the fortnight following the harvest of 1871 all wines suffered an immense depreciation owing to the great heat, which caused the wines, yet hot from an active fermentation, to pass at once into the acetous fermentation (I have tasted so many wines of that kind that I am fully able to believe that the loss in money value which the Jerezanos suffered during that fortnight was something like a quarter of a million of pounds sterling). If these wines had fermented in cellars, or had been put into cellars after their fermentation, this deterioration could not have occurred, and the cellars would in one fortnight have repaid the cost of their construction.

This is a matter entirely apart from the question of the vacio. To prevent misunderstanding, I point out that I am quite convinced that wines ripen quicker with the aid of the vacio than without—that wines ripen quicker in warm air than in cooler air. But warm air and vacio together force the wine to go wrong, and compel the addition of brandy. Warmth without the vacio does not easily spoil wine, and vacio without warmth is a safe condition for Jerez wine. Therefore, the Jerezanos, by transfering their wines to cellars, would only insure themselves from loss, although their wines, if left altogether in the cellars, would ripen more slowly than in the bodegas. But what would compel them to leave their wines always in the cellars? Having got them clear and cool, having timed them over the dangers of great autumnal and summer heat, what would prevent them from placing the wines in the bodegas for the temperate months of the year, October to April? Why should they not in this respect do as the Champagne makers do, transport their wines to that cave which is most suitable to their then condition? Surely, to introduce the conditions of certainty into these operations is a desirable thing, and not an innovation to be dreaded, and it can by no means alter the character of their wine except for the better, and, therefore, can affect their trade only in the sense of expansion.

Notes on the History of Viticulture and of the Trade in Wine at Jerez.

It is probable that viticulture in Jerez is not of very great antiquity. In Roman times no wine seems to have been made there, while the provinces of Catalonia and Valencia produced plenty. The first reliable historic evidence of the existence of vineyards at Jerez is in the year 1268, when Alonzo el Sabio, after having defeated the Moors, rewarded forty of his knights by giving to each of them vineyards in bearing, as the document of donation preserved in the archives of the municipality at Jerez has it—"sex aranzadas de viña" and land on which they might plant vines—"sex aranzadas de tierra para majuelo." It does not appear in which district these vineyards were situated, but an Arabic document, a diary of the field operations of the Moorish army, published by the Royal Academy of History, recites that in 1285, when General Jusuf laid siege to Jerez, he encamped the body of his army between the river Guadalete and the town, in vineyards and gardens. This is the place where up to this day we find the greater number of Jerez gardens and a great number of vineyards. The army was ordered to cut down the vines in the vineyard during the 4th, 5th, and 6th days of May, in order to clear the fields for the encampment, from which we may conclude that the vineyards had considerable extension. The vineyards presented to the knights in 1268 amounted to 240 aranzadas, and if they had planted their fields, might have risen in 1285 to double that number. Probably there were other proprietors besides these knights. The vines which the Moorish general ordered to be destroyed were in the shape of cepas, the low stocks at present in use, and parras, or vines nailed up to walls and espaliers, with which the properties were surrounded. From those times dates a Castilian proverb, which is said to have originated as follows:—Diego Perez de Vargas was pruning his vines, when the King Alonzo el Sabio happened to come by, and entering the vineyard began to collect the cut-off branches. On Vargas expressing his astonishment, the King is said to have replied, "á tal podador, tal sarmentador," meaning that the labourer was by no means too good for the bricklayer, in this case. In the fourteenth century, the Jerez vineyards seem to have been neglected, mainly in consequence of epidemics of pestilence; in 1402 Enrique III. expressly forbade their destruction by the proprietors. But after that the cultivation of the vine took a fresh start, and in 1431, when the inhabitants of Jerez and Puerto de Sa Maria agreed upon the boundaries of their relative communes, and recorded them in documents, they mentioned the enclosures of the vineyards of Barbaina and of La Gallega.

In the fifteenth century vineyards were also fully established at San Lucar, and in a manuscript from that period, preserved in Madrid, it is related that they were dug round in March.

The Jerez wine of the fifteenth century, which was the most esteemed, was red wine; for on September 13th, 1410, the town council of Jerez, desirous of making an important present (un presente grande) to Alonzo Nunez de Villavicencio, the Alcade Mayor of Jerez, who was then assisting at the siege of Antiquera, sent him ten arrobas of the best red wine. In 1456, the town council, in expectation of the visit of Enrique IV. to their town, ordered that all persons who had wine to sell, should sell the best of red, as well as white, at the price of six maravedis the azumbre. Nowadays, says a modern writer, "the mode of making red wine is no longer known at Jerez; and the wants of its population and its traders are supplied by the viticulturists of Valencia, Cataluñna, and La Mancha. The maravedi of the fifteenth century is supposed to be equivalent to fifteen maravedis in the present day; consequently the arroba of wine was fixed in 1456, at a little more than 21 reals; the bota of 30 arrobas, therefore, at 42 pesos. (A peso being the imaginary unit by which all wine in Jerez is bought and sold, equal to 15 reals.) This price is almost the same as in the present day. In 1479 the harvest failed, owing to rains in May and continuous Levantes and great heat, and the azumbre of wine rose to 40 maravedis, which is equal to more than 141 reals the arroba, and 282 pesos the bota. Such prices were, in subsequent years, only realised once, namely in 1863, when all extractors believed the Millennium had begun.

ANNUAL INTERNATIONAL EXHIBITIONS.

The Council, having been informed that her Majesty's Commissioners do not intend to publish Reports on the different departments of the Exhibition of the present year, and looking to the great importance to Arts, Manufactures, and Commerce that these annual displays should not pass away without some record, have decided to undertake that duty, and for this purpose have engaged the services of gentlemen specially skilled in the subjects of the several sections, to prepare such Reports for publication in the Society's *Journal*. The Council, however, desire it to be understood that, in publishing these reports, they do not necessarily adopt all the views expressed in them, which must be taken as those of the writers only.

The following report is the twelfth that has been issued. The remainder will appear as soon as they are complete.

THE COLONIAL CONTRIBUTION TO THE INTERNATIONAL EXHIBITION AT SOUTH KENSINGTON.

The contribution made by the Colonies to this year's International Exhibition comes almost entirely from Australia, and is contained in one annexe, with the exception of the portion from Queensland, which occupies a space apart. The annexe consists of two rooms, which were originally occupied by Belgium, and these are shared by Victoria, New South Wales, and South Australia, who have expended about £2,000 in preparing and furnishing them. The room containing the Queensland contribution is smaller, and separate from the so-called "Australian" annexe, but, like it, can be entered from the gallery in which the silk products are shown.

What most strikes the eye in the Australian contribution is the grand display it makes of objects of commercial and economic value. The large room occupied by Victoria is in particular distinguished by this feature. The collection consists, first and foremost, of a rich assemblage of food-substances, in large and abundant samples, showing every kind of produce that the Colony has to turn to account in this way, whether for export or for home consumption. The preserved meats are, of course, in great force, and in a variety which indicates that great enterprise is being used in the development of this somewhat new industry. Besides beef, in the various forms of roast, boiled, corned, and spiced, ox-cheek and kidneys, ox-tail soup, roast veal and leg of mutton, there are the more luxurious viands, roast goose, duck and giblets, rabbit boiled, curried, and smothered in onions, sheeps' tongues, friccasseed turkey, and kangaroo-tail soup. Very fair samples are also exhibited of bacon, salt-butter, and cheese, and even preserved milk. Of corn Victoria shows splendid samples of wheat, the grain heavy and full-bodied. Wheat appears also in the form of flour, and of various kinds of biscuits, including macaroons and ratafiâs.

The colony believes in its wines, and means to have them recognised in the home market if one may judge by the number of the samples. There are no less than about a hundred and fifty different kinds mostly under three years old. Thirty-five samples are from the Melbourne district, and one of these, called Ivanhoe, made from the Reisling grape, was selected for the writer to taste, as being one of the choicest kind. It is a sound white wine, a good deal like second-quality Barsac, being dry, well, though not richly, flavoured, and of some strength. It should, even in this early form, be accepted as a welcome addition to the English cellar. Several varieties of mineral waters are likewise exhibited, one named Coimadai, having a very pleasant resemblance to the best seltzer.

The fruits that grow near Melbourne are shown in beautifully executed models. They include, besides the common English fruits, figs, citrons, limes, and lemons, and appear most of them also in some form of preserve. The other food substances which Victoria exhibits are pearl barley and oatmeal, cocoa and soluble chocolate; a series of condiments, such as mustard, sea-salt, currie powder, tomato sauce, and pickles of various sorts; also chicory and hops. Sugar appears only in two samples extracted from beet root.

Among manufactured articles, leather makes a good show, in the form of white, tanned, and black kangaroo skins; also of calf skins, which seem to be of good texture, soft and yet strong. Solid portmanteaus of colonial leather made in Melbourne are shown; paper cases, handsomely inlaid and finished, and boots of many kinds, conspicuous among them being long shining boots for the use of miners at the gold fields. There are also furs of the kangaroo, opossum, wallaby, native cat, and bear, with rugs, mats, muffs, and an opera cloak made of them. Together with good samples of washed and unwashed wool, in fleeces and bales, are exhibited excellent tweeds and shawls manufactured at the Victoria Woollen Mills, Geelong. There are also small samples of Orleans cotton, silk cocoons of good size and quality, contributed by Mrs. Neill, and a collection of ostrich feathers from naturalised birds.

Native ores and samples of the metals extracted from them are, of course, prominent objects in the Victorian collection. Gold-bearing quartz from Ballarat is shown in huge blocks, of which it is stated that such as do not yield more than six pennyweights of gold to the ton will repay the crushing. Besides samples of extracted gold, very interesting models of remarkable nuggets of the true size are shown, the largest of which is marked the "welcome nugget," Bakery-hill, Ballarat, weighing 2,217 ounces, and worth £9,325. Fine hæmatite and iron ore, and large ingots of iron, appear in abundance; also tin ore, stream tin in ingots, lead ore and lead in ingots

Among a large series of articles illustrating subordinate industries of the colony may be noticed soap and candles, knife-polish, and blacking, carpet brooms made from millet straw, washing-powder, a clothes washer and a wooden churn, both of home contrivance; tobacco, cigars, and snuffs; artificial manures of various kinds, disinfecting powder, glue, madder, nutgalls, gum, spectacles in colonial-made frames, native baskets and table-mats, bricks, tiles, pottery, stoneware-casks, jars, bottles, and filters; and glass lamp-shades, chimneys, and jars. There is also an extensive series of spirits, essences, extracts, and oils, prepared from vegetable substances, among them being a native peppermint obtained from a species of eucalyptus, tar extracted from the *Pinus Larix*, and pitch from *Eucalyptus viminalis*. There are besides specimens of vinegar and ardent spirits.

Numerous samples of native woods are exhibited. and two handsome pieces of furniture that have been made from them. The one is a lady's work-table, inlaid with many varieties; and the other an enormous sideboard, of carved wood, representing, not only fruit and flowers, but the animals peculiar to the colony, such as emus, kangaroos, wombats, &c. Its natural history is represented by cases of stuffed birds and stuffed skins of the edible fishes of the Australian seas, among them a gigantic crab. The scenery of Victoria is fully illustrated by drawings and photographs, and there are also pretty models of the rough timber fences and of the wooden huts which are in use at the outlying stations.

Of manufactured metals, the colony exhibits, besides steel springs and lead pipes, some convenient forms of cooking stoves and ranges adapted to home service, but its most ambitious effort in this direction is a powerful stone-breaking machine, driven by steam, which is being kept at work by the inventor, Mr. Hope. Motion is given to its powerful grooved jaws by a crank working on a heavy fly-wheel that is driven by a portable engine of from 3 to 5 horse-power. The machine works with great steadiness, and deals with stones 15 and 16 inches across in their largest measure, delivering from 80 to 120 cwts. of crushed stone per hour. This machine will be found in the open-air, outside the annexe.

The New South Wales collection occupies the half of the second room, which joins on to that containing the Victorian, and like it is marked by consisting chiefly of articles of economical and commercial value, the samples however being less numerous. There are preserved meats, wines labelled Hermitage, Burgundy, Madeira, white Pincan, Buckullu; specimens of gold-quartz, and of gold, tin, and antimony, both in blocks and in ore; samples of fine wool, and of tweeds manufactured from it; large slabs of about 10 kinds of wood, and a piece of one called the Black Butt, which is still perfectly sound, although it had been in the ground 33 years. Besides these, which it has in common with Victoria, New South Wales exhibits specimens of coal in sections of columnar forms, so as show the thickness and quality of different seams. These came from four separate collieries; and there are likewise specimens of cannel coal from another, and of bituminous slate, which yields oil, from a place called Hartley.

In addition to photographs of scenery and buildings, New South Wales has on the walls of its department some remarkable drawings of native plants, contributed by a Miss A. F. Walker. Specimens of native sponges are also exhibited, and the industrial part of the collection is completed by samples of colonial India-rubber, and of mats made by the convicts at Sydney.

That corner of the New South Wales department which adjoins the Victorian, is given up to a large case containing fabrics made from New

Zealand flax. These are exhibited by Mr. Cornelius Thorne, who has taken great interest in the development of this branch of industry, and consist of towellings, Scotch sheeting, coarse linen cloths for wool packs and corn sacks, twill, bleached and unbleached, stair carpeting, canvas, Hessian cloth, huckaback, plain and dice-patterned table cloths and napkins, ladies' light morning dresses, and string, cord, and rope. The woven fabrics have been made principally in Scotland, at North Lopham in Norfolk, and at Lurgan in Ireland. Most of them consist exclusively of New Zealand flax, but some have warps of other flaxes, or of jute, cotton, or silk. All the cloths are of excellent quality, and are not to be distinguished from the ordinary forms of the goods whose names they bear. Besides the fabric, the case contains the raw fibres of the plant in various states; and in the centre of it is a salver of Buckland silver, in which the plant itself, the *Phormium tenax*, appears, modelled in Canterbury gold. The salver bears an inscription, stating that it was presented to C. Thorne, by the Canterbury Flax Association of Christchurch, in recognition of his services in developing the uses of the New Zealand flax. The specimens of the products of this plant are all that the colony contributes to the Exhibition.

In a space of no larger size, and next to that which is occupied by New Zealand, both having been most liberally spared out of its own allowance by New South Wales, the small colony of Natal contrives to give an admirable exhibition of the chief of its staple industries. There are beautiful samples of sugar, of coffee, tea, arrowroot, cayenne-pepper, wheat, tobacco, ground nuts and the oil obtained from them, spirits of wine and rum, currie-powder, with banana and tamarind chutneys, and preserved fruits are also shown. All are arranged so as to have for their centre a tabular statement of the commercial progress of the colony, giving the yearly value of the different articles of export, and just above is a large map of Natal showing the broad industrial features of the land. The arrangement is attractive and business-like at the same time. For the tabular statement the colony is indebted to the Hon. F. C. Drummond.

South Australia occupies the other half of the second room, and exhibits much the same things as New South Wales and Victoria. Its collection, however, is conspicuous for the beauty of the samples of wool and the massiveness of the ingots of metal. Of the wool much is shown in cases, with photographs of the sheep that yielded it before they were shorn. But there are also entire snow-white fleeces spread upon the tables and hung up against the walls. One fleece is marked as having been grown in 52 weeks, and weighing 16 lbs., and the wool of a prize Leicester ram and ewe, as being respectively 11¼ and 10¼ inches long. Copper appears in huge ingots and blocks, the produce of various mines, and bismuth is also shown in large masses. Wheat is exhibited weighing 68 lbs. to the imperial bushel. The export of wheat from Adelaide in 1872 was 26,629 tons, and of flour 34,758 tons. There are the usual samples of preserved meats, also of wines, a great abundance of preserved fruits, all of English kinds, and, besides these, currants and muscatel raisins from some of the vineyards. The exhibition is completed with the usual photographs of scenery and places.

Queensland makes its greatest show with woods, stuffed birds, and photographs, all of which have been arranged and displayed so as to give this department a very attractive appearance. In the interspaces between these one comes upon a variety of objects, which lead to the supposition that at the present time Queensland has taken the place which was once assigned to Natal, that of being the "colony of samples." Among them are its specimens of sugar, of which some are hung against the wall in flat glazed cases, a few inches square, and looking a good deal like pictures of different sand-papers. Some finer specimens are placed in show-glasses on the table. The specimens come from plantations which extend through ten degrees of latitude. The other "samples" which Queensland shows comprise silk, wheat, maize, barley, coffee, tea, arrowroot, tobacco, gums, coal in small cases, gold quartz, and iron, lead, and copper ores. Preserved meats appear in some variety, and so also does wine, but on close examination it is found that a great array of bottles means only one sample of a true Queensland vintage, named "Toongaii" after the vineyard that yields it.

Of the really fine and numerous specimens of woods the colony displays, the most beautiful are red-cedar, black iron-bark, and cypress pine. It exhibits likewise sugar hogsheads and tallow-casks, made of a wood that is called silky-oak. The specimens of stuffed birds are most numerous and beautiful, and have evidently been arranged with great taste. They are grouped in large cases, richly and diversely filled, and, being dispersed throughout the department, give it a marked brightness of aspect. Intermixed with them is a great assemblage of photographs of Queensland scenery and settlements, which help still further the ornamental appearance that has evidently been aimed at in this room.

There is one very curious substance amongst the objects in the Queensland collection, called "Bêche de mer." It looks like a leathery mass, and is collected on the sea-shore, being probably a kind of Holothuria. It is valued by

Chinese epicures as the peculiar ingredient of Bêche de mer soup. It may well be so esteemed if prepared according to a receipt annexed to the specimen, as that directs that it is to be stewed in beef or veal stock, and flavoured freely with wine.

REPORT ON STEEL.

Note.—In the report on Steel, published in the *Journal* for August 22, it was stated (p. 775) that a perforated circular saw was exhibited by Messrs. Wheatman and Smith. It should have been said that Messrs. Taylor Brothers, Adelaide Works, were the exhibitors.

The number of visitors admitted to the Exhibition during the week ending Saturday, August 30th, was as follows:—Season tickets, 691; on payment, 15,189; total, 15,880.

The removal of exhibits will commence on Saturday, the 1st November, and it is hoped that foreign commissioners will so arrange that everything shall have been removed by Saturday, the 15th November.

In accordance with the resolution passed at the meeting for the promotion of technical education, at which his Royal Highness the Prince of Wales presided, the Court of the Ironmongers' Company have forwarded the sum of £10 to the London School Board, to enable the Board to send school children to inspect manufactures and their processes at the London International Exhibition of this year.

Last Saturday evening a special lecture was delivered in the School of Cookery to an audience composed of members of the Working Men's Club and Institute and their families. The lecture was made to suit the particular class of hearers that had assembled. A tureen of soup was prepared on the *pot à feu* principle, which was fully explained, and the spectators were shown how for 15d. enough soup could be made for five persons. The cooking of a dish of tripe was also practically illustrated, and the best manner of frying potatoes was shown.

EXHIBITIONS.

Vienna Exhibition Awards.—A first list of awards to exhibitors in the British section appeared in the *London Gazette* of August 26th. In the *Gazette* of the 2nd inst. a similar list of awards to exhibitors from the Indian Empire and the British Colonies was published.—Messrs. Thorne, of Norwich, have obtained a medal for "progress" for a cab, similar to that now shown at the International Exhibition amongst the cabs competing for the Society's prizes.

America at the Vienna Exhibition.—(*From a correspondent*).—Although the American Department made a bad start at Vienna, things have now been fairly arranged, and the show made by the United States is by no means the worst in the Exhibition building. For new and really valuable inventions of public utility the Americans are unsurpassed. In all other sections we find large quantities of articles which are rather for sale than for show. There are many objects of art and luxury; fine jewellery, bronzes, and statues in abundance; superb porcelains and glassware; carpets and fine stuffs; but scarcely an article not seen every day in the year in the shops of Regent-street and on the Bouvelards des Italians. Of course the samples exhibited by manufacturers and tradesmen are artistically made and exquisitely finished, but after all we see very few articles in many of the sections which have not long been known to the public, and offered for sale in the principal cities of Europe. In the American Department, on the other hand, the majority of the articles exhibited are entirely new to Europeans, or present improvements which are highly creditable to the inventive genius of our American cousins. In novelties in agricultural machinery this nation is unrivalled. There is a patent pump, which causes general astonishment, on account of its great power and extreme simplicity; a woolspinner, so simple in its mechanism, and yet so wonderful in its work, that it may be fairly said to be one of the most remarkable machines in the exhibition. The American sewing machines are well worthy of careful examination, some of them exhibiting improvements of great value, and all attracting universal attention. In the preparation of oils, in classifying petroleum, in working stearine, in making felt, gold pens, dental instruments and artificial teeth, in preparing starch, in tanning leather, in soda fountains, ships' compasses, military arms, and in the manufacture of many other articles of general utility, the Americans are unrivalled. I was particularly struck with a case of bank-notes, specimens of American steel engraving, and a case of dental instruments, made and finished in the very highest style known to modern art. In the fine arts the Americans are behindhand, nor can they compete with the French in jewellery or bronzes; but in all matters pertaining to practical industry, the Americans may certainly claim the palm.

Italy at the Vienna Exhibition.—Twenty-one diplomas of honour have been awarded to the Italian department at the Vienna Exhibition; of these two to the Minister of Public Works, for works that have been carried out in Italy. Two diplomas have also been awarded to the Minister of Agriculture, for workmen's houses and for progress that has been made in the cultivation of the vine; one diploma to the Minister of Public Instruction; a diploma to the Senator Fiorelli, for report on the excavations at Pompeii; and amongst other well-known names who have received diplomas may be mentioned Castellani, of Rome, the well-known art jeweller; Dr. Salviata, of Venice, for mosaics and glass; the Marquis Ginori, of Florence, for majolica and the manufactory of mosaics at the Vatican.

A Curiosity in Shorthand Writing is shown at the Vienna Exhibition by Herr Schreider, professor of stenography at Vienna. It consists of the whole Iliad of Homer, written in so small a space as to be enclosed in a nutshell.

Philadelphian Exhibition, 1876.—The plan of classification adopted at the Paris Exhibition of 1867 will be carried out at the forthcoming Universal Exhibition at Philadelphia, that is to say, each class of exhibits will have a space assigned to it, and each country exhibiting will have a portion of that space, so that the best opportunity will be afforded for comparison. The following are the divisions under which they will be arranged:—(1) Raw materials—mineral, vegetable, and animal. (2) Materials and manufactures used for food or in the arts, the result of extractive or combining processes. (3) Textile and felted fabrics—apparel, costumes, and ornaments for the person. (4) Furniture and manufactures of general use in construction of dwellings. (5) Tools, implements, machines, and processes. (6) Motors and transportation. (7) Apparatus and methods for the increase and diffusion of knowledge. (8) Engineering, public works, architecture, &c. (9) Plastic and graphic arts. (10) Objects illustrating efforts for the improvement of the physical, intellectual, and moral condition of man, &c. The Centennial Commission for the inauguration and conduct of the great exhibition have already made most commendable progress. Committees from their number, having in charge special departments of the vast scheme, are in constant session, and the general outline of the work seems to have been fully developed. The site for the buildings used for the occasion has already been secured in Philadelphia's beautiful park, and the formal transfer of the ground by the city authorities to the control of the Centennial Commissioners took place, with suitable ceremonies, on July 4th. The decoration of the ground for the purpose, the planting of shade trees, &c., is to be taken in hand at once.

Oriental Congress and Exhibition.—The Exhibition of Art, Archæology, and Industry, organised by the Oriental Congress, was opened, as announced, on the 1st of September, at the Palais de l'Industrie in Paris.

SILK-GROWING IN AUSTRALIA.

The following communication from Governor Weld to the Earl of Kimberley is gratifying, as showing how, from all sides of the great continent of Australia, favourable reports on the prospects of successfully raising silk are being received:—

Government House, Perth,
20th May, 1873.

My Lord,—In reference to my former correspondence with your lordship, regarding the culture of silk in this colony, I have much pleasure in informing you that the first small sample that has been sent from this colony to the Chamber of Commerce and Arts of Como, Lombardy, has been officially reported upon most favourably by that body. The sample has been tested against silk produced in the province of Como and the Branza, which has hitherto been considered the finest in the world, and for elasticity and strength, and yield per cocoon, the Western Australian sample gives excellent results, in spite of some easily remedied faults of manipulation.

2. Mr. Gugerie, a gentleman well able to judge, writes:—"I am now quite certain of the results attending sericulture" [in Western Australia], "and my principal reason for making this statement is, that the enclosed sample was produced from seed of an inferior kind, imported years back; and, notwithstanding the drawbacks of the unskilful management, the silk produced is proved to be of a superior kind.

3. I may here mention that I have grown, and am growing, large numbers of mulberry trees for distribution, at little expense, by pauper labour, and that recent discoveries in the art of sericulture, or, as I believe it is now termed, sericiculture, have much increased the probability that this industry will be a source of vast future wealth for Australia generally, if the people can only be induced to turn their attention to it, particularly to Western Australia, which is so especially adapted to it by soil, climate, and position.—I have, &c.,

Fred. A. Weld, Governor.

The Right Hon. the Earl of Kimberley.

Mr. Maraini, of Lugano, says the *Swiss Times*, has received permission from the Italian Government to study the plan of a connecting railway between Lake Maggoire and the Lake of Como, and has applied to the Conseil d'Etat of Tessin for permission to study the ground for the portion from Gandria to Fornasette, on Swiss territory.

The value of the steam engines exported in the first seven months of this year was £1,715,618, as compared with £1,416,930 in the corresponding period of 1872, and £1,104,152 in the corresponding period of 1871.

Dr. Clement Winkler has published an essay in which he strongly recommends the use of aluminium as the best metal for small coins.

SCIENTIFIC AND TECHNICAL EDUCATION IN ENGLAND.

(From *Iron.*)

The chief encouragement to the scientific instruction of our working classes comes from three sources—the Science and Art Department, the Society of Arts, and the Guilds of the City of London. No doubt there are minor local societies scattered through the land doing good work in the same direction, but these three are admittedly the principal, and may therefore fairly be considered alone. The funds expended by the Science and Art Department come out of the national revenues; the Society of Arts depends upon the voluntary subscriptions and donations of its members; and the City Guilds have their own resources from the savings and bequests of centuries.

The only scheme of popular scientific education which is entitled to the term "national" is that organised and carried out by the Science and Art Department. This, as any one who has diligently studied its "Directories" can testify, is very good as far as it goes. It is based upon the principle of helping those who are willing to help themselves, by paying a capitation grant upon all students taught according to prescribed rules, and who pass certain examinations. Nominally, the payment of a certain fee by the student is required, but there is a tendency to relax this salutary rule. The Department speaks with an uncertain sound; it is always recommending local schools to become "self-supporting," and to prepare for ultimate withdrawal of Government aid, and yet no care seems to be taken to insist on payment by students. On running down the table of fees charged, we see all kinds of sums mentioned, from a guinea the course down to a penny a lesson, with here and there the word "free." In our experience, if a workman is wishful to learn science, he is willing to pay. He may not be able to pay what his teacher is worth; in that case, it is advisable to give him assistance, and, on the whole, there is no better manner of doing this than that adopted by the South Kensington authorities. No government can be too "paternal" in the matter of genuine instruction; if anything, ours is not paternal enough, seeing that South Kensington only spends about £25,000 annually on science teaching, for which sum about 37,000 students are taught by 1,000 teachers. An important auxiliary to the Government grant is the munificent endowment of Sir Joseph Whitworth.

The Society of Arts has for many years done good service, through its annual examinations, in stimulating scientific education. Latterly, the curriculum has been revised, and subjects identical with those in the South Kensington syllabus have been removed. At the same time a new class of "technological" examinations has been organised, which seems destined to take a high place among the recognised tests of efficiency in this country. The scheme is but a year old, and only six persons have as yet been examined under it; hence little can be said of its results, though its prospects are good. The mode of operation is explained by the Society's own statement of its object, namely, "to supplement the existing examinations of the Science and Art Department, by organising examinations in the science and technology of the various arts and manufactures of this country, to be conducted by examiners capable of testing the practical knowledge and skill required in the application of the scientific principles involved in each art or manufacture." It is gratifying to find that the Commissioners for the Exhibition of 1851 have decided to aid the Society of Arts by granting three studentships, of £50 each, to the persons who shall most distinguish themselves in the subjects of steel, silk, and carriages respectively at the technological examinations in the present year. The scholarships are to be awarded on the very sensible condition—"that the recipients go for a year to some place of scientific instruction, such as the

Royal School of Mines, the Royal College of Science in Dublin, Owens College, Manchester, or the English, Scotch, or Irish Universities, or other school approved by her Majesty's Commissioners, or travel abroad for the purpose of improving themselves in their trades." Some of the City Companies are also willing to aid the Society of Arts by donations, and we believe the Clothworkers' Company intends to found scholarships in its own branch of manufacture.

The Trade Guilds of London have been fair game for reformers many years. Perhaps, on the whole, no attack upon them has been so successful as that of educationalists. At any rate, the companies themselves have become as wide awake to their newly-discovered duty of encouraging technical education as most people. The Turners' Company, one of the smallest and poorest, was the first to offer medals and the freedom of the City as prizes for excellence in its own handicraft—a course which it is intended to continue from year to year. The Coachmakers' Company—another small one—is following in the same direction; and one of the richest, the Stationers' Company, organised in the spring of the present year a course of lectures to persons engaged in the printing trades. The lectures were excellent of their kind, but by no means practical—a thing not at all astonishing, since Mr. Ellis A. Davidson, who delivered them, though a skilful artist, is no printer. For their first attempt, however, the Stationers are to be commended, and it is to be hoped the second will take a more practical turn.

The Trades' Guild of Learning has not yet sufficiently developed its plans for it to be brought into consideration as a principal agent in technical education, though, as a spontaneous movement of those who are to be educated, it is deserving of all encouragement.

To come at length to something practical for the present and future, what course is the best adapted for stimulating the scientific and technical instruction of our workmen? We have already, in the Science and Art Department's scheme, the nucleus of a truly national system, and it is strikingly evident that there are public bodies and private individuals who are able and willing to assist in its development. There is also some disposition on the part of those needing instruction to take advantage of the facilities at their disposal. The duty of those anxious for the spread of scientific and technical education is to cultivate the desire to learn on the one hand, and to improve the means of instruction on the other.

THE WHITWORTH ENGINEERING SCHOLARSHIPS.

At the suggestion of Sir Joseph Whitworth, the Lords of the Committee of Council on Education have announced certain important alterations in the conditions under which the scholarships in mechanical engineering, founded by that gentleman, are henceforth to be held, the experience in the past competition for the scholarships having proved to him the necessity of establishing rules which shall ensure that the holders of them shall devote themselves to the studies and practice necessary for mechanical engineering, during the tenure of the scholarships.

It is therefore resolved that, as soon as possible, that is, in the competition of 1875, every candidate for a scholarship shall produce a certificate that he has worked in a mechanical engineer's shop, or in the drawing office of such a shop, for two years consecutively. In 1874, nine months' consecutive work only in the engineer's shop will be required. The age of intending candidates will still remain twenty-two years, as at present. Each candidate will be examined in the appointed sciences, as also in smith's work, turning, filing, and fitting, pattern-making and moulding, as already established, and the same marks will be awarded as at present.

In 1875, and the following years, each holder of a scholarship appointed under these new rules will be required to produce satisfactory evidence at the termination of every year, that he has made proper advances in the science and practice of mechanical engineering, by coming up for an examination similar to that which is prescribed for the competition, both in theory and practice; and thus, although the scholarships may still be held for three years, they may be withdrawn at the end of each year, if the scholar has not made satisfactory progress.

The number of scholarships in the competition of 1874 will be reduced from ten to six. Each scholarship will be of the fixed annual value of £100, together with an additional annual sum, determined by the results of the progress made in the preceding year. Then, at the end of each year's tenure of the scholarship, the scholars appointed under these new rules will, as before stated, be examined in theory and in practice in the same manner as in the competition for the scholarships. On the results of this examination the following payments, in addition to the £100 before mentioned, will be made among each year's set or batch of scholars:—To the scholar who does best in the examination, £100; to the second, £60; to the third, £50; to the fourth, £40; to the fifth, £30; and to the sixth, £20, provided that each scholar has made such a progress as is satisfactory to the Department of Science and Art, which will determine if the sum named, or any other sum, shall be awarded.

At the expiration of three years' tenure of the scholarships under these new regulations, a further sum of £300 will be awarded, in sums of £200 and £100, to the two scholars of each year's set or batch who have done best during their own scholarship. And in this way it will be possible for the best of the scholars, at the end of his period of tenure of the scholarship, to have obtained £800, and the others in proportion.

The prizes of £100 down to £20 will be awarded according to the total number of marks obtained by the students in practice and theory, in the examination at the end of the year, and the prizes of £200 and £100 will be awarded by adding together the marks obtained by the students at the end of the three years.

The Whitworth scholarship prospectus will be revised in consonance with these regulations.

THE ICE TRADE.

The following details are extracted from a recent article on this subject which appeared in the *Standard*:—

The ice harvest, as conducted in America and on the Norwegian lakes and fjords, is an interesting operation. It commences when the ice is about a foot thick, and the first step is to plane off the snow, or rough surface ice, with an instrument, drawn by horses, called the ice-plane. When the required superficies is cleared, the ice-ploughs, which are like saws with plough-handles to them, and drawn by horses, set to work. Their business is to mark out the ice-field into squares of from two to three feet, like a chess-board, penetrating the surface from one to three inches. The blocks of ice, weighing from two to three hundred weight, are then easily detached by gentle taps on wedges, or by the use of a kind of crow-bar, and floated through an opening in the ice, or canals, to the ice houses, where they are stored most carefully with layers of sawdust between them, for shipment as required. Vessels carrying 500 tons and upwards bring them to London, where they are unloaded at the Surrey Docks, or Limehouse Basin, and thence conveyed to the different ice-stores, in barges on the canals, or other means of transport.

The quantity of ice used in the metropolitan district annually has risen to high dimensions during the last few years. Perhaps it would not be an exaggeration to put it at 60,000 tons, not including the "rough" ice, collected from ponds, rivers, and canals in the neighbourhood of London. Some of the large merchants get rid of more than 10,000 tons in the year. The stores are immense, one belonging to Mr. Leftwich, for instance, being 44 feet across and 108 feet deep, and holding 4,000 tons. Yet our metropolitan consumption does not equal that of Boston or New York. It is only of late years, comparatively speaking, that we have taken to ice. Americans have long looked on it as a necessity, and not merely as a luxury. They use it almost as freely in the winter as in the summer. The moderate and, indeed, free use of iced drinks in hot weather is certainly wholesome, and, as a rule, there is no more danger in taking them when the body is very hot than in bathing in that state. It is a popular error to suppose that the shock in either case is dangerous. It is satisfactory to find that ices and iced drinks are now within the reach of the very poor, the former being obtainable at almost every street corner for the modest sum of a half-penny. Generally speaking they are wholesome, and even at this low figure it is said a very handsome profit is made out of them.

Independently of the personal pleasure derived from the use of ice as a luxury, it is a valuable article for a variety of purposes. Without it we could not have the supply of fish which now come in such large quantities from distant fishing grounds to our markets. It is true that its application does, to a certain extent, deteriorate from the flavour of fish, but it is better to get a good supply of fish with the use of ice than that it should be limited without it. Without ice it would be impossible to lay telegraphic cables of great length in warm latitudes, for the gutta-percha with which they are encased would melt. To obviate this, tanks containing ice are placed in contiguity to the tanks containing the cables. By the use of ice brewers are enabled to sell their beer cheaper. In former times, when ice was very dear, brewers generally could only brew once a week, in consequence of the time taken for "the wort" to cool. By icing the tanks this can now be done in a few hours, and brewing goes on every day. By the use of ice the ova of salmon and other fish, as well as the eggs of birds, can be transported thousands of miles; and thus new and useful forms of animal life are diffused throughout the world. For medical and surgical purposes the value of ice is inestimable. For many affections of the head, such as sun-strokes, its application is most beneficial. and in numerous cases iced drinks produce the best possible results; while, for surgical operations, the employment of ice to deaden pain and arrest hæmorrhage is now considered indispensable. Thousands of tons are used annually in our metropolitan hospitals. Such are some of the uses of ice, and we may, therefore, be grateful that such an abundant supply of cheap ice is always at hand for these and other purposes.

NOTES ON BOOKS.

Hygiene Elementaire.—Par le Dr. Léon Soubeiran. (*Paris: Hachette*), 1873. This little manual is devoted to an exposition of the elementary principles by which health is governed. Chapters are devoted to "Atmospheric agents;" "Soil and water;" "Habitation;" including warming, ventilation, &c.; "Clothing;" "Personal hygiene;" "Contagious and other diseases;" "Food;" "Exercise;" "Sleep;" "Hygiène des sens," dealing with the proper method of keeping each sense in due health and activity; and "Mental and physical occupations." The whole forms a compact but thorough elementary treatise on the subject.

The French Government propose to appoint a special commission to inquire into the practicability of making at Boulogne a new deep-water harbour, which shall be accessible at all hours.

GENERAL NOTES.

Albumen Extracted from Milk.—Schwalbe has found that if oil of mustard be added to cow's milk in the proportion of one drop to 1·1 drams, the milk does not coagulate even after being kept for a considerable period, but that the caseine is transformed into albumen. If this discovery, says *Les Mondes*, is confirmed, it will be of considerable importance in the printed fabric industry.

Bath Stone.—The great extension of the demand for Bath stone during the last few years has led to the apprehension that the existing quarries would soon be exhausted. This apprehension has been dispelled by the discovery of a large extent of building stone in the neighbourhood of Corsham, which is now being opened by Messrs. Randell and Saunders. The quantity is sufficient to supply the existing demand for half a century. It will be connected by railway with the Great Western system.—*Bristol Daily Post.*

The Book Trade.—The Custom-house returns for 1872 show that the export of printed books from this country in that year reached 81,422 cwt., of the declared value of £883,914, an increase of no less than 19,212 cwt. in quantity, and £164,872 in value over the preceding year. On the other hand, the import of books into this country was only 14,172 cwt., of the value of £149,189, showing a decrease of 335 cwt. in quantity, and of £9,240 in value.

The Narrowest Gauge, or Single Central Rail, Railway—We (*Builder*) understand a project will be brought before the British Association for the Advancement of Science for engines and carriages to be constructed with a single row of central wheels, ranged *a la* bycicle, to travel on a single line of rails. The advantages claimed for it are economy in construction, easier motion, greater safety, and the facility which it offers for rapidly extending railway communication at home and abroad.

Re-building the Alexandra Palace.—The *Builder* understands that the plans for reconstructing the Alexandra Palace having been drawn up and agreed upon, the ruins have now been handed over to the builders, and that the rebuilding of the palace will be commenced as soon as the *débris* can be cleared away. It is said that, with the exception of the walls of the central transept, the building will be entirely reconstructed. The new palace is to be larger than the old building, being both longer and broader. It is to have three transepts, one forming a concert-hall, another a theatre, and the third is, it is stated, to be devoted to bazaar purposes. These will be connected by corridors, in which light goods will be exhibited for sale. In some respects the new building will resemble the Crystal Palace, it having been decided that iron and glass shall be largely used in the construction of the building. It is expected to be completed and ready for opening in June next.

Report of the Commissioners of Patents.—In the year 1872 there were 3,970 petitions presented for grants of letters patent in this country, and a stamp duty of £5 was paid upon each; there were 2,988 notices given of intention to proceed with the application, and those also bore a stamp of £5 each; there were 2,773 warrants signed for patents, also with the £5 stamp; 2,771 patents were actually sealed, and bore the £5 stamp. In the same year 2,745 specifications were filed, bearing the £5 stamp. The progressive stamp duty of £50 was paid upon 791 patents, to prevent their becoming void at the end of their third year; and the further duty of £100 was paid on 193 patents, to prevent their becoming void at the end of their seventh year, when half their term had run out. About 72 per cent. are allowed by non-payment to lapse at the end of their third year, and only about 9 per cent. are kept alive beyond the seventh year. The fees on patents paid in 1872 to the Attorney-General and his clerk amounted to £6,030; the Solicitor-General comes under the new rule for payment of the law officers by salary for non-contentious business. The compensations payable from the patent fee fund to the Scotch and Irish law officers amounted in the year to £3,450. The whole income reached £137,840, and the expenditure left a surplus of £85,611, paid into the Treasury.

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FRIDAY, SEPTEMBER 12, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

GENERAL EXAMINATIONS, 1874.

The Programme of Examinations for 1874 is now ready, and may be had gratis, on application to the Secretary.

These Examinations, in 1874, will be held on the evenings of the 21st, 22nd, 23rd, and 24th April. The Time-table has been arranged as follows :—

TUESDAY, April 21, From 7 to 10 p m	WEDNESDAY, April 22, From 7 to 10 p m.	THURSDAY, April 23, From 7 to 10 p.m.	FRIDAY, April 24, From 7 to 10 p.m.
Arithmetic. Logic. Floriculture.	Theory of Music English History. German. Spanish.	Political Economy. French. Fruit and Vegetable Culture.	Book-keeping. English Language. Italian.

Friday, April 24, 6 to 7 p.m.—Dictation.

The rule which formerly prevented a candidate who had once obtained a first-class certificate in a subject from being again examined in that subject with a view to gaining a prize, has, in accordance with the wish expressed at the Conference, held on the 27th June, 1873, been rescinded. In future, therefore, a candidate who has obtained a first-class certificate in a subject may be again examined in that subject, but not more than one first-class certificate in any subject will be counted for the Prince Consort's Prize, or for the Council Prize to Females. A candidate having taken the first prize in any subject cannot again take a prize in that subject, nor can a candidate take a prize of the same grade twice in any subject.

The Elementary Examinations, held by the District Unions and Local Boards, for which papers are furnished by the Society, are fixed for the 10th, 11th, and 12th March.

Full details in reference to the Examinations are given in the Programme, copies of which should be applied for to the Secretary of the Society of Arts, by all intending to come forward as candidates, or otherwise interested in the Examinations.

NATIONAL TRAINING SCHOOL FOR MUSIC.

1. The necessity for a National Training School for promoting the art of Music in this country has long been felt, and has at various periods been urged on the attention of successive Governments by the highest authorities. Such has been the unanimity of all those who are competent to give an opinion in this matter that it is needless to discuss the question here. Suffice it to say that the whole subject of Musical Education in this and foreign countries was investigated and fully reported on by a committee appointed by the Society of Arts in 1865.

2. Although it appears from the Reports of the Science and Art Department that the question of a State Training School was at one time under the consideration of the Lords of the Committee of Council on Education—Earl Granville being then Lord President—the Department of Science and Art up to this time has not taken any active steps towards its establishment. It has therefore been decided by the Society of Arts to take the initiative, and establish a Training School by voluntary effort, with the full intention that it should, and under the confident hope that it will, eventually, be transferred to the responsible management of the State.

3. The fundamental principle and primary object of the School is the cultivation of the highest musical aptitude in the country, in whatever station of society it may be found. In order to carry out this principle to the fullest extent, admission to the School will be obtained by competitive examination alone.

4. As the gift of musical ability is found in all grades of society, and frequently among the classes of very limited means, it is evident that in a large number of cases, the student must not only receive gratuitous instruction, but also be supported during the period of his training. To provide for this it intended to establish about 300 scholarships, for which the most influential support has already been promised, and further support is solicited.

5. The proposed scholarships will be of two kinds, the one to afford free instruction by paying the students' fees, the other to give free instruction with a maintenance allowance in addition. It will be open to any county, town, public body, or private individual to establish one or other of these kinds of scholarships for competition under given limitations. Should there be more accommodation in the school than is requisite for the instruction of these scholars, students paying their own fees will be admitted by competition to fill the vacancies, care being taken that they show sufficient aptitude.

6. It is proposed that the School should provide in the first instance for the free instruction of about

300 scholars. The school fee without maintenance, it is estimated, will be between £35 and £40 a year. The maintenance allowance for the support of the scholar will be in addition to this fee, and independent of the school.

7. The Council of the Royal Albert Hall are prepared to devote certain rooms, including two small lecture theatres, to the use of the School at a nominal rental, when proper arrangements shall have made been made for its conduct. This assistance is estimated to be worth about £1,000 a year.

8. The Royal Commissioners for the Exhibition of 1851 have offered a plot of ground immediately adjoining the Albert Hall for supplementary suites of practising and lecture-rooms, and have agreed to grant a lease of the same to Mr. C. J. Freake, a member of the Council, who has most munificently undertaken, at his own cost and risk, to erect the necessary buildings thereon. Indeed, the plans for these buildings are in a forward state of preparation.

10. The School is under a Committee of Management, consisting of two members appointed by the Royal Commissioners for the Exhibition of 1851, two members appointed by the Council of the Royal Albert-hall, and three members appointed by the Council of the Society of Arts, and the Committee thus formed consists of H.R.H. the Duke of Edinburgh, H.R.H. Prince Christian, Admiral the Right Hon. Lord Clarence Paget, K.C.B., Major-General Eardley-Wilmot, R.A., F.R.S., Henry Cole, Esq., C.B., Major Donnelly, R.E., and Sir William Anderson, K.C.B.

All communications relative to the establishment of Scholarships, and all inquiries about the Training School, should be addressed to the Secretary of the National Training School for Music, Kensington-gore, London, S.W.

P. Le Neve Foster, *Secretary.*

SIR JOSEPH WHITWORTH'S PRIZES FOR THRIFT ESSAYS.

Sir Joseph Whitworth has offered prizes of the value of one hundred pounds, to be awarded by the Society of Arts, for the best Essays on the "Advantages that would be likely to arise if railway companies and limited companies generally were each to establish a savings-bank for the working classes in their employ." With this offer he has transmitted the following observations:—

1. Is not a good rate of interest, with perfect security, more likely to promote the habit of saving than any other plan that can be devised?

2. Sir Joseph Whitworth suggests that the interest to be paid on the deposits should be the same as the dividend, with a guarantee that it shall not be less than 4 per cent.

3. By paying the same rate of interest as the dividend earned, there is a bond of union established between labour and capital.

4. An Act of Parliament might make the deposits of the industrial classes the first charge on the estate.

5. The proprietor of a private establishment, whose profits are not made known, might undertake to pay, say 7 or 8 per cent. when the profits reached that amount or more, the proprietor giving an undertaking to pay not less than 4 per cent.

6. In the case of Agriculture, each county might have its savings-bank for the savings of both men and women in the said county, and the interest to be paid might be 6 or 7 per cent.

7. To do this there might be a rate collected along with the poor-rate, to be called the interest or industrial rate.

8. As this rate increased, no doubt the poor-rate would diminish, and if the habit of saving became general among the labouring classes, there would probably be great gain to the property-owning classes, considering the great variety of ways in which they have now to contribute for the support of the unfortunate who now make no provision for themselves.

9. In order to realise what might be the probable saving to those who encourage the savings-banks thus suggested, Sir Joseph Whitworth points to the list of charities, also institutions, such as infirmaries, hospitals, union-houses, prisons, police, &c., &c.

10. In any establishment, if only one-third of those employed deposited savings, they would have immense influence over the other two-thirds of their fellow-workmen.

11. Men who spend all their earnings are generally reckless, and become the dupes of agitators; but the man who has put by some of his earnings will be likely to exercise forethought, and will not be led away by others.

12. In South Wales is it likely there would have been the late turn-out, if the different establishments had each had such a savings-bank as that proposed?

13. In the case of a man or woman falling into distress from causes beyond their control, what better proof could be given that they were deserving of sympathy and assistance from their friends, than the fact that they had put by savings at a time when they were able to do so? The rule of action should be to do as little as possible for those who do as little as possible for themselves.

14. Some of the points to be considered by the essayists will be the amount to which the savings shall be limited, and when the depositor wishes to withdraw the whole or any part of the sum deposited, what notice shall be given.

15. The co-operative system is no doubt effecting much good, but if the system here sketched out were adopted, the greatest good, in the shortest time possible, might be effected.

To the above observations Sir Joseph Whitworth has added the following:—

I think it will be admitted as desirable that one-third of the period of man's existence should, if possible, be spent free from the necessity of labour and toil.

The middle period of life is, therefore, the time when man's energies should be put forth, and the greatest amount of work should be done that strict obedience to the laws of health will permit. The experience of industrious men goes to prove that the most pleasurable existence is insured by following this course.

It is therefore wrong, in every sense, for the Amalgamated Engineers and other Trades Unions to combine and endeavour to compel young and middle-aged men, in the prime of life, to limit and reduce their hours of labour to the extent now being attempted, and thus prevent them from saving so much, and laying it by for that period of life when man's energies begin to fail, when work becomes irksome, and when rest is necessary in order to pass a comfortable existence. May not the case between the industrious working man who saves part of his earnings, and the man who is reckless and will not save part of his earnings, be fairly stated thus:—

That the man who does not save when he is in health and strength, robs the man who does save, because the law compels him to support those who have not saved, and to bury them when dead?

The principal subjects which the essayists should consider are the preceding.

After commending these observations of the enlightened and liberal donor to the consideration of the competing essayists, the Council, however, would further call their attention to the liability to frauds of various kinds to which such a system may be subject, such as, for instance, that of colourable investments being made by parties investing, in their own names, moneys not bonâ fide their own; and would impress upon the competitors the importance of suggesting the best means of preventing such abuses.

There will be two prizes, £70 for the best, and £30 for the second best essays. The judges reserve the right of withholding the prizes altogether, or awarding lesser sums.

The following are the conditions to be observed:

1. The essays must be sent to the House of the Society of Arts, Adelphi, London, addressed to the Secretary, on or before 1st December, 1873.

2. They must be delivered either in print or in manuscript. If in manuscript, they should be written distinctly on foolscap paper, on one side of the paper only. Every paragraph must be numbered.

3. They must be sent in sealed, with only a motto or cypher; and a separate letter, also sealed, with the motto or cypher marked outside, must accompany the essay, giving the name and address of the writer.

4. Brevity will be considered as a merit.

5. They may have been published anonymously before being sent in.

6. The Society is to have the right of publishing the two prize essays in its *Journal*.

7. The award of the judges will be final.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The second lecture of the third course of Cantor Lectures for the Session, "On Wines; their Production, Treatment, and Use," was delivered by J. L. W. Thudichum, Esq., M.D., on Monday evening, April 28th, 1873. The concluding portion runs as follows:—

Lecture II. (*concluded*).

The Vineyards of San Lucar de Barrameda.

The situation and extent of the vineyards of San Lucar is best appreciated by an inspection of the map of Consul Suter. They are mainly situated upon albariza hills, and are worked upon the same principles as the Jerez vineyards. But at San Lucar all vineyard labours throughout the year are performed a fortnight earlier than at Jerez. The vintage is in the beginning of September, when the grapes are in a much less ripe state than that in which a fortnight later they are harvested at Jerez. This is probably caused by the proximity of the sea, which in September brings rains and winds, both of which are destructive of ripe and over-ripe grapes. The vines are mostly "listanes," the same as those which at Jerez are termed palominos. Vinification is the same as at Jerez; plastering, vino de color, dulce, and brandy are used to make up the semblance of sherry. But there is a speciality produced at San Lucar, which may be termed the parallel to the Jerez amontillado, namely, the so-called manzanilla de San Lucar. This wine has a particularly nice, though thin flavour, while young; with age it becomes very dry, and somewhat bitter. It has the character of all wines made from somewhat underripe grapes, and becomes passado at less than one-third of the age of genuine sherries. It should always be termed "manzanilla de San Lucar" in full, to distinguish it from the wines of Manzanilla, an important viticultural district not far from Seville. The production and trade of San Lucar are in the hands of growers or cosecheros, holders, or almacenistas, and extractores, or shippers, as at Jerez. When I visited San Lucar, in October, 1871, I inspected more particularly the viticultural pagos of El Merino on the east and La Malaya on the west of the new road from Jerez. In some of the vineyards labourers were already engaged in arranging the soil for the winter. The vines were kept even lower on the ground than at Jerez. Close to San Lucar, I observed orange-groves of great beauty, and, as I was told, of great value. In San Lucar I visited several bodegas, among others that of an old gentleman who was supposed to possess the oldest wine in the place. I heard him relate that in 1804 he had in his bodega three botas of vino de color, which were, to his knowledge, at least twenty years old. These three botas had since then, by simple evaporation, become concentrated to one. It was sold in my presence for ninety pounds sterling, and the purchaser thought the value of his acquisition at least ten times that sum. I myself, however, looked upon this wine as merely a pickle of sulphate of potash, caramel, and spirit, from which the soul of wine had fled ages ago. In the same old bodega in which this relic was kept I also observed some of the underground tinajas of 130 arrobas, or six botas capacity each, executed in brickwork, which in former ages used to receive the wine. They had evidently been disused for generations, and now served as the playground of a numerous colony of rats.

In another large bodega I much admired some fine Manzanilla de San Lucar, ten years old, price *in loco* 300 pesos, equal to £45 per bota. I tasted wine of 1870, worth, at the time of my visit, from forty to fifty pesos, which in 1873 would probably sell at 140 pesos, or £21, per butt. On the whole I came to the conclusion that the San Lucar wines on an average command less than half the average price of Jerez wines. The wines in the bodegas were not highly brandied, but they do not come to England in that state. They are always suffocated in spirit before shipment.

The Algaida and its Indigenous Vines.

The Algaida is a forest of about 9,000 aranzadas in extent, on the south bank of the Guadalquivir, to the east of San Lucar. It is reached by a long journey along the sandy and marshy banks of the river, through fields and forests, and over uncultivated plains of vast extent. It is surrounded by swamps (marismas) and during the rainy season is itself inundated to a great extent. The soil consists partly of clay, partly of sand, and in many parts it contains deserts of pure sand. It is planted mainly with the sea-pine (*Pinus maritima*), but contains also groups of the silvery elm, and large tracts are covered with shrubs of lentiscus. Almost its entire border, and many large and small open spaces in its interior, are lined with the wild vines, first described by Clemente, which were the principal object of my excursion to the spot.

I was accompanied by some friends, and we engaged two foresters to guide and guard us, all being well armed. There are no roads whatever, and paths, beaten by the herds of goats of the distant villages, exist only round the circumference and in the shrubby parts. In walking along I soon perceived some wild vines covering an oleander bush; further on, wild fig-bushes and trees in numbers. Then more vines, much pulled about by men and beasts. When, after a long walk, I arrived in a part where white silver-elms form a large continuous group, I found vines covering the whole of large fir-trees; there were at the same time brambles and sarsaparilla in blossom, creeping up shrubs and trees. From a formidable rampart of brambles, covered with vines, one of my companions fetched some vine branches upon which were (on October 13th) eight bunches of blossoms. By this means I was enabled immediately to determine and to demonstrate to all present, that these garañonas, as the Spaniards term the wild vines, are really indigenous wild plants, and not stray children of vineyards; for all the flowers had the *stamina recurvata*, which we know to be the characteristic of the female type of the *dioecic* wild vine, and no erect stamina; and the recurvation was so strong and typical that I observed several stamina which had grasped the little cap ordinarily pushed off the bud, and kept it closely pressed to the flower-stem. As often as I bent it back so as to cover the umbilicus the stamen returned again with the cap, and showed its nature.

Such flowers are represented in fig. 3, p. 6, of Thudichum and Dupré's "Treatise on Wine," &c., and the account there given of the indigenous vines of European countries is confirmed in all essential particulars by the foregoing observation in the Algaida. Some vine-leaves were red, indicating black grapes. The shepherds and goats had not left a single berry on this side of the forest. We were informed by the foresters that the shepherds not only eat these wild grapes, but make wine from them. After a long struggle through miles of forest, brushwood, and brambles, through sand and difficulties of every kind, I at last came to the place described by Clemente:—" In this place the vines form impenetrable thickets, magnificent banquetting halls, most graceful pavilions, grottoes, places, covered walks, winding footpaths, crossed walks, labyrinths, walls, arches, pillars, and a thousand other original and indescribable caprices." This description, which dates from the year 1803, is literally true in the present day. From a large tree I took a vine branch 50 feet in length. Many other canes of the same size were hanging down, and forming a perfect screen, in the shade of which I rested for some time to admire the phenomenon.

We then passed miles upon miles of vines; at last we struck across the sandy interior of the side of the forest on which flows the Guadalquivir. A march of two hours through loose sand brought me to a part where all the forms of wild vines were found, round a swamp, in their most intense concentration. A wild fig-tree was covered with a wild vine full of grapes. They were small and black, acidulous, but good to eat. The vine was much affected by the oidium. The swamp gave me a good idea of the circumstances under which the fossil vines described in our Treatise, pp. 14-15, were living. At Salzhausen, the fossil vine leaves are found together with the leaves of a fig-tree. The vines are growing in such masses in this forest, that the foresters estimated the quantity of wine which could be made, if all the grapes could be collected, at a hundred botas. It is probable that these garañonas have, by cultivation, yielded the black palomino, also called tempranillo of the south, identical with the graciano of the Ebro valley. The doctrine which I advocated before this Society some years ago, in a paper printed in vol. 18, p. 109 of the *Journal*, namely, that the peculiar wines of the great viticultural districts of Europe were derived from wild vines indigenous to these districts, and not imported into them by the agency of man, has thus obtained an important confirmation.

The Vineyards of Rota.—Tintilla de Rota.

The soil of the Rota district is almost pure sand. All the celebrated Rota vegetables and fruit, as well as the tintilla, are indeed grown upon sand thrown upon the shore by the sea. The parcels of land are all surrounded by sand-walls, and these latter are fixed by stockades of reeds, the well-known cañas. The parcels are mostly small, or, if large, are frequently subdivided by such reed-palings, to break the force of the wind and keep the sand in its place. The wines in the bodegas of Rota I found to be of three very different qualities. The first quality, the principal product of the vineyards of Rota, is the tintilla. This is not wine in the ordinary significance of the term, but more of a syrup, made from passulated grapes or raisins by a peculiar process. The black grapes of the tintilla vine are dried in the sun, taken off the stalks, and put into upright barrels open at the upper end. Must, which has been evaporated to the consistence of a fluid syrup, arrope, is now put over the raisins, and the mixture is allowed to stand and macerate, the tops of the casks being covered with mats. The raisins now become disintegrated, until the mass is like a jam. More arrope is added from time to time; in January the mass is trodden on the lagar and pressed. The resulting thick, dark, reddish brown liquid is the tintilla. No spirit, as I was informed, is added to it at any time, and therefore the finished tintilla, which is said not to ferment, ought not to contain any alcohol. But on tasting the product of 1870, in one of the bodegas, I found it to be in a slightly effervescent state, producing the well-known prickly sensation on the sides of the tongue. And on subjecting a quantity of old solera tintilla to distillation I obtained 5·89 per cent. by weight of alcohol, or 12·87 per cent. of proof spirit. Another specimen of tintilla from another bodega contained 5·6 per cent. by weight of alcohol, equal to 12 per cent. of proof spirit. It is therefore certain that the tintilla of Rota contains alcohol, and that this is probably the product of a very slow fermentation. From the mode in which the arrope-drenched raisins are kept in the bodegas, it appeared possible that the product might contain much acetic acid. On subjecting a quantity to distillation with oxalic acid it yielded, however, only 0·228 per cent., another specimen 0·2 per cent. Distilled with some caustic potash the tintilla yielded an alkaline distillate, containing ammonia and compound ammonias, easily recognised by the peculiar and disagreeable smell. The existence of these ammonias is accounted for by the long maceration which the albuminous matters of the raisins undergo in the casks while moistened with arrope. Although the tintilla is made from black grapes, it does not contain the red or blue colouring matter of their husks, for this would require much alcohol and acid for extraction, as the alcohol is not added and is not produced until after the juice is separated from the husks; the colouring matter remains behind. The great amount of sweetness and the flavour of dried grapes, together with the mass of extractives and the little alcohol in juxtaposition to the free acidity, make the tintilla an article of the class of agreeable, drinkable sweets. A bota full of the best quality costs at Rota about £40, but the current price of the great bulk of the produce is about £20 to £24 per bota.

The second product of importance of Rota is vino de color. The tinto grapes are plastered, pressed, and the white must is allowed to ferment. Another quantity of the same white must is evaporated to the consistence of a syrup, and is added to the fermenting natural must, and the mixture completes its fermentation. Then spirit is added in larger or smaller quantities. This vino de color has a horrible taste, and is, in fact, undrinkable. Its principal, perhaps only use, is for mixing with pale country wines, to give them the external falsified resemblance to the similarly prepared brown, pale, and golden sherries.

The third quality of Rota product, and the one which approaches nearest to wine, is the tinto, or tent of English authors. It is made by fermenting the juice with the husks, and thus becomes a truly red wine. I have tasted tinto thoroughly fermented, dry, free from sugar and adventitious spirit, which was really delicious, and showed what tinto might be if properly prepared and left alone. But such is not to be, for it is not to the taste of the wine merchants, who want Rota tent with burning spirit and lots of sweet. This treatment completely ruins the peculiar fine flavour of this wine. The tinto grape of Rota therefore fares like the same grape of Tarragona. It is misused for the production of the vilest imitation of port wine that could be imagined, and sold to the British public as "Spanish port" at prices which are several hundred per cent. higher than the original cost. The unhappy inmates of hospitals and other charitable institutions are its principal consumers. The prices of this wine at Rota vary between £4 and £9 per butt. As Catalonia can undersell Rota in this particular article, the manufacture at Rota is likely to come to an end.

As one of the principal objects of these lectures is to bring before the Society of Arts new knowledge not hitherto recorded, I shall not enter upon any long description of those other vineyards of Spain on which I have nothing new to communicate. A short and systematic account of them can be read in Thudichum and Dupré's Treatise, p. 653 to 658. The wines of Catalonia, Aragon and Valencia, white as well as red, are almost all plastered, and several Spanish oenologists have strongly protested against this practice, which they term an adulteration and a fraud. Some wines are unintentionally plastered by being kept in underground cisterns of masonry, of which the binding and lining material is plaster of Paris. I think it likely that the practice was discovered in this manner. In the Ebro valley, however, much wine is made in the purest possible manner, and it is not unlikely that we may be supplied hereafter with exquisite wine of moderate price from the part called the Rioja.

On the whole, then, we find that the wines of Spain are by nature generally excellent, but are easily and quickly spoiled in part by unskilful and unscientific treatment. They are subject to many so-called diseases which destroy their value, and to counteract these or their result the producers use plaster, sulphurous acid, boiled plastered must, brandy, and sweet must preserved in alcohol. These admixtures are, however, more or less objectionable, because unwholesome to the consumer. It ought therefore to be the object of oenologists in the future to prepare—sherry in particular—and other wines, so as to exclude these admixtures. In that case the wines of Jerez would probably assume and hold the first place amongst all wines of the world.

ANNUAL INTERNATIONAL EXHIBITIONS.

The Council, having been informed that her Majesty's Commissioners do not intend to publish Reports on the different departments of the Exhibition of the present year, and looking to the great importance to Arts, Manufactures, and Commerce that these annual displays should not pass away without some record, have decided to undertake that duty, and for this purpose have engaged the services of gentlemen specially skilled in the subjects of the several sections, to prepare such Reports for publication in the Society's *Journal*. The Council, however, desire it to be understood that, in publishing these reports, they do not necessarily adopt all the views expressed in them, which must be taken as those of the writers only.

The following report is the thirteenth that has been issued. The remainder will appear as soon as they are complete.

AUSTRALIAN PROVISIONS.

By **J. D. Copeman** (Yeats, Acocks, and Copeman).

The rapid rise of the Australian Colonies may be said at the outset to have been due to the gold discoveries. The useful functions which these colonies performed in furnishing an increase to the metallic currency of the world, just at the period when Great Britain started upon a new career of free trade, under the teaching of Messrs. Cobden and Bright, and through the instrumentality of Sir Robert Peel, mark an era in the commercial history of recent times. The great representative pyramid of gold at the Exhibition of 1851 is still present in the minds of Englishmen. Many of our notions with regard to Australia have in this manner been moulded and perpetuated even to the present day. The time has, however, arrived when we can regard the new phase upon which these colonies have apparently entered. The International Exhibition furnishes an opportunity which might not otherwise have arisen for remarking the progress that commerce and agriculture have of late years been making. The constant demand for all descriptions of food for the population of our own island, where the people are so largely engaged in industrial pursuits, the mining operations, the spinning of yarns and the weaving of textile fabrics, and the extraordinary high prices to which the necessaries of life have risen in consequence, have led to experiments, hitherto successful, for the introduction of tinned and preserved meats. These matters have been dealt with in a former report, and attention will now be more especially directed to the other productions of Australia.

It may be observed that the British market is at all times open and ready to receive the products of any and every part of the globe, however remote, either for home consumption or for transhipment; that the British trader is always willing, and even desirous, if only from self-interested motives, to advise, assist, and further the preparation of articles that can by any means be brought to enter into his transactions. It may also be said with equal truth that, possessing as he does the command over an almost unlimited area, and being at the same time called upon to cater for a somewhat censorious constituency, he is obliged to be critical and exacting about the minutest particulars, and what does not perhaps strike the producer as important becomes with him a matter of necessity. The upper and middle classes of England have always been consumers of first-class qualities of produce, but the artisans have now entered the field with apparently equal tastes and determination. Although the market has been vastly extended by this means, the difficulty of furnishing what is required has been increased to a degree hitherto unknown. These remarks apply more especially to London and the manufacturing districts, where only the highest prices can be obtained, and where we presume our colonial friends desire to acquire a permanent and profitable footing. We have seen how America has persevered in a course of agricultural industry, until from small beginnings and, at the outset, apparently hopeless attempts, she has come to occupy a position of importance that cannot be gainsaid or disregarded. I may cite, for instance, that at the time I write, cheese to the extent of 50,000 hundredweights has been received during one week, and this an article which twenty years ago was only saleable to meet the necessities of the lowest classes. I mention these matters for the encouragement of our Australian friends who have favoured our International Exhibition with their valuable and instructive collection of products. And having thus prefaced this subject with opinions upon general questions, I proceed to observe the particulars presented to notice by Mr. Levey, the secretary to the Victorian Commission. I ought to mention that, owing to the extreme heat which had prevailed, many of the samples had been withdrawn, and my attention was confined to the following:—

No. 174 (two sides of bacon), J. Foord, Ballarat.—This specimen is fairly proportioned with regard to fat and lean, and more valuable than if fatter. It is well-cured, from a well-fed hog; too salt, however, for the London market, but saleable at the present time at 50s. per cwt. The Australian curers and exporters for this market have to guard against three things:—First, the extreme heat of the tropics; secondly, against a cost of more than 44s. to cover freight and insurance; thirdly, against its arrival in this country between August and March, because from September to February the markets are fully supplied both from England and Ireland.

No. 176 (two sides of bacon), Samuel Henderson, Melbourne.—The feeding is superior to the American in every respect—the fat solid, the colour good; the bacon is well-cured, and streaky; and if brought over in quantity, equal in condition to this sample, it would realise at the present time 44s. per cwt. The markets are now at a fair average price, but, during scarce seasons for home produce this description of bacon would realise 50s. to 56s. per 112 lbs., and occasionally even more.

No. 173 (two hams), J. Foord, Ballarat.—This is well-cut, from a well-fed hog, but too salt for the best markets. It has, I think, been salted more than necessary, and if slightly milder it would make the passage and arrive in equal condition. The smaller sizes are always more valuable in proportion.

Mess pork, Watson and Patterson, Melbourne.—Shipowners will find this equal, if not superior, to American, but not equal to Irish or Hamburg meat; but a little extra attention would bring it up to their standard. At present prices this is worth 80s. per barrel of 204 lbs.

Cheese.—The samples show that great improvements are needed both in colouring and in the mode of *pressing*. The specimens are all ill-flavoured, which may, however, in great measure, arise from the extreme heat through which they have passed, both in their passage and during their exposure in the building. This shows also the absolute necessity for having the cheese extra pressed for export. The mode of entirely covering the cheese with a cloth is very prejudicial to the flavour; it is quite sufficient to cover the peel about two inches round the top and bottom. Had these cheeses been in sound condition, their present market value would be 54s. per cwt. By way of encouragement to the Australian cheese makers, we would observe that fifteen years ago similar qualities were imported from the United States; now American cheeses fetch prices varying from 60s. to 74s., according to season, and they are taking the place of English cheeses that fall below the quality of the fancy dairies.

No. 177, keg of salt butter, exhibited by Jeffry Samuel, Yan Yean.—This was originally fine butter, well-made, and good in colour. The flavour has become tallowy throughout; the outside has lost its proper colour, and presents the appearance of tallow. The value at the present time is 56s. per cwt. The stocks of old butter having been nearly cleared out last year, butter of this class is now above its average value. Many experiments have been already tried by exporters to secure the butters from the melting effects of the tropics—all have proved failures, the packages generally used being old porter kilderkins; but we are bound to believe that, inasmuch as butter was formerly exported from Cork, and arrived in Australia in good condition, the same may be done *vice versa.* We recommend the maker to prepare for this market from the time it leaves the churn solid butter thoroughly cured by a sufficient admixture of salt, say 6lbs. of salt to 60lbs. of butter. The difference between its arriving in the state of the inspected tub and fit to compete with good ordinary salt butter would be 40s. per cwt.; this allows a wide margin for going to some considerable expense with the package. The casks containing the farinaceous articles at the Exhibition, made of silver wattle wood, indicate that a package might be prepared which would meet the necessities of the case. This should be of well-seasoned wood, not liable to shrink, and as nearly air-tight as possible. It would be desirable also to secure a fast vessel for the transit, and a cool place on board for stowage.

The making of butter has been most successfully carried on in Holland, Ireland, and France, and it would be well if the Australian farmers and squatters would adapt the circumstances of their case to the examples to be found in each of these countries. In Holland and Ireland there are regular dairy farmers, who make this calling their sole occupation, and who have a large number of cows, with cow-houses and all other appliances. In France, owing to the sub-division of property, the farmers are producers of smaller quantities, not sufficient in themselves for export, but these smaller quantities are collected by the merchants, who attend the country markets for that purpose, and who carry on, upon their own premises, a regular sorting, mixing, and packing of the butters so collected. Any Victorian whilst upon a visit to this part of the world, would find a trip to Cork a remunerative one for gaining an insight into the method of packing there adopted.

Amongst the other articles scattered throughout the Victorian and New South Wales Court, I may mention that the trophy case of biscuits, exhibited by Messrs. Guest and Co., contained a great variety of biscuits, all, so far as I can judge, excellent in quality, and quite equal to any of British manufacture. The vinegar exhibited by Messrs. Gutheil, Butner, and Co., Standard Vinegar Works, Prahan, seemed upon trial of the very best quality; in fact, I scarcely ever remember having tasted any superior. The sugar from New South Wales reminded me of the old Jamaica sugar of former days, now to a certain extent superseded by the more questionable light-coloured sugar and extraction from beet-root. The Tomato Sauce, exhibited by E. Zorn, Oakleigh, is excellent, and can be produced in large quantities, as an article of export. The samples of glue exhibited by F. Walker, Preston, near Melbourne; and the candles, tallow, and soap, by T. Kelsall, Ballarat, point to the use of animal refuse in a country where such raw produce must be exceedingly cheap. The cigars exhibited by Messrs. White, of Melbourne, appear upon trial equal to the ordinary home-made British cigar.

Hops.—The sample shown has neither the strength nor the flavour of Sussex hops, to say nothing of Kent, and, although better than samples I have seen in the market, still the value is below those produced in the most inferior districts in Belgium.

370. Tong and Hurst, Western Market, Melbourne.—Samples of assorted Victorian jams, viz.:—Raspberry, black currant, red currant, gooseberry, damson, strawberry, apricot, cherry and gooseberry, and plum.

There seems to be an opening for the preservation of fruit, as the variety, both from South Australia and Victoria, is good. The large tins of the South Australian Jam Company (Limited) appear to have attained the desired perfection, and are thoroughly excellent and recommendable. With regard to the Victorian preserves, the apricots do not possess sufficient of the natural flavour of the fruit. This is attributable to the use of a syrupy sugar whereas a refined sugar, provided all other operations were correct, would, in my opinion, rectify this defect, which obtains generally throughout the other varieties. As fancy articles, bought generally by ladies, and often allowed to stand open upon the table for breakfast and dessert, I would suggest an improvement in the colour and designs of the labels. In this matter I cannot do better than point to the highly-finished boxes of preserves imported from Portugal and France, which serve as ornaments to the windows of the Italian shops in Piccadilly, Bond-street, and other thoroughfares of the West End of London. This may appear a matter of small importance where the quality is really good, but in such articles the exterior often attracts the eye of the purchaser. The preserves of themselves are thoroughly good, honest, and wholesome, and this seems the characteristic of all the productions that came under notice. This exhibition as a whole in fact impresses me strongly with the feeling that Australia is preparing herself for a profitable business, for the management of which experienced and skilled hands will be found necessary, and the remarks made have been with the wish to instruct, so far as possible; but success will only be achieved after many experiments, and probably many failures.

P.S.—Since writing the above, attention has been especially directed by Mr. Levey to some very important experiments in meat preserving which have recently been made in Melbourne. It appears that amongst the new discoveries published at the Exhibition held there in the latter end of the past year, was one made by Mr. James Harrison, a gentleman who has had considerable experience in refrigeration, and who is the inventor of an ice-making machine, largely used both in Australia and South America. The terms in which he described his process were as follows:—"Fresh meat, frozen and packed as if for a voyage, so that the refrigeratory process may be continued for any required period." By this process, the inventor states that the hold of a ship can be filled with the carcases of sheep and cattle, which are frozen in the act of being stowed. The expense of freezing 500 tons before starting will be £100, and of keeping the cargo in a frozen state during the voyage of three months, £75, or 7s. a ton in all. At the commencement of the Exhibition, Mr. Harrison packed his meat in a preserving house, erected in a rough but substantial way, of common deal boards, in the very hottest portion of an unlined zinc building, and in the middle of the hottest season in Australia. At the end of 25 days, the place was opened, in the presence of the Rev. Dr. Bleasdale, and the half of a large sheep and piece of beef taken out. Upon examination the meat was found to be perfectly sweet, and remained in that state after the ice was taken away, and during lengthened exposure to the air. The Commissioners that watched the experiment awarded to Mr. Harrison the gold medal of the Exhibition; and so well satisfied are the landed proprietors and graziers of Victoria with the results obtained, that they have subscribed the sum of £2,500 for the purpose of despatching an experimental cargo to London. At the time of the last mail leaving Australia the arrangements were in a very forward state, and the ship selected was to leave in the early part of July. Its results will be watched with considerable interest. The preserved meats hitherto supplied are so well known in England that it is needless to express any other opinion than this, that much as the Australians have advanced in this respect, there is still something to be overcome before perfection is attained. It is quite possible that the invention of Mr. Harrison may give the desired results; if not, however, without doubt patience and perseverance will overcome the difficulties, and an Englishman may yet enjoy the luxury of a roasted "joint" of colonial mutton or beef at a moderate price.

SUPPLEMENT TO "REPORT ON CARRIAGES."

Some time after this Report was drawn up there arrived several carriages from Russia, and one from Australia. The lateness of these arrivals tends to support the view that the Special Committee for each department, with the experts nominated by the City Companies (where the Companies are willing to assist), should be called together many months in advance of the opening of the Exhibition, in order to allow time for letters and notices to reach the most distant parts of the world, so that would-be exhibitors may be enabled to prepare their goods and to transport them under very varying conditions of climate and opportunity.

Late as are these arrivals, they are opportune and interesting, as illustrating different tastes and manufactures, and show how utterly opposite are the ideas of the makers and users in the places of their origin, and what different conditions of service have to be met.

The C and under-spring Victoria Phaeton of Mr. C. Nellis, of St. Petersburg, is a well built and proportioned carriage, and does much credit to the Russian workmen who made it. The excessive thickness of the wheel-tyres will probably astonish the makers of wheels in England; they are, however, found to be necessary on the Russian roads, which are every year broken up by the thawing of the ice-bound surface in spring.

The stuffing of the body is worthy of notice, as such work requires to be done with a light hand, and English workmen have not hitherto succeeded in this department as well as the French, Germans, or Russians.

The Droski sent by Mr. Jakovleff, also of St. Petersburg, is a thoroughly national carriage. It is hung on an iron perch, with high C-springs, low wheels, and short axles; the principal seat has no support for the back, and the driver's feet are supposed to rest on a footboard fixed without springs to the under-carriage, while his body and legs are carried by the C-springs. A leather pad somewhat relieves the concussions, but the comfort of drivers is evidently not quite so much considered in Russia as in England. Such carriages are driven at great speed in Russia, and afford quite as rapid a means of getting about as the Hansom cabs of London.

The sledge, also from Mr. Jakovleff, is an illustration of how light such vehicles can be made. The principal seat has no support for the back, and the driver's seat is about 4 inches in width, while the space provided for his lower extremities shows in what singular positions some men have to do their work, the receptacle being in shape like a wooden bag (were such a thing possible). However, the form and workmanship of the sledge are excellent; and if it fulfils its purpose, and those who use it are satisfied, why should Englishmen object?

The Phaeton sent by Mr. Daniel White, of Melbourne, is a close copy of American work, being very light, and having high wheels and long axles—almost as great a contrast to the Russian Droski as can well be imagined. In point of workmanship the Russian carriages, however, much excel the Australian one.

Comparing them with English carriages, there is, however, this great difference—that the Russian and Australian carriages for one horse only carry two persons each, and the pair-horse carriage only four; whereas the one-horse carriages shown by England, mostly carry four persons, sometimes six, and in a few cases six are carried in a carriage that forms an open or close one at pleasure.

The English pair-horse carriages carry four to six persons, and sometimes eight; the four-horse brakes carry eight persons, and the drags fourteen. So that with the same horse-power, a greater result is obtained than with the Russian or Australian carriages.

The action taken by the Coach Makers' Company of London in order to encourage the art of drawing among those who carry on the manufacture in England, has been before the public now for several years, and some of the prize drawings are hung in the French annexe; side by side with these are working-scale drawings, side views, and sections of six carriages, sent by Mr. L. Looschen, of No. 8, Erteleff Pereoulok, St. Petersburg. This gentleman has probably been trained in the school of practical carriage-drawing in Paris, and now shows to English manufacturers that the proper system of planning, and the proper construction of carriages are well understood in St. Petersburg, and that they have formidable competitors to meet where they probably little expected to find them.

Working drawings of carriages have also arrived from France and from Servia, but the Russian artist has on the present occasion sent the best contribution of the kind in the Exhibition, and proves himself very competent and clever in his art.

A similar exhibition of carriages will not be held in London for ten years, and it is to be regretted that more foreign carriages have not been sent, as the interchange of ideas tends to progress, creates more emulation, and makes known to us the changes taking place in various parts of the world; whether England holds her ground, or is giving way to rivals.

In one matter, as regards the export of carriages, the tables prepared by the Board of Trade, at the request of the Carriage Committee, show a comparative condition of trade that may surprise English manufacturers. The exports of France, Austria, and the United States, being greater than the British, in some cases two-fold.

English carriages have held a very high reputation for a long period, and foreign builders readily cede the highest place to the best London carriages; but there has arisen a great demand for cheap vehicles, both for home use and for export, that has taken the trade from many competent builders, and closed their establishments; they have been replaced by makers that have suited the public taste for cheapness, while sacrificing the soundness and good qualities that are essential to give permanent satisfaction to home and foreign buyers.

Combined with this, foreign makers have made rapid progress, and it behoves England to make strong efforts, if she is to take such a position in the export of carriages as her other manufacturers have won for her in the markets of the world.

The number of visitors admitted to the Exhibition during the week ending Saturday, September 6th, was as follows:—Season tickets, 693; on payment, 15,555; total, 16,248.

EXHIBITIONS.

THE VIENNA EXHIBITION.

One of the principal features at the Vienna Exhibition is the number of kiosks and pavilions that are scattered about in the park. The number of these buildings is 168, some of which are used as cafés and restaurants; but many, like those of the Austrian Lloyds and Danubian Steam Navigation Company, are the property of large companies or private firms, and contain specimens of the products or manufactures of their owners.

The above-mentioned companies, as well as the Maritime Department of Trieste, exhibit in their respective pavilions a large number of models of steam vessels, engines, ropes, and ships' stores of all kinds, that are manufactured at their yards.

In the pavilions of the Archduke Albert, and of the Prince Swarzenberg, samples of the productions of their lands are shown, such as coal, marble, grain, fruit, cheese, wines, beer, sugar, samples of the plants, and implements used for their cultivation.

An obelisk, built of blocks of coal from the mines of the Prince Hohenlohe, each block representing a different mine, occupies a conspicuous place in the ground. The pavilion of the Minister of Agriculture, an irregular shaped building, contains samples of the produce of the crown lands, and of the industries that are Government monopolies. Tobacco of every kind, from Hungary, Croatia, Transylvania; salt from the Government mines of Gallicia, and Salzburg. Amongst the curiosities in this pavilion is a large vessel, said to contain 1½ tons of mercury, that has been obtained from the Government mines; on the surface, which resembles a mirror, a a large cannon ball floats.

In a long lateral gallery upwards of 200 specimens of ploughs are shown, from the rudest form used by the Hungarian peasantry, to the latest American notion. The classification of these ploughs, which have been collected and arranged with extreme care, adds much to their value.

Occupying a place of honour, on a damask coloured table, is an old and rusty plough, of the commonest form, and the visitor is informed by the inscription that it is the same plough that was taken by Joseph II. from the hand of a ploughman, and with which with his own royal hand the Emperor ploughed a furrow, much to the astonishment of his courtiers.

In the pavilion of the provinces of Styria and Carinthia are shown specimens of the mineral products for which they are noted.

In the pavilion of the *Neue Freue Presse*, the most important newspaper of Vienna, the Walter Printing Machine may be seen daily at work; and on the continuous web of paper travelling at the rate of 15 miles per hour the *Abendblatt* is printed.

Amongst the curiosities at the Vienna Exhibition the great map of the network of the North Pacific Railway in the American department should not be passed by without comment. This map, which is probably one of the largest that has yet been executed, measures 42 ft. in length by 9½ ft. in width, and represents a tract of country 1,950 miles in length and 336 miles in breadth, covering an area of 655,200 square miles. Besides showing clearly the general topographical features of the country, the lines of railway opened and in course of construction are distinctly marked. The length of the main line, from Columbia River to Paget's Sound, is 2,000 miles. The following are the partial distances on this railway:—Between Duluth and Red River, 259 miles; from Red River to Missouri, 200 miles; from the Missouri to Yellowstone, 250 miles; from Yellowstone to Helena, 400 miles; from Lake Superior to Helena, 1,100 miles; from Helena to the Orville Pond, 350; from Orville Pond to the Columbia River, 210 miles; from this point to Kalama, 250 miles; from thence to Paget's Sound, 90 miles.

Five weeks were occupied in executing this map, the draughtsmen working day and night at it, and it is by far the most complete of any map of this region that has yet been made.

The railway material exhibited in the Austrian Department is by far the most complete and numerous in the whole building, and the workmanship leaves nothing to be desired.

EXHIBITION BY SCHOOLS OF DESIGN AT VICTORIA.

The following account is condensed from the *Melbourne Argus* of July 2:—

The third annual competitive exhibition of drawings by pupils in schools of design associated with the Technological Commission was opened in the annexe of the National Gallery on July 1st. Both in the quality and quantity of exhibits this exhibition is a decided improvement on last year's. The rapid pace at which industrial development has progressed of late years in nearly every country in the world has, here as elsewhere, given an impetus to the desire for technological instruction. It is generally admitted, in fact, that any country which does not wish to be left behind in the race for material wealth must not ignore such education. The plan of schools of design established three or four years ago in Victoria is calculated to supply this desideratum to a certain extent, though it falls far short of the system which the colony ought to have. Pupils attending the schools are volunteers only, and the boys here are, as a rule, no more willing to work when their ordinary companions are at play than boys elsewhere. The total number of pupils on the rolls of the nineteen schools in connection with the commission, on the 31st December, 1872, was only 1,417. None of the schools, too, are open for more than from one hour to two hours in one night each week. So great, however, is the desire of many of the pupils to be taught, that they attend at more than one school a week. As far as it has gone, the present system has certainly done much good, and the sphere of its operation is continually expanding. There were in all sixteen schools represented. The exhibits from each school are hung up separately on the walls, each lot being divided by a red line. All the drawings are not of the mechanical class. No pupil who goes to one of the schools is refused admission if he or she profess a desire to be taught, say landscape drawing only, though the chief aim of the commission is, of course, to promote practical knowledge. The walls are adorned with very many coloured and other crayon and chalk studies of fruit, landscapes, and the human figure, several of which show artistic taste and ability of a high order. Indeed, the mere fact that many of the pupils are girls is sufficient to prove that it would be undesirable to limit the tuition to strictly utilitarian subjects. Most of the exhibits, however, are geometrical, architectural, and mechanical drawings, comprising sketches of buildings and columns, ornaments for the decoration of the interior or exterior walls of buildings, illustrations of machinery, and of many other things in everyday use by artisans of various trades. There are several plans showing the principle of isometrical and ordinary perspective, on teaching connected with which much attention has evidently been bestowed. The examinations in practical geometry, mechanical drawing, architectural drawing, and freehand drawing were to be held on July 8th. Mr. S. H. Roberts, the inspector of schools, and acting secretary to the commission, who has rendered great service to the cause of technological instruction, prepared the plan which is to be submitted to the competitors in practical geometry. During the first week the exhibition was open daily from 10 a.m. to 5 p.m. There was no formality about the opening. The exhibition, to which admission was free, was visited by some hundreds of persons on the day of opening.

National Exhibition at Rome.—The Society for the Encouragement of Arts, Industry, and Commerce, have decided upon holding an exhibition at Rome next spring. This exhibition will include every description of Italian produce and manufacture, but no foreign products will be admitted.

HINTS TO COLONISTS ON THE CULTIVATION OF SILK.

By B. Francis Cobb.

(Continued from page 743).

Wherever the colonist finds himself located, there he should plant the mulberry tree. The fruit alone will repay him well for all his trouble, it being a wholesome and useful adjunct to his store, and will "preserve" readily. The writer has lived for days at a time upon a diet of ripe mulberries and boiled rice, and found himself in no way the worse for it. Cattle will nearly all eat the leaves; and when oxen or sheep get the taste of the young leaves, it is sometimes difficult to keep them away from the plantation. In Italy, when the season for rearing the worms is over, what is left of the leaves is usually sold for feeding cattle; and, it has been stated, that sheep fed largely on mulberry leaves have improved in their wool in a marked degree over those fed otherwise—a thing for our Australian friends to "make a note of." It also makes excellent hedges, and may be planted sufficiently close, when used for this purpose, to form, after a year or two, a good, strong, useful fence.

As regards the land suitable, provided it be neither clay nor chalk, almost all lands that any man would attempt to cultivate are suitable. The most so is a rich, free loam; if it be slightly sandy the mulberry flourishes wonderfully; and provided the position be not too dry it is extraordinary upon what apparently sterile soil it will grow. As to situations, the slopes of hills where the air can circulate about it appear to be its favourite position; low, damp flats are to be avoided, but the conditions vary so much in different colonies that the settler must form his own opinion, and take these hints as hints only, not as rules. The Chinese have thousands of mulberry trees reaching from the Hochow hills along the banks of the Grand-canal, to the Tai-ho lake, all on so flat a country that they are enabled to irrigate the trees; but this is never done by bringing water to the tree itself, but only to within a short distance of the tree. Were the water brought to the tree the leaves would be weak and watery, and not good for the worms. This is why a clayey flat is ordinarily about the worst field for a sericiculturist, but in a very dry climate a subsoil that retains the moisture would be rather of service. In the new rich soils of most of our colonies the mulberry will grow anywhere and everywhere; and when it is remembered that in many parts of Europe and Japan, where the land is not good enough for anything else, the mulberry is planted, we may rest assured that there will be few disappointments wherever it is planted round and about the settler's location.

There are many descriptions of the mulberry tree—*Morus nigra*, or the black mulberry, the common mulberry of England; *Morus alba*, the white mulberry, in many countries the very best for producing silk; *Morus morettiana*, or Dandolo's mulberry, a variety of the white, said by both Dandolo (the great authority) and Moretti to produce the most beautiful of all silks; *Morus multicaulis*, or the Philippine mulberry, originally introduced there from China, was supposed some years ago to be the best of all mulberries for silk culture, but experience has proved that this is better adapted to a dry, hot climate than to any other; but the mulberry presents such different aspects in different climates, that no one's opinion respecting it is worth much, except those who have seen and watched the growth of the plant in its individual locality, and produced cocoons from its leaves. Many of our best descriptions are hybrids, and in some of the colonies these hybrids appear to produce superior results, in crops of leaves and cocoons, to the pure varieties.

The English mulberry is a good stock, and, when reared from cuttings in the colonies, soon loses many of the distinctive features, and assumes those of the white; and it would be difficult to recognise in the beautiful large dark-coloured glossy leaves one finds in the South African colonies, the progeny of the English tree, and yet it is known to be so; and it is a question whether this fleshy, resinous, and rather rough leaf, be not a better silk producer than the finer, brighter-looking leaf of the *alba* or *morettiana*. It is surprising how the mulberry may be made to alter its very characteristics by removal to more genial localities. The following, which is vouched for by undoubted authority, conveys a good idea of the changes that may be effected in the mulberry by peculiar treatment. The red mulberry (*Morus rubra*) is indigenous to North America, and bears very large, numerous wrinkled leaves, which, although unfit, can be made most excellent food for silkworms, if the tree be inoculated with rings of bark taken from the best white mulberry.

Some years ago the writer, then in South Africa, was discredited for a time by hazarding the statement to a learned botanist that he could, by changing its conditions, produce leaves from the mulberry tree before them which the botanist would class as of another description. A cutting was taken and planted in a sheltered warm nook, in a rich, free loam, at two thousand feet less elevation, where the refuse of an adjoining stable was frequently thrown about it. Two years after, the parent tree, then five years old, or in its prime, in a poor dry soil and exposed situation, produced a rough, small, dark brownish leaf, full of woody fibre, about four inches extreme length, while its progeny, the cutting at two years of age, yielded a large, light, bright, green-coloured smooth leaf, measuring 17 inches in length by 12 inches in width, and in no instance corresponding to the leaf of the original tree.

The botanist pronounced it to be *Morus alba*, while its progenitor was known to be *Morus nigra*. The "moral" of this anecdote may be thus summed up. Don't bother your heads about species, nor wait to get white mulberry while you have any other; take what you can obtain on the spot, and trust to a genial climate, good soil, and proper cultivation to do the rest. After all, the results of feeding are the true tests, worth more than all the opinions about different descriptions, and the worm itself, where there is any choice, will immediately select the leaf which is the fittest.

The mulberry leaf contains five different substances. 1st. The solids or woody fibrous matter. 2nd. The colouring matter. 3rd. Water. 4th. The nitrogenous saccharine. And 5th. Resinous substance. The woody fibre, the colouring matter, and the water, excepting what in part composes the body of the silkworm, cannot be said to be nutritive to that insect; the saccharine matter is therefore the only part which nourishes it, promotes its growth, and forms its animal substance, and the leaves should contain plenty of this to be a suitable food for the silkworm. The resinous substance is that which, separating itself gradually from the leaf by the peculiar animal organisation, accumulates, clears itself, and insensibly fills the two reservoirs or silk-vessels which form the integral parts of the worm. According to the different proportions of these elements composing the leaf, cases will occur in which a greater weight of leaf will yield less that is useful to the silkworm, both for its nourishment, as well as with respect to the quantity of silk to be obtained from the insect. The result must therefore be that the silkworm which consumes a large quantity of leaves less nutritive, must be more fatigued and more liable to disease than that which eats a smaller proportion of more nutritive leaves. The same applies to those leaves which, though containing a sufficiency of nutritive matter, carry but little resinous substance. In this case the insects would thrive and grow, but not produce a cocoon proportionate to the weight of the worm.

There is no doubt some peculiar substance in the mulberry leaf which is not to be found in any other vegetable production. It is easily shown that the leaves of all the different kinds of mulberry which nourish the silkworm have a kind of granulous surface, covered with a great number of minute tubercules, resembling glands, which seem to contain a sort of essential oil and give out the odour which the leaves exhale. This, some years ago, formed the subject of some careful examinations by certain French chemists, and they have been enabled to ascertain the existence of a matter altogether peculiar to the leaves of the mulberry, having no relation to the general principles of other vegetable productions. It is well known that but very few insects besides the silkworm will touch the mulberry, and even the aphides seem to be destroyed by coming in contact with it. Thus, then, if merely by the substance of this neutral matter the leaves of the mulberry are distinguished from all other vegetables, and it being a fact that the silkworm feeds exclusively on these leaves, and that no other food enables it to make cocoons of good quality, there seems reason to believe that silk is only a metamorphosis of the matter in question, and that it is within the range of possibility that some other laboratory, besides that of the silkworm, may be found with the power to convert the mulberry leaf into silk. At the French Exhibition of 1867 some French chemists declared they had discovered the method, and attracted some attention at the time; but we hear nothing more of it, and our colonial friends may rest assured that, although one cannot deny the possibility of such a thing, it will be a long time before any other laboratory than that of the silkworm itself will succeed in converting mulberry leaf, or any portion of it, into silk.

Messrs. Berthollet, Fourcroy, and Chaptal have declared that silk has much analogy with the tissue of horn, and that by distillation they have obtained from it carbonate of ammonia and a large portion of oil. Roard, in his paper on the subject, addressed to the National Institute of France (Decreusage des Soies), gives an analysis conformable to the observations of the three celebrated chemists above named. He demonstrates that the yellow silk contains, of gum 24 to 25 per cent.; of colouring matter, which is a resinous substance, 55 to 60 per cent.; of a wax, which no doubt forms the exterior brilliancy of the silk, 1·2 to 1·25 per cent.; and a volatile oil, having a strong disagreeable odour. By these characteristics we may conclude that silk is of an intermediate nature between vegetable and animal, which will correspond with the qualities discovered by the above chemists.

(*To be continued.*)

THE FISHERIES OF NEWFOUNDLAND.

The papers relating to her Majesty's colonial possessions contain some interesting observations upon the fisheries which furnish the largest portion of the exports of Newfoundland, and the chief means of occupation for the population. The physical features of the country seem peculiarly adapted for the purpose. The bays which indent the whole of the line of coast are among the finest in the world. These bays are in turn indented by countless minor bays, inlets, and harbours, which carry the great arms of the Atlantic, laden with the finny treasure, many miles into the interior, besides providing water communication of immense value. The cod fishery, which is the staple produce of Newfoundland, is prosecuted from June till October, and affords employment to the mass of the population, who carry on this fishery around the shores of the island and on the coast of Labrador, from whence one-third of the annual catch is now, during a prosperous season, taken. The fishery on the banks is almost exclusively confined to the French and Americans. It is remarkable that the cod-fishery shows no progress, the catch of fifty years ago being almost as great as that of the present time. Thus, while the population has more than doubled, there has been almost no increase in their chief means of support, which, as experience has proved, is somewhat variable and precarious. The manner in which the business is conducted between the merchant and the fisherman, is for each of the former to supply food, clothing, boots, tackle, &c., to a number of the latter, to support them and their families, on the understanding that the fishermen, or, as they are called, "dealers," sell to the merchant all the fish taken at the market price, the value of the goods supplied being, of course, deducted from the cost of the fish. It will thus be seen that a bad fishery brings no loss to the merchant, except for the quantity of goods given by him on credit to the fisherman; whereas a good voyage brings ample remuneration, as the prices charged for the supplies are exceedingly high, owing to the presumed risk of loss on the part of the merchant. In addition to the common cod oil exported, a quantity of cod-liver oil is manufactured. The best kind is made without boiling, by applying to the livers a slight degree of heat, and straining through thin flannel or similar texture. When carefully prepared it is quite pure, nearly inodorous, and of crystalline transparency.

The seal fishery, which ranks next in importance to that of the cod, commences about the 1st of March in each year, and terminates in May. Of late the seal fishery has greatly declined. Twenty years ago about 400 vessels were annually engaged in it, now not more than half that number. Within the last few years screw steamers have been employed with great success, and there can be little doubt that in this fishery steamers will ere long be almost exclusively employed. These steamers are very strongly built of wood, sheathed with iron at the bows, in order to contend with masses of floating field-ice, through which they must frequently force a passage in order to reach the seals, which are generally found in the centre, and not on the edges of packs of ice. Thus, the steamers have a considerable advantage over sailing vessels, the latter being obliged to grope through chance passages in the ice fields, or remain at the edges until a strong wind disperses the pack. Another advantage in respect to steamers consists in being able to come close to the spot where the men despatch the seals, whereas, in reference to sailing vessels, the seals are frequently killed at some miles from the ship, thereby entailing great labour on the already hard-worked sealers, who are obliged to drag the carcases along the ice to the respective ships. One-third of the value of the seals is divided among the crew of the steamers, and one-half of the value of the seals in respect to sailing vessels. The amount advanced to each man is deducted from each share. The merchants, as in the case of the cod fishery, supply each sealer with food, clothing, &c., in anticipation of being paid by a successful voyage. Some idea of the value of the fishery may be gathered from the fact that, in the spring of 1871, the steamship *Commodore* brought in seals to the number of 32,000, valued at about £24,000 sterling, one-third of which, viz., £8,000, was divided among the sealers, say 200, giving to each man £40, a sum realised in six weeks. In addition to seal oil, a large quantity of seal skins are annually exported, the number in 1871 being nearly 500,000. There are four kinds of seal, viz., the harp seal, the most valuable of all; the hooded seal, which has a hood it can draw over its head; the square flipper; and the bay seal.

In the month of June each year the shores of Newfoundland are visited by enormous shoals of caplin, for the purpose of spawning. The masses of them in the various bays and harbours are so great that two men with a small landing net will fill a boat in a couple of hours. So little account is made of this delicious fish, that it is largely employed in manuring the fields and gardens. Naturalists name the caplin *Salmo articus.* The flavour of it, when fresh, is delicious, and its size is about that of a sardine. There is little doubt that, if properly cured, the caplin might compete with either sardines or anchovies, which are so profitable to the fishermen of the Mediterranean. If merely pickled and dried it would be worth more than a dollar a barrel; but no attention is paid to this little fish, the supply of which seems inexhaustible. Herrings are found in large quantities, and of the finest quality, on many parts of the coast, while the Labrador herrings enjoy a wide-spread reputation. The chief seats of this fishery are St. George's Bay, Fortune Bay, Bay of Islands, and Bonne Bay. In the Bay of Islands, during the winter, holes are cut in the ice, and the herrings taken in nets; the fishery lasts from December till April. The salmon fishery is abundant, and the fish are of excellent quality. In certain localities this fishery is large and constantly increasing. The method of taking the fish is generally in nets. So plentiful is the supply of fresh salmon during the season in St. John's, that it is often sold at four or five cents per lb. Owing to the cupidity, selfishness, and ignorance on the part of the fishermen, the salmon fishery, principally on the French shore, is slowly, but very surely, becoming exterminated. In the bays fleets of nets are frequently laid down — sometimes twenty, forty, and even fifty at a time, and every inlet stopped; and if the fish should by any chance be able to escape the first barriers, the rivers are so obstructed by weirs, traps, dams and nets—the latter frequently stretched right across, and at close intervals—that it is a wonder that this fishery has not long since come to an end. Some of the river obstructions are generally removed before the anticipated arrival of a man-of-war, only to be replaced when she leaves the neighbourhood, and it is highly desirable that some active measures should at once be taken by the Government to stop this deplorable state of affairs, before the salmon fishery of Newfoundland becomes a thing of the past. With reference to other fisheries, mackerel, halibut, turbot, and lobsters, are taken on the coast.

THE BRITISH EXPORT TRADE AND COMMERCIAL TREATIES.

As the modern commercial treaties between this country and several continental nations have now been sufficiently long in existence to afford a test of their value to the export trade of this country, it may be useful, as well as interesting, to ascertain what advantage this country has gained by the partial abolition of the protective system by many European states. Our export trade, as is well known, consists of two branches. First, the exports of the produce of the kingdom; and, secondly, the re-exports of foreign and colonial merchandise. The last number of the "Statistical Abstract for the United Kingdom" furnishes the statistics of both these branches of export, and from it the following tables have been compiled:—

1. *Total Value of British and Irish Produce Exported.*

—	1860.	1872.	Increase.	
			Value.	Per cent.
	million £	million £	million £	
To European States	50	110	60	120
To all other parts	86	146	60	70
Total	136	256	120	90

Only a part of the new French tariff came into force at the end of the year 1860; that year may therefore be taken as the starting point, and, as will be observed from the table above, the increased value of exports from this country to Europe in 1872, as compared with 1860, was sixty millions sterling, which was equal to the increased value of exports to the whole of the rest of the globe. It will also be seen that the increase of exports to Europe was in much greater proportion than to other parts of the world, the former having progressed at the rate of 120 per cent., whilst the latter only advanced at the rate of 70 per cent. It should perhaps be remarked that, for facility of comprehension, all the above totals have been stated in round numbers.

2. *As regards the Exports of Foreign and Colonial Produce, we have the following facts:—*

—	1860.	1872.	Increase.	
			Value.	Per cent.
	million £	million £	million £	
To European countries	24	46	22	91
To all other parts	4	12	8	200
Total	28	58	30	108

Here, again, we find, although the progressive increase is not so large to European countries as to other parts, that this branch of trade nearly doubled itself in the period under consideration, the increase in 1872 being twenty-two millions sterling. The superiority of our mercantile marine and the facilities for warehousing in this country are the chief causes of the increase of this branch of trade; for it is worthy of remark that, although by the treaty with France of 1860, wool from Australia, and cotton and jute from India, were admitted into French ports free of duty in English or French vessels, scarcely any direct trade in those articles has taken place, the French imports having been almost entirely made indirectly through English ports.

3. *Summary of Total Export Trade.*

—	1860.	1872.	Increase.	
			Value.	Per cent.
	million £	million £	million £	
To European States	74	156	82	111
To all other parts	90	158	68	75
Total	164	314	150	91

The above table exhibits the total value of all kinds of goods exported from the United Kingdom in 1860 and 1872. It will be seen that the total export trade of the country advanced ninety one per cent., representing a value of one hundred and fifty millions sterling. Of this increased export, Europe took eighty-two millions, against sixty-eight millions sent to other parts. It will also be observed that our trade with Europe is progressing in a greater ratio than with the rest of the world, and that the total value of the trade in the year 1872 was only two millions short of that of the entire export trade to Asia, Africa, America, and Australia put together. With such facts before us, we can hardly doubt that a very large proportion of the increased trade is due to the operation of our treaties of commerce with the several European states.

NOTES ON BOOKS.

Mechanical and Architecture Drawing Copies.—By W. Busbridge. This is a series of lithographed working drawings of the details of various engines, machines, buildings, &c. There are short directions attached, and a list of the technical terms for each portion of the machine described. Each drawing deals with a separate part of the machine, &c. Thus one sheet gives a design for a governor, a second one for a spur-wheel, a third a king-post-truss, and so on. It may be added that the drawings have been recommended by the Science and Art Department as supplying a want much felt by teachers of mechanical drawing.

Six American railway cars, constructed by the Pulman Company, have been shipped at Montreal for the Midland Railway. They are in sections, and will be fitted at Derby by a staff of men sent over from Detroit.

The Leeds Corporation, having tested wood pavements, are about to lay them down in several important thoroughfares, and especially near the Leeds County Court, whose proceedings have thus far been inconvenienced by the noise of vehicles passing over the stone pavements near.

Over one hundred and fifty kilns, engaged in making crockery ware exclusively, exist in the United States. These kilns are capable of producing at the rate of about 30,000 dollars' worth of ware each per year, making a total of the whole of nearly 4,500,000 dollars per day.

An American is said to have brought into use a new motive power that promises to revolutionise existing modes of propulsion. The inventor substitutes the vapours of bisulphide of carbon for steam, the vapours being condensed and used over again with very little loss of the chemical. The vapours are produced in a water bath, which at boiling point creates a pressure of 65 lbs. to the inch, at least so says the *Boston Globe.*

GENERAL NOTES.

British Association.—The final arrangements for the Bradford meeting of the British Association are as follows:—The first general meeting will be held on Wednesday, September 17, at 8 p.m. precisely, when Dr. Carpenter, LL.D., F.R.S., &c., will resign the chair, and the President-Elect, Professor W. A. Williamson, F.R.S., will assume the presidency, and deliver an address. On Thursday, September 11, at 8 p.m., a soirée; on Friday, September 19, at 8·30 p.m., a discourse by Professor W. C. Williamson, F.R.S., of Manchester, on "Coal and Coal-plants;" on Saturday evening, September 20, a lecture on "Fuel," to working men only, by Mr. Siemens, F.R.S.; on Monday, September 22, at 8.30 p.m., a discourse on "Molecules," by Professor Clerk Maxwell, F.R.S.; on Tuesday, September 23, at 8 p.m., a soirée; on Wednesday, September 24, the concluding general meeting will be held at 2.30 p.m., and a grand concert will be given in St. George's-hall, at 8 p.m. The excursions on Thursday, September 25, will be to Harrogate, Ripon, Studley, Bolton Abbey, Gordale Scarr, Malham, Clapham Caves, Settle Caves, and Ingleboro'. Lists and prices of lodgings, and other general information will be given on application at the Local Secretaries' Office, Bradford.

Tunnel Locomotives.—The *Engineer* for last week has a suggestive article on this subject, *apropos* of the Metropolitan Railway and the defective ventilation therein. After pointing out the difficulties which arise from the necessity of keeping up pressure for a time sufficient for a journey, and consequently of keeping the blast on and discharging into the air the products of combustion, the article concludes with the following novel proposal:—"We believe that infinitely the better plan would be to arrange at each terminus a modification of the Siemens' furnace. Each engine would be brought over a suitable gas burner, if we may use the word, and steam may be got up with lightning speed. There would be no delay to get the fire up. It would only be necessary to bring each engine over the gas-burner on a siding, turn on the flame, and run up the pressure. Engine would succeed engine with perfect regularity, and the production of steam would be really continuous. In a word, the engines would take in heat as they now take in water. And here we must call attention to one most important feature of the scheme. Not only would the tunnels be kept perfectly clear of gas, but, instead of using most expensive coal, the companies could at once resort to the use of small cheap slack. Any kind of coal, indeed, would give good results in the Siemens' gas producer; the saving from this cause would soon tell sensibly on dividends."

Iron and Phosphorus.—A new light has been thrown upon the manufacture of finished iron by Professor Scheerer, of the Mining Academy of Freiburg. The Professor recommends, for the removal of phosphorus from pig-iron during the puddling process, that chlorides of calcium and sodium in equal parts be fused together, and introduced into the puddling furnace in the proportion of about three times as much as the phosphorus contained in the iron. The phosphorus and the chlorides combine, and are removed in the slag. In these days of dear coal the discovery of Professor Scheerer assumes considerable importance, inasmuch as one of the principal objections urged against the use of peat and preparations of peat for smelting purposes has been the presence of phosphorus—in large or small quantities—in that description of fuel. If the elimination of phosphorus is reduced to the simple process described, its presence in such pig-iron as is intended to be subsequently "finished" will become of minor importance, and the long-predicted rivalry of peat with coal will at least assume a formidable appearance.—*Iron.*

Production of Glauber's Salts in the Caucasus.—A natural deposit of Glauber's salts has recently been discovered in the Caucasus. In the trial hole that was sunk the first foot furnished marl, then grey moist clay 2½ feet, dark grey bituminous salty clay 9 inches, and pure Glauber's salt bored into 5 feet. The entire deposit probably amounts to 15½ millions of cubic feet. The salt in some places is entirely free from other salts, and contains only 8·10 per cent. of mechanical admixture.

Transparent Paper.—A German invention, recently patented, has for its object the rendering more or less transparent of paper used for writing or drawing, either with ink, pencil, or crayon, and also to give the paper such a surface that such writing or drawing may be completely removed by washing, without in any way injuring the paper. The object of making the paper translucent is that when used in schools the scholars can trace the copy, and thus become proficient in the formation of letters without the explanations usually necessary; and it may also be used in any place where tracings may be required, as by laying the paper over the object to be copied it can be plainly seen. Writing paper is used by preference, its preparation consisting in first saturating it with benzine, and then immediately coating the paper with a suitable, rapidly-drying varnish before the benzine can evaporate. The application of varnish is by preference made by plunging the paper in a bath of it, but it may be applied with a brush or sponge. The varnish is prepared of the following ingredients:—Boiled bleached linseed oil, 20 lbs.; lead shavings, 1 lb.; oxide of zinc, 5 lbs.; Venetian turpentine, ½ lb. Mix and boil eight hours. After cooling, strain, and add white gum copal, 5 lbs., and gum sandarac, ½ lb.—*Journal of Applied Science.*

Making Paper from Hops.—The *Maidstone Journal* is informed that it is intended to carry out in this country, in an extensive way, the French invention, lately noticed in the *Journal*, of making paper from the sheath of the hop-stalk, when the outer skin has been removed. The substance made from this material is of great suppleness and delicacy, and by its employment in this manufacture a new and considerable source of profit will be opened for the hop-grower. The importance of this discovery to Kentish farmers cannot well be exaggerated, for if the season should not prove favourable, and fail to produce first-rate hops, the paper-making material will compensate for the deficiency in this respect. No doubt the growth of hops will be introduced in future in many districts where they are not known at present, as the large amount of material which they will supply for paper-making will alone ensure a good return for their cultivation. The price of the article is very high at present.

A Substitute for India-rubber.—The *Scientific American* states that a substitute for india-rubber has been found in a gum from the milkweed plant, or other plants of the *Asclepia* tribe, and from flax and other seeds. This process consists in macerating and fermenting the substances, and then by evaporation reducing the liquid so obtained to a thick gummy mass. The gum produced in this manner is alleged to possess many of the valuable qualities of india-rubber; it is insoluble in water, and may be vulcanised with sulphur. The price of pure rubber is now very high, and the discovery of an economical substitute is a matter of great importance in the arts.

Alexandra Park.—The directors of the Alexandra Palace have secured the entire Japanese Colony at the Exhibition in Vienna, including the bazaar, the Moorish house by Dr. Schmidel, the Austrian Consul in Tangiers (with all its fittings), and the two Moorish Courts in the large exhibition building, besides many other foreign houses, furnished tents, &c.

NOTICES.

THE LIBRARY.

The following works have been presented to the Library:—

Annals of the Queen's College, Birmingham. Edited by William Sands Cox, F.R.S. Vols. 3 and 4. Presented by the Editor.

Report of the Forty-second Meeting of the British Association for the Advancement of Science, held at Brighton, in August, 1872. Presented by the Association.

Transactions of the Royal Irish Academy. Vol. 24, parts 16 and 17. Vol. 25, parts 1 to 4. And the Proceedings of the Academy. Vol. 10, part 4; and Vol. 1, second series, parts 2 to 8. Presented by the Academy.

Statistics of the Colony of Victoria for 1871. Part 8, Sickness and Infirmity. For 1872, Part 2, Finance, &c.

Paris, 1867. Havre, 1868. Amsterdam, 1869.

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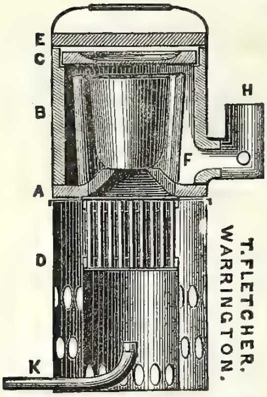

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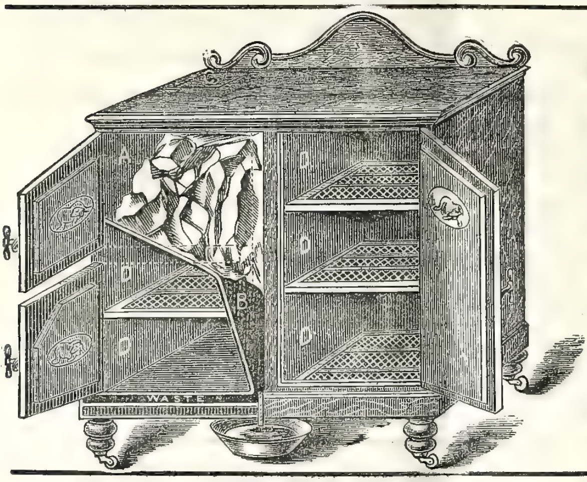

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No. 1,087. Vol. XXI.

FRIDAY, SEPTEMBER 19, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

GENERAL EXAMINATIONS, 1874.

The Programme of Examinations for 1874 is now ready, and may be had gratis, on application to the Secretary.

These Examinations, in 1874, will be held on the evenings of the 21st, 22nd, 23rd, and 24th April. The Time-table has been arranged as follows :—

Tuesday, April 21, From 7 to 10 p.m	Wednesday, April 22, From 7 to 10 p.m.	Thursday, April 23, From 7 to 10 p.m	Friday, April 24, From 7 to 10 p.m.
Arithmetic. Logic. Floriculture.	Theory of Music English History. German. Spanish.	Political Economy. French. Fruit and Vegetable Culture.	Book-keeping. English Language. Italian.

Friday, April 24, 6 to 7 p.m.—Dictation.

The rule which formerly prevented a candidate who had once obtained a first-class certificate in a subject from being again examined in that subject with a view to gaining a prize, has, in accordance with the wish expressed at the Conference, held on the 27th June, 1873, been rescinded. In future, therefore, a candidate who has obtained a first-class certificate in a subject may be again examined in that subject, but not more than one first-class certificate in any subject will be counted for the Prince Consort's Prize, or for the Council Prize to Females. A candidate having taken the first prize in any subject cannot again take a prize in that subject, nor can a candidate take a prize of the same grade twice in any subject.

The Elementary Examinations, held by the District Unions and Local Boards, for which papers are furnished by the Society, are fixed for the 10th, 11th, and 12th March.

Full details in reference to the Examinations are given in the Programme, copies of which should be applied for to the Secretary of the Society of Arts, by all intending to come forward as candidates, or otherwise interested in the Examinations.

TECHNOLOGICAL EXAMINATIONS.

The subjects in which examinations were held this year, namely, Cotton Manufacture, Paper Manufacture, Silk Manufacture, Steel Manufacture, and Carriage-building, will be retained in the Examinations of next year, with the addition of Cloth Manufacture, Glass-making, Pottery and Porcelain, and the Manufacture of Gas.

The Programme is in preparation, and will be published as soon as possible.

ECONOMICAL USE OF COAL FOR DOMESTIC PURPOSES.

With regard to these prizes it has been decided that testing rooms will be provided, in which the various competing articles may be tested in succession, each competitor having allotted to him in turn a room and chimney, for a limited period, where he may fix his apparatus for the purpose of its being tested by the judges appointed by the Society of Arts, the same to be removed when directed by the judges; such fixing and removal to be at the cost of the competitor.

The competing articles must be delivered at the London International Exhibition Building, South Kensington, on the 1st December, 1873, with a view to their being tested, and subsequently shown in the Exhibition of 1874.

HALL-MARKING OF JEWELLERY.—PRIZE FOR ESSAYS.

1. It having been brought to the knowledge of the Council of the Society of Arts that what is termed "Hall-marking" of jewellery and articles of gold and silver, is inadequate to secure to the public that protection in the quality of the materials for which it is intended, they have accepted the offer of one of the members, Mr. Edwin W. Streeter, to place £25 at their disposal, to be awarded as a prize for an Essay treating on this subject, with suggestions for an improved system.

2. The Essays must be sent in not later than the 1st of November, 1873, marked with a motto, or cypher only, accompanied by a sealed letter, with the corresponding motto or cypher marked outside, giving within the name and address of the writer of the Essay.

3. Brevity will be considered a merit.

4. The Council shall have the right of publishing the prize Essay in the *Journal*, and they reserve the right of withholding the prize altogether, or of awarding a lesser sum, if the judges shall so recommend.

P. Le Neve Foster, *Secretary.*

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The third lecture of the third course of Cantor Lectures for the Session, "On Wines; their Production, Treatment, and Use," was delivered by J. L. W. Thudichum, Esq., M.D., on Monday evening, May 5th, 1873, as follows:—

Lecture III.

Description of the vineyards of the Alto Douro, from personal observation of the lecturer. Contrast of geological position of these vineyards to those of Jerez; varieties of vines cultivated. Indigenous vines in the province of Entre Douro e Minho. Viticulture in the Alto Douro. The vintage and wine-making. Elderberry and logwood.

The vineyards of Jerez, which I described in my first lecture, are so beautiful and productive that they might well be termed the vineyards of Venus. Undulating hills, easily accessible from all sides, are covered with a luxurious growth of vines, which every September finds heavily laden with an enormous mass of luscious fruit. A poetical enthusiast might call these hills the very breasts of nature. Very different is the aspect and condition of the vineyards of the Alto Douro. Here all is rock, gorge, almost inaccessible mountain, precipice, and torrent, while over, or along, all these rude features of nature are drawn countless lines of stone walls by which man makes or supports the soil in which the vines find their subsistence. When opposite Tua, I had counted 150 stone-built terraces, one above the other, covering the rock which rises almost out of the waters of the Douro. I thought that if Jerez was the vineyard of Venus, this Alto Douro vineyard must be termed the vineyard of Hercules.

The vineyards of the Alto Douro may be visited from Oporto. There are mail-coaches running twice a day either way, which deliver their passengers at Regoa or Oporto in less than 24 hours; but it is more convenient to travel in a hired carriage, particularly when the traveller desires to make studies by the road-side; although the price of such a carriage in the middle of September, when the great exodus of British merchants to the vineyards take place, is, as a rule, eight pounds sterling for the night journey. Now this journey is often described after the manner in which the Phœnicians related the dangers of their sea-voyages; along it are supposed to be found defiles like those of Scylla and Charybdis. My surprise was therefore agreeable when I drove to the very foot of the vineyards on a beautifully-constructed macadamised road, while the scenery during the whole journey surpassed in beauty many of the reputed great sights of Europe. Indeed, the rise up to the watershed of the Douro valley is not surpassed by anything I have seen in Switzerland, the Pyrenees, or the mountains in central and southern Spain. The ascent should be made on horseback, while the carriage is being drawn up by the steady bullocks, which take half the labour from the carriage-horses.

Vines of the Province Entre Douro e Minho.

During the entire journey up to the water-shed the observer sees no vineyards, properly so-called, but he sees all round the houses and villages, along the roads, along the margins of woods, vines creeping up trees, and competing with their foliage for air and sunshine. I observed only black grapes on these vines, and all those which I tasted were very acid and astringent. From them is made the beverage called "green wine" (vinho verde), from its resemblance to wine made from unripe fruit. The fruit is, in fact, unripe, and, moreover, never becomes ripe in any year, owing to its being grown high up in the air. I have not been able to ascertain what kind of grapes and wine these vines would yield if they were cultivated in good situation and low on the ground. On the whole, what I saw gave me the impression that these nondescript vines, which I also observed in forests and in woody valleys, covering shrubs and brambles, were like the vines of the Algaida, described in the former lecture, true children of the soil, indigenous plants, which, with a minimum of help on the part of man in the shape of pruning, produce an enormous quantity of harsh fruit, having the same relation in taste to the wine-berry as a crab-apple has to a fine French pippin. The vinho verde is only produced in this province of Entre Douro e Minho, and no other wine, particularly none of the quality produced in the Alto Douro, termed "vinho maduro," ripe wine, is here grown.

Soil of the Alto Douro District.

The river Douro, in Portugal, flows through a valley with precipitous sides, mainly formed of a clay-schist formation. This reposes upon or alternates with granite, and the latter rock not rarely appears on the heights forming the water-sheds. The clay-schist forms the viticultural soil, for many reasons. It is easily broken into parallel slabs, with which terraces can be built, so-called dry walls, requiring no mortar or other binding material; it is easily disintegrated by the atmosphere, and forms a clay soil, which retains the water with pertinacity, and allows it to sink deep into the fissures of the schist, where also the roots of the vines are able to follow to great depths. The granite, on the other hand, lacks most of these properties; it does not easily break up, and becomes very dry in summer, and then is generally situated so high above the level of the sea that the vine becomes excluded from it by the coldness of the climate resulting from the elevation. A great part of the soil of the wine districts could not be planted with any other crops; the valleys bear a few strips of land used in maize cultivation; here and there are some olives. Corn, and a few fodder plants are grown on the mountains above the wine region. It is the vine, and the vine alone, which has made the rocks of the Alto Douro a cultivated part of the earth's surface.

Topographical Notes.

The topography of the Alto Douro is best understood with the aid of the maps which have been elaborated by the late Baron Forrester. The largest and most beautiful of them has, I believe, never been published for sale, but only printed for private distribution by the baron. A useful copy, on a reduced scale, was published by Parliament in 1852, in the Report of the Committee on Import Duties on Wines. The limits of the cultivation of the vine are on this map marked by a red line, which includes what was formerly the district under the surveillance of the so-called Agricultural Company. The cultivation of the vine is most extended, and as regards the production of a particular class of wine, most successful, on both sides of the river Corgo, a tributary of the Douro, coming from the north. The district west of the Corgo, usually called the Lower Corgo, has the most ancient cultivation. This begins at a distance of about 42 miles English above Oporto, and occupies the triangular space between the Douro and Corgo. The part east of the Corgo, ending near the river Taah, is termed the Upper Corgo. On the south of the Douro there is also a strip of mountainous territory planted exclusively with vines, but it is much narrower than that district on the north bank. On the whole it may be said that the vineyards of the Alto Douro extend over a piece of mountainous country 30 English miles in length from east to west, and 10 miles in width from north to south. The part of the district above Tua, which contains several excellent though relatively new vineyards, is now frequently termed the Alto Douro Superior, as distinguished from the Alto Douro.

Modes of Planting and Training the Vine.

In the Alto Douro one can see nearly all the varieties of culture side by side, but the prevailing mode is a rational low cultivation. Near and below Regoa there are yet many espaliers, forming covered walks, about two yards high, over which the vines are trained; all these give bad grapes and bad wine. Above Regoa they disappear entirely, and the vines are trained low on on the ground, but the pruning is not so methodical as at Jerez, and consequently with the age of the vine its bearing part rises higher, sometimes a yard above the ground. Grapes grown at that height mostly remain sour, and, particularly in dry years, form acid raisins, which spoil the wine from the lower fully ripe grapes. The viticulturists treat such wines by forming layers, bending the highest branch towards the ground, drawing it through a trench, and allowing it to project at a distance. The young vine is never separated from the old stock, and the old stock is never allowed to grow branches; such old loop-shaped vine-trunks, projecting from the earth, and destitute of leaves, are seen in great numbers, particularly in old vineyards. There are vines trained to sticks, as in France and Germany, and vines trained without them; in some vineyards the vines were planted through holes in the perpendicular walls; but it appeared that many so planted had died from drought and heat.

The operations on the soil are not so methodical as at Jerez. There is an excavation made round every vine in autumn to catch the rain-water; at the same time the vine is pruned. Each of the two or three, or more, main branches of the vine is allowed two or three eyes for the bearing branches, and a spur of one eye with the subsidiary small eye for the growing of wood. All the vineyards are kept carefully free from weeds, so that the sun has free play in heating the soil.

The Douro vines have this peculiarity in common, that their fruit is not large-sized like the grapes of Andalusia, nor small-sized like the grapes of Burgundy or the Rhine, but medium-sized like that of the paludal vines of the Gironde.

Vintage and Modes of Vinification.

The vintage in the Alto Douro begins at the earliest on the 20th of September, and ends about the 10th of October. The vineyards in low situations, close upon the Douro, are the earliest to harvest, and even then the grapes are sometimes over-ripe, so as to be partially passulated; the latest vintages are in the third or top region of the slopes. The vintage is executed by men and women, all from Gallicia, hence termed Gallegos. These also do all the other labours on the ground required throughout the year; the settled population of Portuguese is too small in numbers, and too sickly for heavy work; for the entire district is extremely unhealthy. The Gallegos receive on an average 7d. per day in money, and food, which, however, does not include bread. The daily food consists of a pound of salted dry cod, of which large quantities are imported into Portugal from Newfoundland, and of a quart of a kind of soup, consisting of cabbage leaves, beans, and lard, boiled in water. The Gallegos of each vineyard not only mess together, but also sleep together in the same shed, and any attempt to separate the sexes is immediately followed by protests, and, if these are unheeded, by an exodus. The women assist in the collection of the grapes only, but the disintegration of the grapes, their pruning, &c., is all done by men.

The Lagar.

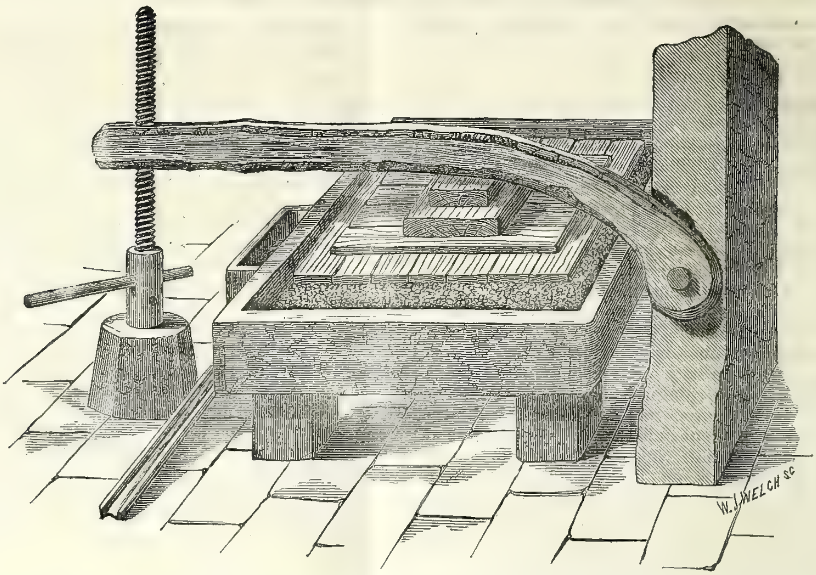
The receptacle in which the grapes are collected while the vintage is proceeding, in which the grapes are mashed, extracted, and pressed, is termed a lagar. It is always built of stone, generally granite, more rarely slate, or masonry. In size it varies, so that it may hold the grapes for only a few pipes of wine, or for many up to 10 and 16. In the large vineyards there are, therefore, lagars of several sizes, so that they are immediately adapted for large and small harvests. The shape of the lagar is mostly square, or oblong, its depth about two feet, or a little more, and its sides vary in length between three yards and eight or ten yards.

The Press.

Over and across each lagar is fixed one of the old-fashioned lever or beam-presses, of which the sketch (see next page) herewith gives an idea. Such presses do yet occur in Würtemburg, but they are not any longer in use on the Rhine; I have never seen any in France.

Treading of the Grapes—Fermentation.

After the lagar has received its full complement of grapes, or as much as it can conveniently hold during the entire operations of vinification, a number of Gallegos, with their legs bared to the upper thighs, go on to the lagar and tread the grapes into pulp. This operation lasts from 24 to 48 hours without interruption, the men being changed from time to time for refreshment and rest. During or after this operation fermentation begins, and proceeds, according to temperature, quicker or slower, but it is hardly ever very tumultuous; more frequently it falls below the necessary energy, owing to the stone walls of the lagar abstracting too much heat. In that case as many men as can stand in the lagar are put on to it, and they are kept slowly stirring the mass with their feet until they have communicated so much heat that the fermentation can again proceed alone. When the fermentation has so far progressed that the amount of alcohol formed counter-balances the specific gravity of the remaining sugar so far as to bring the glucometer to the zero point, the fermenting mass is again trodden by the Gallegos, this time in order to extract the colouring matter from the husks. When the wine is as dark as may be desired, and a sample runs over a white plate so as to leave streaks of thick, dark red dye behind, fermentation is considered complete. The wine is now drawn off by a pump, syphon, or tap, or through a hole



in the bottom of the lagar, the exit being guarded by some sort of strainer, and run into a large wooden cask, which may hold from 5 to 30 pipes, and is termed a "tonnel." From four to eight volumes of brandy, of about 40° Cartier, are added to every hundred volumes of wine, and the mixture is left to clarify itself by gravity.

Remarks on this Mode of Vinification.

The mode of making port wine is extremely unclean, and the proceedings are very crude and elementary; nevertheless, so good a product is obtained that its faults are, as it were, drowned in its good qualities. In Thudichum and Dupré's treatise, p. 677, a complete scheme for the reform of the making of port wine is given, which has already been partially carried out, in the autumn of 1872, under my personal supervision, in the Alto Douro, and the wine so produced is now in the London market ready for consumption. I can, therefore, refer to it as a complete justification of our scientific theories, which will, I hope, find an expanded application in the future. The great object of the wine makers must be to produce good and durable wine with only so much alcohol as shall not be injurious to the wine drinker. This cannot be said to be the case with the ordinary thick, heavy, so-called loaded ports of 40 to 42 degrees of proof spirit, and for this reason whole classes of society in Britain have ceased to drink any port wine whatever. Yet good port wine is one of the most wonderful productions of the earth; and I am sure, when vinification in all its branches and variations shall be once fully understood on the Alto Douro, it will produce such excellent red wines as hitherto have not been exported from the Peninsula.

Elderberry and Logwood.

It is said that port wine is coloured with elderberries and other dyes, and sweetened with jeropiga and treacle, besides being dosed with brandy; but I have been unable to find any evidence of this, at least as regards Alto Douro wines. Elder trees are very scarce in the Alto Douro, and I can in this respect fully confirm the statement of Mr. Consul Crawford. Moreover, the Alto Douro wine, of a good year at least, is so deeply coloured, in fact, so excessively loaded with colouring matter, that it cannot by any means require any addition of colour; and although I must fully maintain the fact stated in the "Treatise of Wines," pp. 68, *et seq.*, yet I believe that the elderberries there shown to be exported from Oporto, are really used for colouring other wines than port wine, particularly the Spanish ports, Mountain ports, Cape ports, and Sicilian red wines, which are carried to England, and thence exported to countries where people buy wine rather by the name it bears than by any quality it possesses. It is also not rarely stated, and I have stated so myself, upon the evidence of Mr. Cyrus Field, in the report of the Parliamentary Committee of 1852, that port wine is now and then coloured red by means of Brasilwood, commonly called logwood; but this is a great and deplorable error, as it is quite impossible to dye wine of any kind with logwood—for the colour of logwood is purple only in alkaline solution, and not in acid, in which it is only tawny. Moreover, it is very astringent, a quality which almost all port-wine possesses in excess. Logwood is never used in trade for dying anything purple, and the large quantities of logwood shipped to Europe are nearly entirely consumed in the production, by means of iron mordants, of firm black colours on many kinds of tissues; and, although it may occur that particular artists in mixing and counterfeiting, dye some pipes of white wine with elderberries, and give them astringency with logwood, nevertheless I believe that such products would commercially not pay the cost and trouble of their production, and are, at all events, only an exceedingly small fraction of the wines which constitute the bulk of the exports from Oporto. I am, therefore, of opinion that the sooner we dismiss these prejudices and errors regarding elderberry and logwood in port-wine, the better. There is now sold in London perfectly normal wine from the Alto Douro, which is made from the finest grapes, fully fermented, so as to contain no sugar, and not mixed with any brandy whatever. The wine is sold at a very moderate price, considering its body, flavour, and qualities. A few years ago it was declared to be impossible to bring natural port-wine to London, but this wine affords the refutation of this fallacy. Thus, I have no doubt that science will succeed in dispelling errors and fallacies by which men are held in a kind of bondage, which always damages not only their pockets but their stomachs and their minds as well.

Note.—The lecture was illustrated by the exhibits of the portraits of grapes above-mentioned, and the map of the Douro district, by Forrester; by specimens of port-wine from the years 1815, 1834, 1847, 1858, 1870 (dry and free from brandy), 1871 (mild sweet, with little brandy), 1871 (sweet, with no brandy whatever), all of which were tasted after the lecture by many persons. The four specimens of rare old port-wine (1815 to 1858) has been presented to the lecturer for exhibition to the Society on this occasion by T. C. Wigham, Esq,, formerly of Oporto and now of London. The lecturer also exhibited a wine-skin, in which much port-wine is transported from the higher mountainous regions on the backs of men, mules, and donkeys to the lower regions and depositories.

ANNUAL INTERNATIONAL EXHIBITIONS.

The Council, having been informed that her Majesty's Commissioners do not intend to publish Reports on the different departments of the Exhibition of the present year, and looking to the great importance to Arts, Manufactures, and Commerce that these annual displays should not pass away without some record, have decided to undertake that duty, and for this purpose have engaged the services of gentlemen specially skilled in the subjects of the several sections, to prepare such Reports for publication in the Society's *Journal*. The Council, however, desire it to be understood that, in publishing these reports, they do not necessarily adopt all the views expressed in them, which must be taken as those of the writers only.

The following reports conclude the series.

REPORT ON CHEMICALS (VICTORIAN DEPARTMENT).

By W. H. Walenn, F.C.S.

To people unacquainted with the resources of our colonies, regarded from the colonist's point of view (which necessarily includes the character of the country colonised and the energy of the coloniser), the fact of chemicals being produced as an article of commerce from a colony which has only had existence as a separate province since 1850—scarcely 23 years ago—must appear a marvel. The sequel will show this to be the case, and that the investment of large capital has followed upon the productions of the country, that wait to be converted from raw material into those products which a high degree of civilisation can only appreciate. This part of Australia, namely Victoria, was not known until the commencement of this century. The first sales of land took place in 1835, and now, scarcely forty years after, a highly cultivated race of people inhabit it, and claim brotherhood with the most advanced nations upon the face of the earth. The vegetation met with in the neighbourhood of Victoria, like that in other parts of the island, is unique and gigantic. The race of Eucalypti, with their height of 150 feet, and their girth of 30 feet, remarkable for the essences, gums, oils, and alkaloids that they offer; the Acacias, yielding tar, vinegar, alcohol, and catechu; and the *Xanthorrhœa Australis* (the grass tree), yielding a peculiarly-constituted resin, are specimens of vegetable life that can only be realised in description by analogy with kangaroos, opossums, and other exceptional products of these parts of the world.

The *Eucalyptus globulus*, or blue gum-tree, yields a decoction which is said to be a successful rival to sulphate of quinine, on account of its eminently antiperiodic qualities.

These qualities were first brought out, it appears, by the enterprise of Mr. Joseph Bosisto, pharmaceutical chemist of Melbourne, in 1862; for, strange to say, these medicinal properties were not immediately called for by the requirements of the colonists, as the district is remarkably free from all tendency to agueish complaints. Several specimens of *Liq. Eucalypti globuli* and other products are exhibited by Mr. Bosisto. The oil distilled from the *Eucalyptus globulus* ($C_{12} H_{40} O$) is said to be antiseptic. *Eucalyptol* ($C_{12} H_{20} O$) is antiseptic, stimulating, and disinfectant. It should be mentioned that Mr. Bosisto has obtained the award of the Jury of the Vienna Exhibition to this colony.

Amongst the essential oils, the *Ol. Menthæ piperitæ* (true oil of peppermint) and *oleosa*, a powerful solvent of varnish, &c., claim attention.

A great number of exhibits are made by the Royal Commissioners for Victoria, and are prepared by Baron Von Mueller, director of the Botanical Gardens of Melbourne. Amongst these are varnish from the resin of *Xanthorrhœa Australis*, and alcohol from *Eucalyptus globulus*. The resin is soluble in spirits of wine, produces a bright red polish on wood, contains cinnamic and benzoic acids and is said to yield picric acid as a product upon treatment with nitric acid.

Mr. Joseph Sullivan exhibits a disinfectant which is entitled "double chloride of calcium and aluminum." This appears to have completely obtained the confidence of the chemical and medical authorities in Melbourne.

There are at least six chemical works in Victoria, having large capital at command, and managed by men of business, who bring special knowledge to their work.

The whole of this collection of chemicals shows what energy combined with adequate knowledge may do in operating upon the raw products of a new country to develope the most hidden properties therefrom in favour of the wants of the human race all over the world.

SUPPLEMENTARY REPORT ON SCIENTIFIC INVENTIONS.

An interesting series of objects, constructed of Ransome's Patent Stone, are now exhibited at the International Exhibition in South Kensington. These objects are placed in the corridor adjoining the rooms that contain the main bulk of the scientific inventions, and were not included in the Scientific Inventions department of the catalogue at the time that the official report of this section of the Exhibition was drawn up. The process by which this artificial stone is prepared is remarkable for the fact that it involves the conversion of a soft and plastic substance, that is capable of being readily moulded in any convenient or ornamental form, into a hard and very resisting and durable material. Flint boulders are first dissolved into a paste-like mass, by the influence of caustic soda and heat; the pasty silicate is next intimately mingled with fine sand, and in this state of mixture moulded into whatever form it is desired that it should assume. The moulded mass is then hardened by immersion in a bath of solution of chloride of lime, which is made to penetrate the pores of the compound, either by the pressure of water or of air. The hardening depends mainly upon a chemical reaction, a compact and insoluble silicate of lime and a soluble and easily-removed chloride of sodium being formed when the silicate of soda and chloride of lime come into contact. The particles of the sand are cemented together by an investment of silicate of lime. The artificial stone resulting from the process is stated to exceed Portland stone in strength very considerably, and to be equal to concrete in its endurance of heat. In some forms it will bear from 8,000 to 10,500 lbs. of pressure to the square inch without crushing. It is used advantageously for the construction of chimney-pieces, drinking-fountains, pavements, tombstones, steps, window-cills, balustrades, vases, and sinks. Excellent grind-stones, scythe-stones, and emery-wheels, are also made of it. It has been successfully employed for the construction of caissons, and in the form of hollow blocks for building sea walls and river embankments, and a porous kind has been prepared for filtering water in large cisterns. It can be conveniently applied as a surface dressing for walls of either stone or brick, by first washing the material to be protected with a solution of silicate of soda, and then with a solution of chloride of lime. The decomposition of these solutions, and the formation of the insoluble silicate of lime, take place in the pores of the substance. Four gallons of each solution, costing about £2, are sufficient, under ordinary conditions, for the coating of one hundred superficial yards. The stone is prepared upon a large scale at extensive works in Blackwall-lane, East Greenwich, under the auspices of a company, which is presided over by Mr. Henry Bessemer, the inventor of the process Mr. Frederick Ransome, being among the directors.

During the year 1872 there were in operation in the United States 812 paper mills, owned by 705 firms, and of an estimated value of over 35,000,000 dollars.

EXHIBITIONS.

SPAIN AT THE VIENNA EXHIBITION.

Notwithstanding the civil war and the unsettled state of the country, Spain makes a very good show at the Vienna Exhibition.

Foremost in the list is Zuloaga, to whom has been awarded a diploma of honour for the excellent specimens of Damascene work, in which art he has attained perfection.

The ancient art of damascening, which may be said to have been revived by M. Zuloaga, who in 1830 established an *atelier* at Guipuzcoa, is perhaps one of the most beautiful in the art of metal working, and, as its name implies, was first practised, or at all events was carried on in the greatest perfection, in the city of Damascus, whence it was introduced into Spain by the Moors. The examples of the skill of the Moorish metal-workers of a past age leave nothing to be desired, and are the most notable objects of their class in the whole exhibition.

Damascene work, or the art of ornamenting iron and steel, by making incisions upon its surface and filling them up with gold or silver wire, is partly mosaic work, partly engraving, and partly carving. As mosaic work, it consists of pieces inlaid; as engraving, the metal is cut in intaglio; and as carving, gold and silver are wrought into it in *relievo*. The general character of the design is Arabic, to which that class of work is particularly adapted, lending itself to the fantastic combinations of free lines which form so prominent a feature in all Eastern ornamentation.

The two shields exhibited by M. Zuloaga are a triumph of the metallic art. The first is damascene work of most elaborate character in design and excellence of execution, the other is silver inlaid with iron. Both are certainly unique of their kind, and deserve special and careful examination by all interested in the production of artistic metal-work of the highest class. A pair of vases, in the purest Moorish style, of silver inlaid upon copper, are well worthy of attention; other vases, of most exquisite form, and ornamented in damascene work, are treated with great skill, and admirably finished. The dagger-hilts, frames for mirrors, buttons, ear-rings, handles for walking-sticks, snuff-boxes, and caskets of every description attract universal admiration from the character of their design and admirable workmanship. The celebrated factory of Toledo has also been rewarded with the diploma of honour for their sword-blades, the manufacture of which, for centuries, has attained a world-wide renown.

The extreme flexibility of these blades is shown by a sword, in which the point is bent round so as to touch the hilt. The artistic merits of the weapons exhibited by the Toledo factory are certainly below the average, and the examples of damascene work and inlaying are far inferior to those executed by private firms. The specimens of damascene work by Theodore Barzabal, a former workman of Zuloaga, deserve especial praise. The Moorish vases of Ysaura, in imitation bronze, are extremely chaste in design.

The Government small-arms factory exhibit a case of arms, including Worders, Chassepots, and Remingtons, which can compete for workmanship with those of the best Belgian makers.

The collection of arms of Stanislaus Saldavila is particularly remarkable for cheapness. His revolvers combine excellence of workmanship with economy of price.

Spain carries off the palm in saddlery, Spanish leather being celebrated; and the Madrid saddlers are famous for their work throughout Europe. That their work is more an art than an industry may be seen by the cases of José Rodriquez and Garcia Dorado.

The corsets exhibited in the Spanish department are equal to any by the best Parisian makers.

The lace of Barcelona sustains its old reputation, and the manufacture of fans, which may said to be a national industry, is well represented in this department.

The specimens of the ceramic art in the Spanish department are certainly not inferior to those of other countries, and the exhibits from the province of Murcia contain some excellent samples of terra-cotta. The mosaics of Nolla, of Valencia; the enamel tiles of Manuel, Soto, and Tello, of Seville, can compare favourably with those of many a well-known maker. The encaustic tiles of Novela and Garcia, of Valencia, are sold at as low a price as a real (2½d.) per 25 square centimetres.

The manufacture of cigarette paper seems to be a *specialité* of Spain, if one can judge from the great variety of *papel de hilo* shown in this department.

The resinous products exhibited by the Duchess Medina-Coili, from Old Castile, manufactured in the Guadarama mountains, are excellent.

Specimens of rock salt, from the mines of Cordova, are also shown.

Specimens of the agricultural and forest wealth of Spain are also exhibited in this department, amongst which may be mentioned the cork tree and samples of its manufacture, and the wild esparto grass, which of late years has obtained an important commercial value in England, and is used for the manufacture of paper.

In a special building, of two stories, is exhibited a very complete collection of the rocks and minerals of Spain, including sulphur, copper, argentiferous lead, antimony, iron, lignite, pyrites, marble, &c., which prove that were the mineral resources of Spain properly developed, she would be by far the richest country in Europe.

The ground-floor of this building is reserved for the exhibits of the Minister of War, which consist of models of artillery, ammunition-waggons, fire-arms, swords, &c., from the government factories, and a splendid collection of ancient weapons, amongst which may be mentioned a firelock of the time of Charles IV., of excellent workmanship, and superbly chased, being a *chef-d'œuvre* of an armourer of Madrid, Gabriel de Algoza, by whom it was made in 1739. This gun is breech-loading, and proves the old saying, *Nil sub sole novum.*

The specimens of books and printing are only of second-rate excellence, with the exception of the exhibits of the Minister of Public Instruction, who contributes a complete collection of the books and educational appliances used in the public schools of Spain. An edition of "Don Quixote" is shown by a Madrid publisher, which would do credit to any printer.

The surgical instruments and artificial limbs in this department are worthy of attention. The furniture exhibited in the Spanish section is also worthy of attention, but do not present any especial novelty; and, generally speaking, the marqueterie bears a great resemblance to the French.

Philadelphia Exhibition, 1876.—The preparations for the Centennial Exhibition at Philadelphia, in 1876, are gradually maturing, and the work of arrangement entrusted to the several committees is progressing. The executive commissioner, Professor Blake, is at present at Vienna, making personal observation of the arrangement and conduct of that great display. The commission is now in daily sittings at their rooms, Walnut-street, near Ninth-street, where they have employed two secretaries and three heads of bureaux, each of whom is entrusted with the management of some specialty. The necessity of pushing forward as rapidly as possible the preparations for the exhibition building is fully recognised. The statement is made that the committee on plans and architecture have decided to make use of four buildings—a central main building, to be devoted to general exhibition purposes, and separate structures to contain the departments of fine arts, of machinery, and of horticulture. It is further stated that the appointment of the architect will be thrown open to public competition, and that all architects will be invited to contribute plans; the authors of the ten most approved designs each to receive a prize of £200. The decision upon the successful plan will be made about July.

BRITISH ASSOCIATION.

ADDRESS OF THE PRESIDENT, PROFESSOR ALEXANDER W. WILLIAMSON, PH.D., F.R.S., &c.

After a few words of regret that Dr. Joule had been unable to fulfil the undertaking he had made last year at Brighton, to act as president for the meeting at Bradford, Professor Williamson entered on a review of the recent progress of chemistry and the results it had produced. He dwelt especially upon recent advances made in the development of the atomic theory, and its immense extension since the death of its founder, Dalton. After instancing several examples, in which the nature of the theory had been shown—particularly its use for distinguishing isomeric compounds—he referred as follows to the most recent development of knowledge in this direction:—

The original view of the constitution of molecules was statical, and chemists only took cognizance of those changes of place among their atoms which result in the disappearance of the molecules employed, and the appearance of new molecules formed by their reaction on one another. Thus, when a solution of common salt (sodic chloride) is mixed with a solution of silver nitrate, it is well known that the metallic atoms in these respective compounds change places with one another, forming silver chloride and sodic nitrate; for the silver chloride soon settles to the bottom of the solution in the form of an insoluble powder, while the other product remains dissolved in the liquid. But as long as the solution of salt remained undecomposed each little molecule in it was supposed to be chemically at rest. A particular atom of sodium, which was combined with an atom of chlorine, was supposed to remain steadily fixed to it. When this inactive solution was mixed with the similarly inactive solution of silver nitrate, the interchange of atoms known to take place between their respective molecules was nominally explained by the force of predisposing affinity. It was, in fact, supposed that the properties of the new compounds existed and produced effects before the compounds themselves had been formed.

I had occasion to point out a good many years ago that molecules which appear to be chemically at rest are reacting upon one another when in suitable conditions, in the same kind of way as those which are manifestly in a state of chemical change—that, for instance, the molecules of liquid sodic chloride exchange sodium atoms with one another, forming new molecules of the same compound undistinguishable from the first, so that, in an aggregate of like molecules, the apparent atomic rest is the result of the interchange of like atoms between contiguous molecules.

Such exchanges of atoms take place not only between molecules of identical composition, but also between contiguous molecules containing different elements. For instance, in a mixture of sodic chloride and potassic iodide an interchange of metallic atoms takes place, forming potassic chloride and sodic iodide. The result of the exchange in such a case is to form a couple of new molecules different from the original couple. But these products are subject to the same general law of atomic exchanges, and their action on one another reproduces a couple of molecules of the materials.

Thus a liquid mixture formed from two compounds contains molecules of four kinds, which we may describe as the two materials and the two products. The materials are re-acting on one another, forming the products; and these products are, in their turn, reacting on one another, reproducing the materials.

If one of the products of atomic exchange between two molecules is a solid while the other remains liquid (as when sodic chloride is mixed with silver nitrate), or if one is gaseous while the other remains liquid, so that the molecules of the one kind cannot react on those of the other kind and reproduce the materials, then the continued re-action of the materials on one another leads to their complete mutual decomposition. Such complete mutual decomposition of two salts takes place whenever they react upon one another under such conditions that the products cannot react on one another and reproduce the materials; whereas partial decomposition takes place whenever the materials form a homogeneous mixture with the products.

Now, if in any such homogeneous mixture more exchanges of atoms takes place between the materials than between the products, the number of molecules of the products is increased, because more of them are being made than unmade; and reciprocally, if more exchanges of atoms take place between the products than between the materials, the number of molecules of the materials is increased. The mixture remains of constant composition when there are in the unit of time as many decomposing changes as reproducing changes.

Suppose that we were to determine by experiment the proportion between the number of molecules of the materials, and the number of molecules of the products, in a mixture the composition of which remains constant, and that we found, for instance, twice as many of materials as of products; what would this mean? Why, if every two couples of materials only affect in the unit of time as many exchanges as every one couple of products, every couple of materials is only exchanging half as fast as every couple of products.

In fact, you perceive that a determination of the proportion in which the substances are present in such a mixture will give us a measure of the relative velocities of those particular atomic motions; and we may thus express our result:—The force of chemical combination is inversely proportional to the number of atomic interchanges.

With regard to the objections against the theory, he said:—

I cannot quit this part of our subject without alluding to the fact that some few chemists of such eminence as to be entitled to the most respectful attention, have of late years expressed an opinion that the idea of atoms is not necessary for the explanation of the changes in the chemical constitution of matter, and have sought, as far as possible, to exclude from their language any allusion to atoms.

It would be out of place on this occasion to enter into any discussion of the questions thus raised; but I think it right to point out:—

1. That these objectors have not shown us any inconsistency in the atomic theory, nor in the conclusions to which it leads.
2. That neither these nor any other philosophers have been able to explain the facts of chemistry on the assumption that there are no atoms, but that matter is infinitely divisible.
3. That when they interpret their analyses, these chemists allow themselves neither more nor less latitude than the atomic theory allows; in fact, they are unconsciously guided by it.

These facts need no comment from me.

From the discussion of the progress made by chemistry, the President then turned to the uses of the work thus done:—

I think you will agree with me that, in order to judge soundly whether and in what manner such a pursuit is useful, we have to consider its effect upon man. What habits of mind does it engender? What powers does it develop? Does it develop good and noble qualities and aspirations, and tend to make men more able and more anxious to do good to their fellow men? Or is it a mere idle amusement, bearing no permanent fruits of improvement.

You will, I think, answer these questions yourselves if I can succeed in describing to you some of the chief qualities which experience has shown to be requisite for the successful pursuit of chemistry, and which are necessarily cultivated by those who qualify themselves for such a career.

One of the first recuirements on the part of an investigator is accuracy in observing the phenomena with which he deals. He must not only see the precise particulars of a process as they present themselves to his observation; he must also observe the order in which these particular appearances present themselves under the conditions of each experiment. No less essential is accuracy of memory. An experimental inquirer must remember accurately a number of facts; and he needs to remember their mutual relations, so that one of them when present to his mind may recall those others which ought to be considered with it. In fact he cultivates the habit of remembering facts mainly by their place in nature. Accuracy in manual operations is required in all experimental inquiries; and many of them afford scope for very considerable skill and dexterity.

These elementary qualities are well known to be requisite for success in experimental science, and to be developed by careful practice of its methods; but some higher qualities are quite as necessary as these in all but the most rudimentary manipulations, and are developed in a remarkable degree by the higher work of science.

Thus it is of importance to notice that a singularly good training in the accurate use of words is afforded by experimental chemistry. Every one who is about to enter on an inquiry, whether he be a first-year's student who wants to find the constituents of a common salt, or whether he be the most skilled and experienced of chemists, seeks beforehand to get such information from the records of previous observations as may be most useful for his purpose. This information he obtains through the medium of words; and any failure on his part to understand the precise meaning of the words conveying the information requisite for his guidance is liable to lead him astray. Those elementary exercises in analytical chemistry, in which brief directions to the students alternate with their experiments and their reports of experiments made and conclusions drawn, afford a singularly effective training in the habit of attending accurately to the meaning of words used by others, and of selecting words capable of conveying without ambiguity the precise meaning intended. Any inaccuracy in the student's apprehension of the directions given, or in the selection of words to describe his observations and conclusions, is at once detected, when the result to which he ought to have arrived is known beforehand to the teacher.

Accuracy of reasoning is no less effectively promoted by the work of experimental chemistry. It is no small facility to us that the meaning of the words which we use to denote properties of matter and operations can be learnt by actual observation. Moreover each proposition comprised in chemical reasonings conveys some distinct statement susceptible of verification by similar means; and the validity of each conclusion can be tested, not only by examining whether or not it follows of necessity from true premises, but also by subjecting it to the independent test of special experiment.

Chemists have frequent occasion to employ arguments which indicate a probability of some truth; and the anticipations based upon them serves as guides to experimental inquiry by suggesting crucial tests. But they distinguish most carefully such hypotheses from demonstrated facts.

. . . .

Another habit of mind which is indispensable for success in experimental chemistry, and which is taught by the practice of its various operations, is that of truthfulness.

The very object of all our endeavours is to get true ideas of the natural processes of chemical action; for in proportion as our ideas are true do they give us the power of directing these processes. In fact our ideas are useful only so far as they are true; and he must indeed be blind to interest and to duty who could wish to swerve from the path of truth. But if any one were weak enough to make the attempt, he would find his way barred by innumerable obstacles.

Every addition to our science is a matter of immediate interest and importance to those who are working in the same direction. They verify in various ways the statements of the first discoverer, and seldom fail to notice further particulars, and to correct any little errors of detail into which he may have fallen. They soon make it a stepping-stone to further discoveries. Anything like wilful misrepresentation is inevitably detected and made known.

The next point taken up was the value of chemistry as an instrument of education, and, in common with it, the similar importance of all physical science for the purpose:—

Chemistry presents peculiar advantages for educational purposes in the combination of breadth and accuracy in the training which it affords; and I am inclined to think that in this respect it is at present unequalled. There is reason to believe that it will play an important part in general education, and render valuable services to it in conjunction with other scientific and with literary studies.

I trust that the facts which I have submitted to your consideration may suffice to show you how fallacious is that materialistic idea of Physical Science which represents it as leading away from the study of man's noblest faculties, and from a sympathy with his most elevated aspirations, towards mere inanimate matter. The material work of science is directed by ideas towards the attainment of further ideas. Each step in science is an addition to our ideas, or an improvement of them. A science is but a body of ideas respecting the order of nature.

Each idea which forms part of physical science has been derived from observation of nature, and has been tested again and again in the most various ways by reference to nature; but this very soundness of our materials enables us to raise upon the rock of truth a loftier structure of ideas than could be erected on any other foundation by the aid of uncertain materials.

The study of science is the study of man's most acccurate and perfect intellectual labours; and he who would know the powers of the human mind must go to science for his materials.

Like other powers of the mind, the imagination is powerfully exercised, and at the same time disciplined, by scientific work. Every investigator has frequent occasion to call forth in his mind a distinct image of something in nature which could produce the appearances which he witnesses, or to frame a proposition embodying some observed relation; and in each case the image or the proposition is required to be true to the materials from which it is formed. There is perhaps no more perfect elementary illustration of the accurate and useful employment of the imagination than the process of forming in the language of symbols, from concrete data, one of those admirable general propositions called equations; on the other hand, the contemplation of the order and harmony of nature as disclosed to us by science supplies the imagination with materials of surpassing grandeur and brilliancy, while at the same time affording the widest scope for its efforts.

For the efficient advancement of science it was necessary, first, to train up a race of investigators; and, secondly, to put such men in the proper position for continuing their labours to the greatest possible advantage. To this end the President sketched out a sort of scheme.

Let the most intelligent and studious children from every primary school be sent, free of expense, to the most accessible secondary school for one year; let the best of these be selected and allowed to continue for a second year, and so on, until the *elite* of them have learnt all that is to be there learnt to advantage. Let the best pupils from the secondary schools be sent to a college of their own selection, and there subjected to a similar process of annual weeding; and, finally, let those who get satisfactorily to the end of a college curriculum be supplied with an allowance sufficient for their maintenance for a year, on condition of their devoting their undivided energies to research, under the inspection of competent college authorities, while allowed such aids and facilities as the college can supply, with the addition of money-grants for special purposes. Let all who do well during this first year be allowed similar advantages for a second, and even a third year.

Each young investigator thus trained must exert himself to obtain some appointment, which may enable him to do the most useful and creditable work of which he is capable, while combining the conditions most favourable to his own improvement.

Let there be in every college as many Professorships and Assistantships in each branch of science as are needed for the efficient conduct of the work there going on, and let every Professor and Assistant have such salary and such funds for apparatus, &c., as may enable him to devote all his powers to the duties of his post, under conditions favourable to the success of those duties; but let each Professor receive also a proportion of the fees paid by his pupils, so that it may be his direct interest to do his work with the utmost attainable efficiency, and attract more pupils.

Let every college and school be governed by an independent body of men, striving to increase its usefulness and reputation, by sympathy with the labours of the working staff, by material aid to them when needed, and by getting the very best man they can, from their own or any other college, to supply each vacancy as it arises.

In addition to colleges, which are and always have been the chief institutions for the advancement of learning, establishments for the observation of special phenomena are frequently needed, and will doubtless be desirable in aid of a general system for the advancement of science.

At present there was a great need of science teachers, the supply of whom was checked by two causes; first, the absence of any influence calculated to incline young men in this direction; and, second, the improbability of their being able to obtain a competent subsistence by such means.

There would also be good practical results from such a scheme as the above:—

Any manufacturer of the present day who does not make efficient arrangements for gradually perfecting and improving his processes ought to make at once enough money to retire; for so many are moving onwards in this and other countries, that he would soon be left behind.

It would be well worth while to establish such a system of scientific education for the sake of training men to the habits of mind which are required for the improvement of the manufacturing arts; and I have no doubt that the expense of working the system would be repaid a hundred times over by the increase of wealth of the community; but I only mention this as a secondary advantage of national education.

From this point of his address to the end, Professor Williamson dwelt principally on the means by which the supply of education, technical and other, could be increased. He said:—

The keystone of the whole structure is the action of the State in distributing funds carefully among schools and colleges proportionally to the evidence of their doing good work, which could not be continued without such aid.

I am inclined to think that the State ought, as far as possible, to confine its educational grants to the purpose of maintaining and continuing good work which is actually being done, and rarely if ever to initiate educational experiments: first, because it is desirable to encourage private exertions and donations for the establishment of schools and colleges upon new systems, or in new localities, by giving the public full assurance that if any new institution establishes its right to existence, by doing good work for a while, it will not be allowed to die off for want of support; and, secondly, because the judicial impartiality required in the administration of public funds, on the basis of results of work, is hardly compatible with an advocacy of any particular means of attaining such results.

On the other hand, experience has shown that special endowments, which tie up funds in perpetuity for a definite purpose, commonly fail to attain their object under the altered circumstances which spring up in later generations, and not unfrequently detract from the efficiency of the institutions to which they are attached, by being used for objects other than those which it is their proper function to promote.

When there is felt to be a real want of any new institution for the promotion of learning, men are usually willing enough to devote time and money to the purpose of establishing it and giving it a fair trial. It is desirable that they should leave the State to judge of their experiment by its results, and to maintain it or not, according to the evidences of its usefulness. No institution ought, for its own sake, to have such permanent endowments as might deprive its members of motives for exertion.

The State could not, however, discharge these judicial functions without accurate and trustworthy evidence of the educational work done at the various schools and of its success. For this purpose a record must be kept by or under the direction of every teacher of the weekly progress of each pupil, showing what he has done and how he has done it. Official inspectors would have to see to these records being kept upon a uniform scale, so that their results might be comparable. The habit of keeping such records conduces powerfully to the efficiency of teachers; and, for the sake of the due development of the teaching system, it ought to prevail generally. Having such full and accurate means of knowing what opportunities of improvement pupils have enjoyed and what use they have made of those opportunities, Government ought to stimulate their exertions and test their progress by periodical examinations. It is of the utmost importance to allow any new and improved system of instruction to develop itself freely, by the exertions of those who are willing to undertake the labour and risk of trying it on a practical scale; and the pupils who acquire upon such new system a command of any branch of science, ought to have a fair opportunity of showing what they have achieved and how they have achieved it. An able and impartial examiner, knowing the new systems in use, will encourage each candidate to work out his results in the manner in which he has been taught to work out results of the kind.

Examinations thus impartially conducted with a view of testing the success of teachers in the work which they are endeavouring to do, have a far higher value, and consequent authority, than those which are conducted in ignorance or disregard of the process of training to which the candidates have been subjected; and we may safely say that the examination system will not attain its full usefulness until it is thus worked in intimate connexion with a system of teaching,

In order to give every one employed in the educational system the utmost interest in maintaining and increasing his efficiency, it is essential that a due measure of publicity be given to the chief results of their respective labours. Schools and colleges ought, to a considerable extent, to be supported by the fees paid by pupils for the instruction received; and every Professor being in part dependent upon the fees of his pupils will have a direct interest in attracting more pupils to his classes or laboratories. The fame of important original investigations of his own or his pupils, published in the scientific journals, is one of the natural means by which a distinguished Professor attracts disciples, and the success of his pupils in after life is another. His prospects of promotion will depend mainly on the opinion formed of his powers from such materials as these by the governing bodies of colleges and by the public; for if each college is dependent for success upon the efficiency of its teaching staff, its governing body must do their best to fill up every vacancy as it arises by the appointment of the ablest and most successful Professor whom they can get; and any college which does not succeed in obtaining the services of able men will soon lose reputation, and fall off in numbers.

There are, however, further advantages to the working of the system to be derived from full publicity of all its more important proceedings. It will supply materials for the formation of a sound public opinion respecting the proceedings of the authorities in their various spheres of action. A claim for money might be made upon Government by the rulers of some college upon inadequate grounds; or a just and proper claim of the kind might be disregarded by Government. Neither of these things will be likely to happen very often if the applications, together with the evidence bearing on them, are open to public scrutiny and criticism; and when they do occasionally happen, there will be a natural remedy for them.

If I have succeeded in making clear to you the leading principles of the plan to be adopted for the advancement of science, including as it necessarily must do, national education generally, you will, I think, agree with me that, from the very magnitude and variety of the interests involved in its action, such system must of necessity be under the supreme control of Government. Science will never take its proper place among the chief elements of national greatness and advancement until it is acknowledged as such by that embodiment of the national will which we call the Government. Nor can the various institutions for its advancement develop duly their usefulness until the chaos in which they are now plunged gives place to such order as it is the proper function of Government to establish and maintain.

But Government has already taken, and is continuing to take, action in various matters affecting elementary popular education and higher scientific education, and it would be difficult to arrest such action, even if it were thought desirable to do so. The only practical question to be considered is how the action of Government can be systematised so as to give free play to the natural forces which have to do the work.

By establishing official examinations for appointments and for degrees, Government exerts a powerful influence on the teaching in schools and colleges, without taking cognisance, except in some few cases, of the systems of teaching which prevail in them. Again, they give grants of public money from time to time in aid of colleges or universities, or for the establishment of a high school under their own auspices. Sometimes they endow a professorship. In taking each measure of the kind they are doubtless influenced by evidence that it is in itself a good thing, calculated to promote the advancement of learning. But a thing which is good in itself may produce evil effects in relation to others, or good effects incommensurate with its cost. Thus examinations afford most valuable aid to educational work when carried on in conjunction with earnest teachers; yet when established in the absence of a good system of education, they are liable to give rise to a one-sided training contrived with a special view of getting young men through the examinations. If no properly-educated young men were found for a particular department of the public service, and an examination of all candidates for such appointments were to be established for the purpose of improving the system of training, candidates would consider their power of answering such questions as appeared likely to be set as the condition of their obtaining the appointments, and they would look out for men able and willing to train them to that particular work in as direct and effective a manner as possible. The demand for such instruction would soon be supplied. Some teachers would undertake to give instruction for the mere purpose of enabling candidates to get through the examination; and by the continued habit of such work would gradually come to look upon the examiners as malignant beings who keep youths out of office, and whose vigilance ought to be evaded by such means as experience might show to be most effective for the purpose. Once this kind of direct examination-teaching has taken root, and is known to produce the desired effect of getting young men through the examinations, its existence encourages the tendency on the part of the candidates to look merely to the examination as the end and aim of their study; and a class of teachers is developed whose exertions are essentially antagonistic to those of the examiners.

There are no doubt teachers with a sufficiently clear apprehension of their duty, and sufficient authority, to convince some of the candidates that the proper object of their study should be to increase their power of usefulness in the career for which they are preparing themselves, by thoroughly mastering up to a prescribed point certain branches of knowledge; and that until they had honestly taken the means to do this, and believed they had done it effectually, they ought not to go up for examination nor to wish to commence their career.

But it is desirable that all teachers be placed under such circumstances that it may become their interest as well as their duty to co-operate to the utmost of their powers in the object for which the examiners are working. For this purpose their records of the work done under their guidance by each pupil ought to be carefully inspected by the examiners before framing their questions, and ought to be accepted as affording the chief evidence of the respective merits of the pupils.

This is not the place for considering how the general funds for an effective system of national education can best be raised, nor how existing educational endowments can best be used in aid of those funds. It is well known that some colleges of Oxford and Cambridge are possessed of rich endowments, and that many distinguished members of those universities are desirous that the annual proceeds of those endowments should be distributed upon some system better calculated to promote the advancement of learning than that which generally prevails. Indeed, we may confidently hope that, true to their glorious traditions, those colleges will be led, by the high-minded and enlightened counsels of their members, to rely upon improving usefulness in the advancement of learning as the only secure and worthy basis of their action in the use of their funds, so that they may take a leading part in such system of national education as may be moulded out of the present chaos.

But the foundations of a national system of education ought to be laid independently of the present arrangements at Oxford and Cambridge, for we may be sure that the more progress the system makes the more easy will become the necessary reforms in the older universities and colleges.

It is clearly undesirable that government should longer delay obtaining such full and accurate knowledge of the existing national resources for educational purposes, and of the manner in which they are respectively utilised, as may enable them to judge of the comparative prospects of usefulness presented by the various modes of distributing educational grants. They ought to know what has been done and what is doing in the various public educational establishments before they can judge which of them would be likely to make the best use of a grant of public money.

We have official authority for expecting such impartial administration of educational grants; and it cannot be doubted that before long due means will be taken to supply the preliminary conditions

You are no doubt aware that a Royal Commission was appointed some time ago in consequence of representations made to Government by the British Association on this subject, and it is understood that their instructions are so framed as to direct their particular attention to the manner in which Government may best distribute educational grants. The Commission is moreover composed of most distinguished men, and we have every reason to anticipate from their labours a result worthy of the nation and of the momentous occasion.

In speaking of public educational establishments, I refer to those which by their constitution are devoted to the advancement of learning without pecuniary profit to their respective governing bodies. The annual expenditure requisite for keeping up a national system of popular education will necessarily be considerable from the first, and will become greater from year to year; but once Englishmen are fully alive to the paramount importance of the object, and see that its attainment is within their reach, we may be sure that its expense will be no impediment. England would not deserve to reap the glorious fruits of the harvest of knowledge if she grudged the necessary outlay for seed and tillage, were it even ten times greater than it will be. It is no use attempting to establish a national system on any other than a truly national basis. Private and corporate funds inevitably get diverted from popular use, after a few generations, to the use of the influential and rich. A national system must steadily keep in view the improvement of the poor, and distribute public funds each year in the manner best calculated to give to the youths of the poorest classes full opportunities of improvement proportional to their capacities, so that they may qualify themselves for the utmost usefulness to their country of which they are capable. The best possible security for the proper administration of the system will be found in the full and speedy publicity of all the particulars of its working.

It has been frequently remarked that a great proportion of English investigators are men of independent means, who not only seek no advancement as a reward of their labours, but often sacrifice those opportunities of improving their worldly position which their abilities and influence open up to them, for the sake of quietly advancing human knowledge. Rich and powerful men have very great temptations to turn away from science, so that those who devote their time and money to its service prove to us how true and pure a love of science exists in this country, and how Englishmen will cultivate it when it is in their power to do so.

Now and then a youth from the poorer classes is enabled by fortunate accidents and the aid of a a friendly hand to climb to a position of scientific activity, and to give us, as Faraday did, a sample of the intellectual powers which lie fallow in the great mass of the people.

Now, the practical conclusion to which I want to lead you is, that it rests with you, who represent the national desire for the advancement of science, to take the only measures which can now be taken towards the establishment of a system of education worthy of this country, and adapted to the requirements of science In the present stage of the business the first thing to be done is to arouse public attention by all practicable means to the importance of the want, and to get people gradually to agree to some definite and practicable plan of action. You will, I think, find the best way to promote such agreement is to make people consider the natural forces which have to be systematised by legislation, with a view of enabling them to work freely for the desired purpose. When the conditions essential to any national system come to be duly appreciated by those interested in the cause of education, means will soon be found to carry out the necessary legislative enactments.

The highest offices in the State are, on our present system, filled by men who, whatever their political opinions and party ties, almost infallibly agree in their disinterested desire to signalise their respective terms of office by doing any good in their power. Convince them that a measure desired by the leaders of public opinion is in itself good and useful, and you are sure to carry it. And, on the other hand, England is not wanting in men both able and willing to come forward as the champions of any great cause, and to devote their best powers to its service. I may well say this at Bradford after the results achieved by your Member in the Elementary Education Act.

Objections will of course be raised to any system on the score of difficulty and expense, more especially to a complete and good system. Difficult of realisation it certainly must be, for it will need the devoted and indefatigable exertions of many an able and high-minded man for many a long year. Only show how such exertions can be made to produce great and abiding results, and they will not be wanting. And as for expense, you will surely agree with me that the more money is distributed in such frugal and effective manner, the better for the real greatness of our country.

What nobler privilege is attached to the possession of money than that of doing good to our fellow men? and who would grudge giving freely from his surplus, or even depriving himself of some comforts, for the sake of preparing the rising generation for a life of the utmost usefulness and consequent happiness?

I confidently trust that the time will come when the chief item in the annual budget of the Chancellor of the Exchequer will be the vote for National Education; and when in some later age our nation shall have passed away, when a more true civilisation has grown up and has formed new centres for its throbbing life, when there are but broken arches to tell of our bridges, and crumbling ruins to mark the sites of our great cathedrals—then will the greatest and noblest of England's works stand more perfect and more beautiful than ever; then will some man survey the results of Old England's labours in the discovery of imperishable truths and laws of nature, and see that her energy and wealth were accompanied by some nobler attributes—that while Englishmen were strong and ambitious enough to grasp power, they were true enough to use it for its only worthy purpose, that of doing good to others.

I must not, however, trespass longer upon your time and your kind attention. My subject would carry me on, yet I must stop without having half done justice to it.

If I have succeeded in convincing you that a national system of education is now necessary and possible, and in persuading you to do what you respectively can to prepare the way for it, I shall feel that the first step is made towards that great result.

DUPLEX TELEGRAPHY.

By W. H. Walenn.

Duplex telegraphy consists in telegraphing in opposite directions, upon one wire, at the same time. The conditions for its perfect accomplishment imply that at two different stations (A and B) each station can send and receive messages at the same time with one line wire, with the same ease that can be done, under ordinary circumstances, with two line wires that are (together with batteries and instruments) entirely separate from each other. These requirements demand that, two persons being at station A and two at station B (one a communicator of messages to the distant station, the other a receiver of messages from the same distant station), the communicator may proceed with his work with a perfect assurance that his communications will be as well read by the receiver at the distant station as if the receiver by his side were receiving messages along a different line of route. The requirements also demand that the receiver may write down his messages from the same distant station as if the communicator by his side were engaged upon a perfectly independent telegraph line. Given a telegraph engineer and a difficulty to be overcome, and the case of duplex telegraphy appears, at first sight, to be too difficult even for him.

The simultaneous transmission of telegraphic signals in opposite directions between two stations, by means of one line wire only, seems to be a perfectly impossible operation. It appears almost as likely to expect this to be done as to endeavour to send two distinct streams of water, of different speeds and capacities, along a single pipe in opposite directions at the same time. There are the conditions, however, definite enough; there are two stations, A and B, and only the one inexorable wire joining them; these conditions are apparently unmanageable. In reality the currents sent from the two stations do not travel simultaneously in opposite directions through the line wire, but the effect of the signals on each receiving instrument is precisely the same as though the line were being worked in only one direction. Also, to comfort the before-mentioned telegraph engineer (possibly in despair), the said inexorable wire is not the only feature in this problem; there are other data, which by their peculiarities, number, and adjustability to circumstances, would appear to tempt the engineer into this field of investigation and research. Between the earth-plate at station A and the termination of the line wire at that station, there is an interval, which, electrically speaking, may be made use of in many ways; and precisely the same condition exists at station B. For instance, the interval may be occupied by batteries, keys, signal instruments, relays, galvanometers, secondary or local batteries, resistance coils, condensers and other apparatus, and these, separately or combined, offer their aid in the solution of this problem, as will be shown ultimately, not without promise of success.

To proceed from the known to the unknown, it will be well, in the first place, to call the reader's attention to an ordinary telegraphic arrangement between two given stations, say A and B. This arrangement involves the use of a "Morse recorder"—a signal receiving instrument that is worked by an electro-magnet; in this instrument a paper-bearing cylinder, revolving by clockwork, receives a mark from the prepared lever-extension of the armature whenever the key of the distant station is depressed. As one station is furnished precisely the same as the other, it will be sufficient to describe the arrangement at station A. Between the line wire and the earth-plate there are three instruments: 1. A communicating key; 2. a Morse recorder; 3. a galvanic battery. At the key, the line wire splits up into two paths, one through the signal instrument, the other through the battery, and the electric current is capable of proceeding through one or other of these paths, according to the position of the key. In the normal position of the key, the signal instrument is included in the circuit, for the receipt of incoming signals, and the battery is cut out of the circuit. When a signal is made, the battery is placed in the circuit by depressing the key, and the signal instrument is excluded from any participation in the electric work. To realise how this can be easily accomplished, imagine that the wire from the earth-plate is divided into two vertical branches, one including the signal instrument, and the other including the battery, and that the extremities of the wires proceeding upwards from the instrument and the battery respectively are brought to a horizontal plane within a few inches of each other. If now a metallic lever, or "key" (in connection with the line-wire), be mounted on a pivot between the extremities, or "contacts," so that a spring constantly keeps one arm of the lever in contact with the branch wire from the signal instrument, and the other arm away from the battery branch wire, this would represent the normal state of the key; but if the key be depressed, and therefore the power of the spring overcome, the arm that was in connection with the signal instrument is thrown upwards, and the battery only is included in the circuit, by the contact of the other arm with the battery branch wire. In this arrangement simultaneous signalling in opposite directions upon one line wire is not possible; for if the keys of the sending instruments at A and B respectively be simultaneously depressed, the currents neutralise one another, and, instead of a signal being produced at each station, the effect is *nil.*

To make duplex telegraphy possible the neutralisation of the current must enable each signal instrument to register, and the currents sent to the distant station must not affect the home signal instrument. These conditions are complied with in an arrangement which is about to be described in the second place, and which has recently been introduced in America by Mr. Joseph Barker Stearns. It is as follows:—At station A, between the line wire and the earth plate, there are—1st, a communicating key of a peculiar construction; 2nd, a Morse recorder, having its electro-magnet wound with two separate coils; 3rd, a galvanic battery placed between the key and the earth-plate, as in the ordinary method of working; 4th and 5th, a resistance coil and condenser. These two instruments together represent an artificial line, in all respects equivalent to the real telegraph line. At station B the arrangements are exactly the same as at station A. The only point in which the plan is similar to the ordinary method of working is, that the battery is placed between the key and the earth-plate. The currents from both stations are so divided and modified that, in case the keys of each station are simultaneously depressed, the battery current at the home station works its own signal instrument. Unlike the Morse arrangement described in the first place, the receiving electro-magnet is subjected to the action of the home current as well as to that of the distant station. The communicating key is a lever which is connected to one of the battery poles; another lever (in direct communication with the earth plate) communicates with the line wire through the interior coil of the Morse recorder, and with the artificial resistance circuit through the exterior coil of the recorder, thus sending neutralising currents through the home signal instrument, when only the home current is traversing the line. The key lever is so mounted that its normal position is against an insulated stop, but that, upon being depressed, it first makes contact with the free end of the earth-plate lever already mentioned (thus momentarily completing the battery circuit at the home station, or "short circuiting" its current), and, immediately after, it raises the last-mentioned lever from the earth-plate connection, and sends the current along the line wire. The momentary completion of the battery circuit above described may be called the "intermediate position" of the key.

The effects of each relative position of the keys at stations A and B respectively may be traced out as follows:—

1st position.—When neither key is depressed; the normal position of the tail of the key-lever being against an insulated stop, no current traverses the line wire, and no signal is given at either station.

2nd and 3rd positions.—The key of either station being depressed, and that of the other station untouched; the current from the sending station passes through both coils of its own recorder, and therefore does not affect the home recorder, but it proceeds along the line wire, and affects the distant signal instrument by means of its inner coil.

4th position.—The keys at both stations being simultaneously depressed; the line-wire current is neutralised, and each signal instrument is worked by its home battery, which sends a current through the outer coil of its own recorder.

5th and 6th positions.—Either key being in the intermediate position, and the other key not depressed; the battery of the key in the intermediate position is short-circuited, and the other battery is not active, therefore no signal is indicated at either station.

7th and 8th positions.—Either key being in the intermediate position, and the other key depressed; the battery of the key in the intermediate position is short-circuited, and the other battery sends a current through the inner coil of its distant station, therefore a signal is made at the said distant station.

9th position.—Both keys being in the intermediate position; both batteries are short-circuited, and no signal is given at either station.

These nine positions are all the possible positions of the keys relatively to one another.

At each station the resistance coils and condenser separately make direct communication between the outer coils of the recorder and the earth-plate. By this means in all positions of the keys, a line of constant length and capacity is signalled through. The principle upon which Mr. Stearn's invention depends involves a differential arrangement which is known as Wheatstone's bridge. For the sake of simplicity this plan has been described as being worked by a Morse-recorder, but it may be operated by means of a relay with double coils. There are other details which add to the perfection of the plan, but which would unnecessarily complicate the verbal description.

If the reader finds difficulty in realising either of the foregoing telegraphic arrangements, it will materially assist his conception if he sketches out the various parts according to the description. The account of the ordinary Morse telegraph has been written from Fig. 1 in the *Telegraphic Journal* for July 15th, 1873, page 197, and that of Stearns' duplex arrangement from Fig 160 in Jenkin's "Electricity and Magnetism," page 324.

Some of the patents (previous to 1866) that relate to duplex telegraphy are:—Nos. 2,308 and 2,366, of the year 1854, and No. 2,608, of the year 1855. Mr. Stearns' patent is dated November 11th, 1872, and numbered 3,344 Another application for a patent, by Mr. Joseph Barker Stearns, has been filed on September 1st last, with the title, "Improvements in electric telegraph apparatus;" this is numbered 2,870.

Duplex telegraphy was attempted with more or less success by Dr. Gintl, in 1853; also by Edlund, Siemens, Frischen, Eden, and Preece. By the use of the condenser, its most successful introduction was reserved for Mr. Stearns. Sir Charles Wheatstone has also attended to this subject, and successfully employs resistance coils in connection with his magneto-electric alphabetical signal instrument to accomplish duplex telegraphy; his method enables twice the speed of ordinary telegraphs to be attained, and the apparatus will work well, provided that the line is not more than 200 miles long. At a recent trial, forty words per minute, duplex working, were sent between London and Birmingham by Wheatstone's automatic recorder.

The writer is indebted to the above-mentioned works for much of the matter of this article, and he thankfully acknowledges the kind assistance of Sir Charles Wheatstone; also of Mr. Robert Sabine, of the British Telegraph Manufactory.

The difficulties of duplex telegraphy to the supposititious telegraph engineer having been set forth, and the means of overcoming them to some degree explained, it is now evident that his capabilities have evolved success.

The *Liverpool Daily Post* states that 100 tons of American bar iron, guaranteed equal to Staffordshire, have been sold to a Liverpool firm at £11 10s., delivered in Liverpool, thus underselling the English iron market.

The project for establishing various lines of street railways at Naples has at length been approved of by the Municipal Council, and there is every prospect of their being commenced shortly.

It is asserted that the Argentine Republic has accepted the proposition of MM. Clark and Co., to construct the railway traversing the Andes for the sum of 27 millions of dollars, and guaranteed interest of 7 per cent.

CHANNEL PASSAGE.

At the last meeting of the French Geographical Society, M. Dupuy de Lôme read a paper on a rapid maritime service of transit between Calais and Dover.

In it he alluded to the geographical position of England and France—two countries so near to one another, and yet so inconveniently separated; and said that one was astonished, when comparing the great ocean steamers which go to other countries, with the very inferior means of transit between England and France. He was firmly convinced that the traffic would become more extended, and communication easier, by improvements in the navigation. Unfortunately large ships require large harbours, of which there are none on the French coast of Pas de Calais. He was also of opinion that the goods must be carried by train in order to save loss of time, and that the train must be conveyed bodily on board ship. In England, the harbour of Dover is well adapted for a long ship of this kind, on account of the magnificent mole, which will be made still longer. On the French shore there are no harbours which will serve that purpose.

The question was a difficult one. Some men, amongst whom were Messrs. Scott Russell, Béhic, Drouyn de Lhuys, Durrieux, &c., have decided that it would be necessary to build a harbour at Calais as fine as that at Dover. The tide is less strong at Calais than at Boulogne, owing to the current which passes through the Channel; the slope of the coast at Calais is, for the same reason, more advantageous than the slope at Boulogne; nevertheless, there are minor difficulties at Calais. M. Dupuy de Lôme has derived great assistance from a work on the harbours of that coast, by M. Dumas Vance. At Calais, man had constantly to struggle against nature in preventing the sea from flooding his fields, and this was only managed by raising extensive dams. Along that coast the tide rises for eight hours, and the ebb flows for four hours. M. Dupuy de Lôme explained the physical reasons of that phenomenon. Embankments were made to resist the effects of the tide as early as 1688; and the years 1766, 1821, 1822, 1834, and 1842, mark the establishment of the present longitudinal as well as perpendicular banks or moles.

A special study of the practicability of digging a port in the land has shown that the plan was impossible, because the port could never be made large enough. On that account it had been thought preferable to build a harbour for the train transport vessel, by taking advantage of a small oblong island. The harbour will be formed by a crescent-shaped mole, facing the sea, and by another mole nearer the land. Moreover, the slight declivity of the shore offers facilities for establishing the projected harbour.

The steam-transport vessel proposed will be of large dimensions, measuring 119 metres in length, and able to carry fourteen cars for travellers, and four cars for luggage or goods. The engine being of 3,600 horse-power, a steam-transport vessel, with her load of 180 tons when loaded with a passenger train, or of 800 tons with a goods train, and steaming 18 miles an hour with fair weather, will pass over to Dover in an hour and ten minutes; or in an hour and a-half in bad weather, except in the case of fogs or violent snow-storms.

Every precaution will be taken with the view of securing to the steam-transport vessel the best sea-going qualities. It will be easier in such a large vessel to diminish the rolling which is so inconvenient to passengers. There are two sorts of rolling, one arising from the ship, the other from the waves. This last is most violent when it is regular, because the force causing the movement is accumulative. The steamers employed actually for that passage receive by waves coming obliquely, between seven and a-half and eight and a-half blows a minute; and when the weather is bad the steamers make sixteen and a-half oscillations a minute. The steam-transport vessel will make ten and a-half oscillations a minute.

How will the train be shipped and landed? some may ask. The height of the landing-pier above the ship is to be seven metres and twenty centimetres. Three successive embarking places and a draw-bridge of thirty metres in length and three millimeters declivity in each metre, will complete the construction and machinery. Entering the ship, the train will occupy a place under the deck. That space will be well ventilated and surrounded with saloons. Passengers will be allowed to come out of the carriages and walk on the upper deck. The locomotive will remain ashore, being required only to push the train on board. The three different embarking places mentioned above are intended to serve—two for the tidal trains arriving at periods of ebb and flow respectively, and the third half-way between.—*Iron.*

EGYPTIAN RAILWAYS.

The opening up of the Soudan district has been for many years the hope of the Egyptian Government, and never was there so much interest displayed in it as now.

The *Moniteur Egyptien* gives some particulars of the proposed line in the valley of the Nile, which would be 889 kils. in length. The first section extends on the right bank of that river to Kuha, and will be 259 kils. in length. The second section consists in a noble bridge, which crosses the Nile at this point. The third, 349 kils. in length, extends to Amikoula and the frontier, from this place to Chendi, a distance of 281 kils. From Chendi the Nile is navigable, and continues so without interruption to Gondokoro, close to the Albert Nyanza, thus opening out a highway into the very heart of Central Africa, where there is a teeming population waiting for an outlet to extend their products and fertilise largely extended areas to augment the industry and commerce of Egypt and the world. Some distance above Chendi is Khartoom, a large and important town of 40,000 inhabitants, which is the capital of the Soudan provinces. This district is extremely fertile, producing coffee, grain, cotton, sugar, etc., and is also one of the great hunting-grounds of Africa, producing ivory, gold, etc. The cost of this line is estimated at £4,500 per kilometre, or four millions sterling, for the whole line, including stations, warehouses, docks, quays, etc., and it could be completed in three years.

THE EUPHRATES VALLEY RAILWAY.*

The pamphlet by Mr. Andrew, upon the advantages of the Euphrates Valley Railway, is a powerful appeal to the Government and people of England, more especially cogent in view of the recent diplomatic interchanges with Russia, in regard to that very Indian Empire which this route is specially intended by its projectors to cement with this country.

In his introduction Mr. Andrew points out the great historical interest and importance attaching to the line which he advocates. The countries through which the Euphrates flows were formerly the most productive in the world. Throughout these regions the fruits of temperate and tropical climes grew in bygone days in luscious profusion. The soil everywhere teemed with vegetation. Much of this has since passed away. Ages of despotism and misrule have rendered unavailing the bounty of nature. But the land is full of hidden riches. The natural elements of its ancient grandeur still exist in the inexhaustible fertility of the country, and in the chivalrous character and bearing of many of the tribes; nor can the day be far distant when it is destined to resume its place among the fairest and most prosperous regions of the globe. The wondrous fertility of Mesopotamia was in early times carried to its utmost limit by means of numerous irrigation canals, with which the country was everywhere intersected, and some of the largest of which were navigable. These regions need only again to be irrigated by the life-giving waters pouring down from Ararat, to yield once more in abundance almost everything that is necessary to man. Many acres now wasted may be covered with cotton, tending to the employment of the many million spindles of our land.

The establishment of a new and easy line of communication between the East and the West would obviously subserve many noble projects; and the proposed restoration of the ancient route of the Euphrates has therefore the strongest claim upon the sympathy and support of all who feel an interest in advancing the prosperity, civilisation, and happiness of nations. It is not too much to say, that no existing or projected railroad can compare in point of interest and importance with that of the Euphrates Valley. It will bring two quarters of the globe into juxtaposition, and three continents, Europe, Asia, and Australia, into closer relation. It will bind the vast population of Hindostan by an iron link with the people of Europe. It will inevitably entail the colonisation and civilisation of the great valleys of the Euphrates and Tigris, the resuscitation in a modern shape of Babylon and Nineveh, and the re-awakening of Ctesiphon and Bagdad of old. Although various routes have been suggested with the view of bringing Great Britain, by means of railway communication, into closer connection with India and her other dependencies in the East, and of securing at the same time the immense political and strategic desideratum of an alternative highway, there is none—argues our author—which combines in itself so many advantages as the ancient route of the Euphrates—the route of the Emperors Trajan and Julian, in whose steps, in more recent times, the Great Napoleon intended to follow, when the Russian campaign turned his energies in another direction. The special advantages described by Mr. Andrew are briefly these:—It is the most direct route to India. It is the shortest and the cheapest, both for constructing and working a railway—so free from engineering difficulties, that it almost appears as though designed by the hand of nature to be the pathway of nations between the East and the West; the most surely defensible by England, both of its termini being in the open sea; and the most likely to prove remunerative. Both in an engineering and a political point of view, the Euphrates route is stated to possess great advantages over any of the others which have been proposed. All the routes which have been suggested from places in the Black Sea are open to the fatal objection, that while they would be of the greatest service to Russia, they would be altogether beyond the control of Great Britain, while the engineering difficulties with which they are surrounded are of themselves sufficient to exclude them from practical consideration. Some persons have advocated a simple through route from Constantinople to India, but such a project is too vast to be at once undertaken with any hope of success. At the same time it is observed that the Euphrates Valley Railway as proposed, from the Gulf of Scanderoon to the Persian Gulf, has been specially designed with a view to its ultimately forming part of a through line to the head of the Persian Gulf, while it is capable also of being, in due time, extended eastwards to Kurrachee, the port of India nearest to Europe. A regular mail service being already in operation on the maritime portions of the Euphrates route to India—maintained on the Mediterranean side by French steampackets, calling at Alexandretta, and between the ports of the Persian Gulf, and Kurrachee and Bombay, by the vessels of the British India Steam Navigation Company, a railway of little more than 900 miles in length, from Scanderoon (or Alexandretta) on the Mediterranean, to Kowait (or Grain) on the Persian Gulf, is all that is required to secure for us the immense political and strategic advantages of a complete alternative route to India; a shorter and more rapid route than now exists, and one, moreover, which compares very favourably with the Red Sea, both as regards climate and the facility and safety of the navigation in the maritime portions of the journey.

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* "The Euphrates Valley Route to India," by W. P. Andrew, F.R.G.S.

The cost of the proposed railway, according to the estimates of competent engineers, would be under nine millions sterling; and His Excellency Musurus Pacha, the Turkish Ambassador, has officially intimated the readiness of his Government to raise the requisite funds by means of an Ottoman loan, with the counter-guarantee of Great Britain, as in the case of an Ottoman loan raised in 1854. The grand impediment to the improvement of the Sultan's dominions is the want of the means of intercommunication, and no line would promote more effectually their good government and prosperity, or do more to develop their really prodigious resources, than that which would lay open to the capital and energy of the West the expansive and fertile plains of the Euphrates and Tigris. Looked at, therefore, in every light, historically, politically, and commercially, the proposed restoration of the ancient route of the Euphrates, throwing open the portals of the East to the commerce of the world, and to the arts, sciences, and civilisation of the West, is an interesting and noble scheme, fraught with consequences of the highest moment to the destinies of our race.

THE ST. GOTHARD RAILWAY.

The works of the St. Gothard tunnel are progressing most favourably, and on the 25th of last month 5·90 of heading was driven at the Airolo, and on the following day the amount of progress made was six metres. The contractor, M. Favre, to encourage the workmen, has wisely offered a premium to the miners should the length driven exceed that established by him as a proper day's work. The great difficulties that were met with at first, from the quantity of water which hindered the progress of the work of tunnelling at this end, have in a great measure been overcome; and as the length of heading increases, there is every reason to anticipate that very little water will be met with.

The tunnelling machines used at this side are those known as the system Dubois and François, and are similar to those adopted by the "Societé de Charbon de Marihaye," and by the "Companie pour l'extraction de l'huile minerale á Anzin." The total length of these machines is 2·20; their width, 0·23; and height, 0·32. The diameter of the cylinder is 0·07, and weight 220 kilogrammes. Six of these "perforators" are mounted on a carriage, similar to those used at the Mount Cenis tunnel, running on rails, which are laid down as the work proceeds, and worked backwards and forwards as required by the little locomotive "Tessin."

With the Dubois and François boring machine a hole from 15 to 20 cent. in depth per minute can be drilled in schist, and in calcareous rock the rate of progress is estimated to be twenty times greater than by hand.

At the entrance to the tunnel the valley has assumed a most animated appearance, and the little mountain village of Airolo has now the aspect of a manufacturing town; upwards of a hundred houses have been built for the accommodation of the workpeople, who are, for the greater part, Piedmontese. Five large buildings have been established near the works, one of which is used for workshops, another for the engineering staff, a third for the steam-engines which are used at present for driving the tunnelling machinery. In the largest building will be placed the great compressors, which will be used later on for compressing the air for the boring machines; and a canal is now being made from the Ticino, at a great height above this building, which will furnish the motive power for driving the compressors. The construction of this canal, which is being cut in the solid rock, is progressing rapidly.

The works of the railway, from Bellinzona to Biasco, and from Biasco to Faido, are commenced in several points. At Lugano the works are already commenced near the road, to which it runs parallel, as also a tunnel near the Mont St. Salvatore.

The ruins of the castle of Underwalden, at Bellinzona, have been purchased by a company, who intend building a large hotel, from which a magnificent view of the valley of the Ticino, as far as the Lago Maggiore, is obtained.

During the month of July the following progress was made at the tunnel:—

At the north end, at Goeschenen, the length of heading driven during the month was 51 metres, making a total of 259 metres driven up to the 31st July. The length of tunnel completely excavated was increased from 150 metres to 200 metres at that end. At the south end, at Airolo, 47 metres, of heading were driven, making a length of 266 driven up to the end of July. The length of tunnel completely opened out was increased from 214 metres to 253 metres. The total length of heading driven up to the above date was 525 metres, and the length of tunnel completely excavated 453 metres. The average number of workmen employed during the month of July was 945, and the greatest number employed in one day at these works was 1,159.

SILK SUPPLY.

A correspondent of the *Warehousemen and Drapers' Trade Journal* writes on this subject as follows:—

The increased price of labour, of coal, &c., the scarcity and consequent increase in the price of silk of late years, each have their particular bearing upon the trade, though each is different. Those acquainted with the silk trade know there is a deficiency in the supply of the staple article, which has been increasing for upwards of fifteen years. China, Japan, and other countries being unable to meet the demands of the Western trade, the supply was still left deficient. And it is generally admitted that the one great need of the silk trade at the present time is an ample supply of good quality silk at moderate price. How to obtain this is the question most immediately requiring an answer. It has been argued that, following the visit of the Shah to this country and other European nations, the history of Persia will enter upon a new era, and that the development of the country will commence. One of the results of this, it is expected, will be the importation from Persia to this country of large quantities of fine silk. But as this is not yet an accomplished fact, it will be wise to ascertain, if possible, whether there be no new fields whence silk can be exported. This, no doubt, means also fields where the silkworm and mulberry tree can be cultivated. An eminent authority (Mr. B. F. Cobb, in the now extinct *Silk Supply Journal*) on this subject says that many of our vast colonial possessions are admirably adapted for the rearing of silkworms, and that the mulberry tree will flourish luxuriantly, the climate being admirably adapted to both processes. Especially are the African colonies favoured, Natal being peculiarly adapted both in climate and soil to this purpose. In those countries there are fields of rich promise open to the enterprise of capitalists, and the suitability of the climate, &c., to the operations of the silk produce have been fully demonstrated by experiments. In Australia, New Zealand, Ceylon, and India there are numerous districts of many thousands of acres admirably adapted to the production of silk. It is even said by Mr. Cobb "that there are in the British colonies silk-producing capabilities equal in the aggregate to the present silk production of the world, and it is not saying too much to state that in America there can be found as many more." This is a bold statement, but one not to be denied without a great deal of careful and minute investigation. One fact is quite clear, however, that colonists as yet have not thought it worth their while to cultivate silk, preferring, on the contrary, sheep-farming, cotton-raising, and even sugar-planting, the latter being as unfamiliar to the English settler as the cultivation of the mulberry tree and the silkworm. The fact is only to be accounted for by acknowledging that erroneous opinions, sustained by bigotry and prejudice, have been so long uncontradicted that they have become accepted as facts. This is to be regretted, for the chief want of the silk trade will ere long be felt more severely than ever, and is even now leading to an extensive use of cotton in ribbons and other fabrics, to the depreciation of the quality of the goods and the detriment of trade in the long run.

What, then, is wanted is that these vast fields available for the cultivation of silk should be utilised. Men of capital, and men of industry, the millionaire and the working man might combine in an enterprise calculated to greatly benefit the trade and commerce of the mother country.

CONSUMPTION OF HORSE-FLESH IN FRANCE.

According to the report of the Comité De la Viande de Cheval, there were consumed in Paris during the first half of the year 1867, 893 horses, asses, and mules, which supplied 106,030 kilogrammes of meat; during the first half-year of 1870 (before the war), 1,992 animals were slaughtered, giving 366,440 kilogrammes of meat; lastly, during the first half of the present year, the figures amounted respectively to 5,186 animals, and 883,840 kilogrammes—not including hearts, livers, brains, tongues, &c., which are consumed in common with those of neat cattle. The provinces exhibit, says the report, the same progress as the capital in the consumption of horse-flesh.

Horses slaughtered for consumption fetch, on an average, from 125 to 150 francs each, so that the industry has added 100 francs per head to the value of worn-out, but not diseased, horses. In the words of the report, the public wealth of France is increased by the eating of horse-beef to the extent of 480 millions of francs. It is beyond question that horse-meat is received with considerable favour in France, but the high price of butchers' meat and general impoverishment have doubtless considerably aided the progress of horse-butchery.

The Brazilian Parliament has authorised the government to construct railways and to raise a loan of 40 millions of milreis for the purpose. This loan may be raised either at Rio Janeiro or abroad, as the government may think fit, and it is further empowered either to construct the various lines and sections for itself, or to accord subventions or guarantees of interest to 7 per cent. to contractors.

A report comes from the far north to the effect that a railway is projected across the mainland of Orkney, between Kirkwall and Stromness, with a view to meeting the line through Caithness, which will be opened for traffic within a twelvemonth.

Kjerulfine is the name of a new mineral species, described by Von Kobell. It is a phosphate of magnesia and fluoride of calcium, occurring at Bamle, in Norway, and is named in compliment to the Norwegian geologist, Kjerulf.

The tunnel of the Col de Tende has been commenced at both ends simultaneously; the rock is found to be unusually hard, and it is feared that the piercements will present great difficulties.

A new line of railway is proposed from Rome to Naples by Gaeta; the Minister of Public Works offers no opposition, but the Government will not accord any subvention.

CORRESPONDENCE.

RHEEA FIBRE.

Sir,—It is undoubtedly true, as Mr. Simmonds remarks in one of your former numbers, that the progress of the rheea has been very slow, and, in fact, so far as my observation extends, it is less used now than it was formerly. If it is ever to be manufactured extensively, it must not cost more than £50 per ton, but the last that I imported from China cost upwards of £80. My opinion is that it is only a low price that will sell it; although it is the most promising, it is also the most deceptive fibre that is known. After it has been hackled or combed, it looks almost as well as silk, and has almost as much lustre; and I gave up using it for fear of its being mixed with our white silk sliver, which would have caused us serious loss, as they will not take the same dye. Unfortunately, all this lustre vanishes the moment that it is twisted and dyed; it is then almost as dead and dull-looking as cotton. It is true that I have seen some beautiful handkerchiefs made from it, but they do not wash or wear so well as linen. The same remark applies to China grass cloth of native manufacture; it does not wash or wear well, and is indeed very inferior to goods made from the same fibre in England, which is owing to the fibres being gummed together instead of being twisted; and although it looks well, it is worn out directly. Many years ago, when I had no practical knowledge of the fibre, I was so pleased with it, that in a rash moment I sent Mr. George Thompson (the celebrated anti-slavery advocate), at a considerable expense (some thousands), to India, to see what could be done. His mission ended in nothing but my obtaining a few bales of coarse fibre, so coarse, that it was of little value. I then turned my attention to China, and succeeded in obtaining abundant supplies of a very first-class article, at what I considered at that time a very moderate figure, say about £80 a ton, but I did not then know all its defects; it has only been by practically carrying out the manufacture that they have been developed. But with all its faults it would be used to an enormous extent if it could be laid down in England at £50 per ton, and I think it can be produced at much less. The machine patented by Messrs. Sandford and Mallory, which by the efflux of time is now open to the public, will clean the fibre when fresh cut in the most admirable manner, at a very slight cost. And as to the cost of growing it, that cannot be much, as it is attended with very little trouble or expense.

Whilst I am writing I wish to inform Mr. Bennoch (who remarks that "although Lister and Co. were on the list of velvet exhibitors, he could find nothing of theirs in the exhibition") that they could not possibly get their goods ready in time, although an extension was granted at their request. We were anxious to show that we had made some progress in weaving velvets by power, and that there was a prospect that, before another decade had passed, we should not only be able to supply the home demand, but that we should compete successfully in the open markets of the world. At the present time we have room and power for as many looms as would produce about as much as all the looms of Crefeld put together; but owing to bad trade, more especially in low velvets, and keen competition, we are increasing our productions very slowly. It is, however, simply a question of time, as we have no doubt that we shall be able to drive all foreign competition out of the market. We are also preparing to do a large business in ribbon velvets, although there is not a single loom of the kind at work in this country at the present time, excepting the model loom at our works.

S. C. Lister.

Sept. 10, 1873.

GENERAL NOTES.

Society for Physical Research.—The *Athenæum* publishes the following note from Dr. Frederick Guthrie, of the Royal School of Mines, Jermyn-street:—"I wish to try to form a society for physical research—for showing new physical facts and new means for showing old ones; for making known new home and foreign physical discoveries, and for the better knowledge one of another of those given to physical work. You who care for the being of such a society, and who are willing to help in its making, are hereby asked to write to me for that purpose before the 1st of October next, whereupon you will be asked to meet so as to talk over the means.—24, Stanley-crescent, Notting-hill, W."

Social Science Congress.—The seventeenth annual Congress of the Social Science Association will be held at Norwich on October 1st and successive days, under the presidency of Lord Houghton. A great feature of the meeting, as we have already mentioned, will be a sanitary and educational exhibition, the object of which is to bring under notice the latest scientific appliances for the improvement of the public health and the promotion of education. Intending exhibitors should make early application for space to the secretary, Mr. James Robinson, 1, Adam-street, Adelphi. The three special subjects for discussion in the Health section, under the chairmanship of Captain Douglas Galton, are:—1. What are the most convenient administrative areas for sanitary purposes, and what are the best means of administering the sanitary laws? 2. Should there be a special diploma for medical officers of health, and, if so, how should it be granted? 3. What provisions are required in a general Building Act, so as to secure necessary sanitary arrangements?

Selection of Silkworm Grain.—It often happens that the grain met with in commerce will not hatch, from proper care not having been taken in preserving it during the winter months, or from its having been damaged during its carriage, if brought from a distant country. It is, therefore, a most important matter for the sericiculturist, before purchasing a batch of grain, to ensure himself of its soundness. A simple means of detecting whether the grain is fit for hatching is to steep a pinch of it for a few seconds in water, heated to boiling point; if sound the eggs will immediately assume a fine lilac colour; if, on the other hand, the grain is bad, it will turn, after immersion in boiling water, an ash, or dirty yellow, or greenish colour.

Underground Railways in America. — The city of Baltimore is in possession of an underground railway system first amongst American cities. There are now two distinct lines of tunnels in Baltimore, which have been completed at a cost of nearly five millions of dollars, whereby nearly all the various railways centreing in the city have been brought into connexion. The underground railway consists of the Baltimore and Potomac tunnel, whence it extends in a north-easterly direction through the city, under some twenty-nine streets and avenues, emerging at North-avenue, where it joins the track of the Northern Central Railway. The Union tunnel extends from tide-water at the Canton portion of Baltimore, under some thirteen streets and avenues, to the Northern Central Railway. The total length of the Baltimore underground railways is three miles and a half, of which about two miles are closed tunnels, and the remainder open cuts, over which the streets are carried on bridges. The tunnel arches are from 22 ft. to 23 ft. 6 in. high, and from 26 ft. to 27 ft. wide, five rings of brick thick (from stone springers), backed with rubble masonry.

Bronze from Japan.—The British Consul at Hiogo, Japan, reports an export of bronze to foreign countries in 1872 to the value of 450,000 dols., and notices that a large portion of it was furnished by the Buddhist temples. The discouragement shown to that sect by the Government, and the appropriation to imperial purposes of the revenues of many of the temples, have induced the priests to realise as much of their movable property as possible; and the massive bells, which formed a striking feature of these temples, have, with other bronze articles of use and ornament, found their way into the hands of foreign merchants. The high price of copper in England made it profitable to ship the bronze thither, and then extract from it the copper it contains.

Balearic Coal.—High prices have a tendency to awaken long dormant industries. Coal mines have been worked after a slip-shod southern fashion for many years in the island of Majorca, but for want of proper machinery little progress has been made. According to the report of an English engineer—given in 1863—one mine alone might be made to yield 1,000 tons per week. At length a company has been formed for the purpose of working this mine, and the possible development of the Majorcan coal-fields appears a trifle less remote than heretofore.—*Iron.*

Common Scientific Language.—The *Athenæum* notices, as worthy of remark, that Prof. T. Thorell, of Upsala, has lately advocated the introduction of a common scientific language; and, as in these days a return to Latin is neither to be expected nor desired, he considers it not improbable that English may at some time succeed to this position. This he believes, not only because English is far more widely diffused than any other tongue, but also because it can, by most Europeans, be more easily acquired than any other language. Prof. Thorell has given us an earnest of his belief by writing his recent work, "Remarks on Synonyms of European Spiders," entirely in English—in such English, too, that (says the same authority) none of our countrymen need be ashamed to own it.

Artificial Sugar—In the French world of industry and science, great sensation has been produced by an alleged discovery, the importance of which, if it turns out to be true, it is impossible to calculate, nor the effect it may have on the sugar trade of the future. It is asserted that the French engineer, M. Jouglet, has succeeded in making artificial beetroot sugar, which, however, is not real beetroot sugar, but a composition of chemical sugar, if we may be allowed to use such a term. Already has the eminent M. Berthelot succeeded in making alcohol by a synthetic process; but the new discovery is of much more practical value, as it affects a commodity of such general use. Provided the accounts published in the French papers are not exaggerated, although such exaggeration is very likely, this new discovery may possibly bring about a change in the manufacture of sugar, for it is announced that by the new process sugar can be made not costing more than 5f. per 100 kilogrammes, or one farthing per lb.; and that in order to make it, it is only necessary to bring together certain common articles, which, after being liberated from the coarser elements with which they are combined, are known to have a chemical affinity to each other, and produce a sugar said to be equal to that made from cane-juice or beetroot. Henceforward, then, the manufacture of sugar would be placed in the hands of the maker of chemicals. It is added that the discoverer, M. Jouglet, has already sold his invention to a company for the sum of 1,200,000 francs, who intend to work the invention.—*Engineer.*

Coal in India.—Efforts are being made by the Indian Government to develop the great mineral resources of the country, especially the coal-fields of Raniganj, distant about 120 miles from Calcutta. At present the coal production of India is very small—not exceeding 500,000 tons per annum, of which the Raniganj country supplies nearly all. The poor quality of Indian coal explains much of the indifference hitherto shown in raising it. Containing from 10 to 30 per cent. of ash, with a proportion of fixed carbon averaging only 52 per cent., it is only capable of doing from one-third to two-thirds of the work performed by a similar quantity of English coal. It is, therefore, ill-suited for sea-going steamers, but may be made available for railways, river steamers, and other local work, and in the manufacture of iron, a branch of industry likely to be stimulated by the growing demand for the construction of railways. Coal exists in Assam, but for want of labour and transit has hitherto proved practically useless. In the Central Provinces the coal seams of Chandah are, by the agency of a specially constructed coal railway, brought into connection with the Nagpore branch of the Great Indian Peninsula Railway, and may therefore be expected at no distant period to supply the coal market of Bombay, where English coal has recently risen to the enormous price of 40 rupees, or £4 sterling per ton.—*Iron.*

A tract of Hematite iron ore has been discovered in Shropshire, and 1,100 acres have been secured on behalf of certain Staffordshire ironmasters, who will work it as a company. Specimens of the ore contained 57 per cent. of iron.

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No. 1,088. Vol. XXI.

FRIDAY, SEPTEMBER 26, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

GENERAL EXAMINATIONS, 1874.

The Programme of Examinations for 1874 is now ready, and may be had gratis, on application to the Secretary.

These Examinations, in 1874, will be held on the evenings of the 21st, 22nd, 23rd, and 24th April. The Time-table has been arranged as follows :—

TUESDAY, April 21, From 7 to 10 p.m	WEDNESDAY, April 22, From 7 to 10 p.m.	THURSDAY, April 23, From 7 to 10 p.m	FRIDAY, April 24, From 7 to 10 p.m.
Arithmetic. Logic. Floriculture.	Theory of Music English History. German. Spanish.	Political Economy. French. Fruit and Vegetable Culture.	Book-keeping. English Language. Italian.

Friday, April 24, 6 to 7 p.m.—Dictation.

The rule which formerly prevented a candidate who had once obtained a first-class certificate in a subject from being again examined in that subject with a view to gaining a prize, has, in accordance with the wish expressed at the Conference, held on the 27th June, 1873, been rescinded. In future, therefore, a candidate who has obtained a first-class certificate in a subject may be again examined in that subject, but not more than one first-class certificate in any subject will be counted for the Prince Consort's Prize, or for the Council Prize to Females. A candidate having taken the first prize in any subject cannot again take a prize in that subject, nor can a candidate take a prize of the same grade twice in any subject.

The Elementary Examinations, held by the District Unions and Local Boards, for which papers are furnished by the Society, are fixed for the 10th, 11th, and 12th March.

Full details in reference to the Examinations are given in the Programme, copies of which should be applied for to the Secretary of the Society of Arts, by all intending to come forward as candidates, or otherwise interested in the Examinations.

TECHNOLOGICAL EXAMINATIONS.

The subjects in which examinations were held this year, namely, Cotton Manufacture, Paper Manufacture, Silk Manufacture, Steel Manufacture, and Carriage-building, will be retained in the Examinations of next year, with the addition of Cloth Manufacture, Glass-making, Pottery and Porcelain, and the Manufacture of Gas.

The Programme is in preparation, and will be published as soon as possible.

In addition to subscriptions already announced, the Council have to acknowledge the following contributions to the Prize Fund :—

The Worshipful Company of Clothworkers	£105 0 0
G. N. Hooper, Esq.	10 10 0

Also as a special contribution to a Prize Fund for the Examination in Carriage-building.

G. N. Hooper, Esq.	£10 10 0

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The fourth lecture of the third course of Cantor Lectures for the Session, "On Wines; their Production, Treatment, and Use," was delivered by J. L. W. Thudichum, Esq., M.D., on Monday evening, May 12th, 1873, as follows :—

Lecture IV.

White varieties of wine produced in the Alto Douro. Transport of the wines from the vineyards to Oporto. Treatment in the lodges of the holders and shippers at Oporto. Unbrandied and dry natural Alto Douro wines. Causes of the use of brandy and jeropiga ; neglect of scientific guidance here also, but the processes being more simple the variety of results not so great as at Jerez. Change in the port-wine drinking public in England. Description of other Portuguese vineyards. The Bairrada ; Termo of Lisbon ; Valley of the Tagus ; Bucellas ; Fable of the transplanted Rhenish grape ; Collares ; Torres Vedras. General remarks on the nature and difficulties of Portuguese viticulture and vinification, all based upon personal observations of the lecturer.

Many thousand pipes of white wine are annually made in the Alto Douro, and exported mainly to Russia and Ireland—very little goes to England. These wines are not distinguished either by the grapes from which they are made, or by the qualities which they obtain in the course of their development. I have repeatedly pointed out how all the great qualities of Jerez wines are dependent upon a few dominant species of vines, how sweet wines are derived from the Pedro Jimenez ; high-flavoured amontillados and finos, from palomino; oloroso qualities from mantuo castellano ; how Rota wines owe their important characteristics to one vine, the tintilla. In a similar manner we shall see in future lectures how the wines of Burgundy come from one kind of grape, that of the pineau ; and Rhine-wine is characterised by the Riesling. The Alto Douro white wines are not thus characterised ; they are not produced from any dominant vine, or vines, but are the product of the commixture of a great variety of fruit from frequently heterogeneous varieties of vines, amongst them the arinto, boal, verdelho, codega, malvasia fina, estreito, or rabo de ovelha, carnal, Donna Branca, gouveio estimado, moscatel. Of these the rich bearers, yielding coarse musts, termed castas grossas, are most favoured by the growers, and the result appears in the wines. The white grapes are not grown in the best situation, but only in second and third-rate vineyards. The Alto Douro wine districts, as a whole, may be considered as consisting of hills only, without any valley-bottoms between them; the declivities of the hills, all supported by numerous terraces, as described, may be conveniently divided into three zones. The lowest zones, nearest to the river and its tributaries, produce the first class of red wines; the second zones, occupying the middle of the slopes, produce the second-class; and the upper zones, situated near the top of the hill, or covering the tops of the lower hills, are mainly planted with white vines. These latter are also planted on the lower zones of the higher lying valleys away from the Douro. The white grapes are, like the red ones, fermented with the husks and stalks, and in this particular the vinification differs from that of most other wine countries; for in these, white musts are generally pressed out of husks and stalks before fermentation. In consequence of this practice the Alto Douro white wines acquire an astringency frequently amounting to harshness. This may make them more firm and less liable to spoil, but it greatly prolongs the time necessary for their maturation. They are also arrested in their fermentation by the addition of brandy, and, not being so sweet or so fully ripe as the red musts, require more frequent admixture of artificial saccharine ingredients, such as arobe, jeropiga, or sugar. In consequence of this they acquire no very high vinous character, even when kept long in bottle. On the contrary, they frequently develop in bottle a heavy disagreeable odour, termed bottle-stink, which can only partially be removed before the wine is placed on the table by decanting the wine and ventilating it, so that the air may influence the wine, and dispel or oxidise the bad smell. This is also a fault of many of the red ports, which they acquire by being bottled at improper periods and while in an improper condition; the cleaner the wines are when bottled the less they develope of this bottle-stink, and perfect Alto Douro wines have not, and ought not to have, any of it.

Transport of Alto Douro Wines.

Many of the vineyards are so situated that no animal can be led to them, and their produce has therefore to be carried to the lagares on the backs of men. Many of the lagares, again, cannot be reached with vehicles, and the wines made on them have therefore to be transported downhill on the backs of animals; and as it would be impossible to use casks for that purpose, the wines are carried in bags made of the skins of animals. These wine skins are called "odres," and I have here such a skin from the Alto Douro. It is made from a goat-skin, and is taken from the dead animal in such a manner as to injure it in the least possible degree. The hair is only shortened, not removed, and the hairy side is turned inwards. This is done in order to leave the epidermis or scarf-skin intact on the surface of the thick, strong, leathery skin; for this scarf-skin is very impenetrable to moisture, whereas mere leather would be very penetrable. The skin is made more impenetrable and imputrescible by being covered over the entire inside with semifluid pitch, or wood tar. I have seen thousands of these bags in use in the Alto Douro. Some merchants in this country seem to think that these odres are a matter which must be kept a secret from the lovers of port wine; and it happened to me, at a meeting of the Committee on Wines, of the International Exhibition, in Kensington, that, when speaking about these odres, I was flatly contradicted by a port wine merchant, and told that there was no such thing used in Alto Douro. And yet I had, but a month before, seen strings of horses, mules, and donkeys, each carrying two of these odres full of wine, in the establishment of the partner of this very wine-merchant who so vehemently contradicted me, and had seen the wine from the odres poured into the tonels of the partner, whence no doubt it found its way to Oporto in due course. The odres are also used in Spain, as is popularly known from the romance of "Don Quixote," by Cervantes. And if, during vintage time, you travel in Italy, Spain, or Portugal, you frequently see a number of these skins, mostly distended with air, hanging up, either to be prepared for use, or to be washed after use. I am not aware that wine is nowadays anywhere preserved in them. They frequently impart a pitchy taste to the wine, which is never got rid of; when made from the skin of he goats, they also communicate the goat-flavour. In Spain odres are frequently made from pig-skins.

When the wine is collected in the tonels in the adegas attached to the farms, it is is ready for the travellers of the mercantile houses, who now taste, select, and buy. The wine is left in the adegas, until, in winter time, the water in the river Douro is high enough to admit of loaded barges travelling to Oporto. The wine-merchants from Oporto then send up their wine-casks, some filled with brandy (I have seen many casks of Berlin shape, with Berlin brands in the adegas of the Alto Douro, and therefore believe that much Berlin spirit is put into port-wine), the brandy and wine are mixed, put into the casks, returned to the river, and shipped to Oporto. The manner in which the wine-casks, all of the size called pipes, holding 116 gallons, are brought down the hills to the river, is very remarkable. They are brought on strong carts, each laden with one pipe only at a time, and drawn by two oxen. The carts are of the rudest but most solid construction, and the oxen are of the finest breed, large and very powerful. The labour which these oxen perform in bringing such a pipe of wine down the stony, rocky, horrible mountain roads, is really a most astonishing performance of muscular work. The wheels of the carts are fixed to the axle-tree on which the top of the cart rides by two forks. This arrangement causes much friction, by which a creaking noise is produced, which can be heard at great distances, particularly at night. The more noise an axle-tree makes the higher it is valued, and the peasants vie with each other for the possession of the cart which makes the greatest noise.

At last the wine in the pipes arrives at the river-side, and is shipped in boats to Oporto. The manner in which these boats are loaded and steered is well represented on the map of Forrester. Arrived in Oporto, it is carted to the sheds called lodges, and then laid up. The treatment which it receives there mainly consists in the addition of brandy from time to time; the brandy is kept as low as possible, in order not to increase the expense more than is necessary. The last and principal dosing with brandy is only inflicted just before the wine is shipped. If the wine is not sweet enough, a quantity of jeropiga is added; this, when legitimate, consists of sweet must preserved by the addition of one-fifth of its volume of brandy of 40° Cartier, and therefore corresponds to the Jerez dulce. If in bad years, or from any other cause, the colour of the wine is not so deep as may be wished, some deep-coloured wine is added; and some elderberry may be used now and then, but, as already stated, this is not frequently used in making up Alto Douro wine. Those wines which are not mixed with anything except brandy, not even with other wines of similar quality, but of different origin, are called vintage wines, and are kept by themselves. Their date is preserved, and they are made much of by the merchants. Those wines which are not kept by themselves, but are mixed with other qualities, the product of different zones and different years, are termed factory-ports, and constitute the great mass of the wines exported.

CHANGE IN THE TASTE OF THE PUBLIC AS REGARDS PORT.

Much has been written and said regarding the injurious character of strongly-brandied port wine, and in consequence the more polite classes of society have almost entirely turned from port wine, and do not drink it any longer. I have been present at dinners to which ten or twelve gentlemen sat down, and not one took port when it was brought round. An Oporto merchant in London gave a dinner party to twenty gentlemen, and not one of these was found to drink even a single glass of the merchant's own best vintage wine. If this antipathy should continue, it might, perhaps, aid in the reduction of the brandy in port wine to below *delirium-tremens* point. (This disease is common among spirit drinkers, and those who consume much strong port; it cannot be produced by drinking natural wines with less than 26 degrees of proof spirit, even in large quantity.) I have no doubt that when the objection, namely, excess of brandy, shall have vanished, many oenophilists and persons of good taste will return to port, the natural, full-flavoured, fine-coloured, invigorating, and wholesome wine, which, as regards bouquet, body, vigour, and lasting qualities, and as regards its wonderfully exhilarating effect upon body and mind, is not surpassed by the red wines of any other land. But, it must be observed that, although some classes in England have ceased drinking port, others have taken to it, and in consequence the trade in port wine has not at all diminished, but has rather increased. The fact is, the port which was formerly generally bought by gentlemen, clergymen, noblemen, &c., and laid down in their cellars to mature for years, is now mainly bought by publicans, tapped, and sold in glasses at 4d. each. This is the case, not only in this country, but in America, and even in Newfoundland. The fishermen there, a great proportion of whose fish is consumed in Portugal, in return get a quantity of this port wine, and ease the difficulties of their climate and situation by enjoying this most delicious drink.

The price of port wine in the district varies between 14 and 15 milreis per pipe of 636 litres. In Oporto, £15 to £20 is an average price of good factory port. Fine wines and old wines rise to £80 per pipe.

THE WINE COUNTRY OF THE BAIRRADA.

This is a very new wine country, but probably in the course of time it will develope into something of importance. The Bairrada lies between Oporto and Lisbon, rather to the south of Coimbra. The Portuguese Railway runs through the middle of it. The wine grown in the middle of the district, which includes both red and white varieties, is called *vinho de embarque*, or that which may be exported, whilst that grown in the outer belt, and its prolongation towards the north and the south, which is not fit for exportation, but is used in the country, or distilled for brandy, is called *consumo*. The soil there is chalky, of the so called lias formation. The wines of that country are frequently taken to Oporto, and there made up into common class port-wines by a small admixture of Alto Douro wine. They are brought to London mainly for the purpose of being re-exported to the colonies, and many butts of them go to Russia and to America. The wines are peculiar in this, that though dark coloured when young, they quickly lose their colour, and in four or five years, if not assisted by other means, they get so pale as to resemble old port. But they also lose their quality, and therefore they cannot be advantageously reared and kept by themselves. That arises again from the want of consideration for the principle which I have stated; and because there is in the Bairrada no dominant grape, but the peasants who grow these vines mix up every sort of grape they can lay hold of, and the consequence is a want of character and firmness in the product. The grape mainly grown there is the baga, which means berry. It is a small-berried, dark-coloured grape. There is also grown a little of the souzao and a little of the bastardo, which gives some flavour, but there are no coloured grapes like the mourisco or tinta, or tinta Francisca. There is also a white wine, made, as in the Alto Douro, from the boal and ten others; and the jeropiga, or sweet juice made by mixing spirit with sweet must, is largely produced, and further abafado, or must stopped in the middle of its fermentation by spirit, &c. Must is sometimes boiled down, and to the syrup is added brandy. Then there is also made arobe, which is the juice of the grape itself boiled down to a thick syrup, either alone or in company with a quantity of quinces, apples, and other fruit. I quote from the Government report of Portugal, where it is stated the arobe can be of two kinds, viz., simple and compound. The first is the concentrated must produced by the action of heat; the second, or compound arobe is made with sugar and quinces, apples, and other fruits. I have been very careful to lay before you accurate information, to eliminate that which is erroneous, and to know and state only that which is true, and it is for this reason I have quoted this passage from the Report of the Government of Portugal. Now these practices are not at all done with the purpose of imposing upon the customer. They are the results of dire necessities and difficulties in the vinification, such as it would really require the highest skill and science to obviate; and if you consider the poor peasant, who has no means and no scientific guidance, but simply the help of a copper and a little brandy, you may probably look upon these practices with a very different eye to what you would if you looked upon them simply as malpractices, adopted for the purpose of cheating the consumer.

THE VINEYARDS AROUND AND NEAR LISBON.

There is a quantity of wine grown round Lisbon. It is called "termo," from being grown within the bounds of Lisbon, but there is not much of it, and it does not constitute an article of commerce, and therefore need not further detain our attention. Along the Tagus, south-west from Lisbon, there is that beautiful village Carcavellos, which once had a very flourishing production of from 1,300 to 1,500 pipes a year, and still enjoys a reputation, though the production is now entirely destroyed. It was one of the first fields invaded by the oidium, and when I was there two years ago, I believe the whole production did not amount to five pipes, for most of the vineyards have died out. I have here a specimen of Carcavellos wine, which illustrates very well some of the difficulties of Portuguese vinification. It comes from a farmer in Carcavellos, who had a very nice place, but his wine was thick and turbid, viscid, and sulphury, and had the mouse-taste; and yet the material from which that wine had been made was of the finest description; and if it could be properly treated it would be really a very high-class wine, and fully justify the reputation which Carcavellos enjoyed in the past.

VINEYARDS OF COLLARES.

Going along the shore of the Tagus, and turning northwards round the mountain of Cintra, we come to the celebrated vineyards of Collares. They can also be reached by coming down the valley from Cintra, and perhaps that is the most agreeable way of getting there. The vineyards of Jerez, as I have told you, are situated on undulating hills of chalk. Those of the Alto Douro are rocky, but those of Collares are situated on sand, thrown up by the billows of the Atlantic. Owing to the shifting nature of this land, the peasant proprietor is obliged to adopt some device to keep his vineyards and his wine too. The vineyard is divided into a number of small parcels, of the size of an ordinary sitting-room, each of which is surrounded by a hedge of green reeds or cañas. The doors which lead from one to the other are also formed of these living reeds, so that when you pass from one department to another you bend the reeds asunder with the hands, and walk through, and the door closes of itself behind you. In spite of this precaution, when after a windy night the owner of the vineyard comes to look at his vineyard, he often finds his vines covered up with sand, and he is obliged to dig them out. But this apparently barren and unpropitious soil yields a very excellent product. The soil is constantly moist, the heat of the sun strikes it all day long, and the vines lie on the ground, in immediate proximity to pure sand. The result is the excellent wine of Collares. Here is some of the red wine made from a grape called the "ramisco," and from that only. The qualities of this wine are based upon one dominant vine, and it is for that reason I have such great confidence in the wine. It is because of that that it quickly matures, is uniform, greatly improves in bottle, and will keep, although its alcoholity is one of the lowest, being only between 8 and 10 per cent. It is a very firm wine also, as it requires no spirit to be added to it. It is a wine very little known in this country. It has a flavour of its own which cannot be compared with any other, derived entirely from the ramisco grape. It is a most agreeable and wholesome wine. About 1,500 pipes are made in the district.

The Vineyard of Bucellas.

Passing from Collares to Cintra, and thence inland, we come round to the vineyard of Bucellas. It is said that the Bucellas wine is made from the hock grape, alleged to have been transplanted there by the Marquis of Pombal. All over Portugal the Marquis of Pombal is remembered as a viticulturist, and a man who took great interest in the promotion of viticulture and wine making. I have gone through pretty well all the vineyards there, and have asked many experienced persons, but have not been able to find any hock grapes there whatever. The only grape grown there, from which the genuine Bucellas is made, is the Arinto. At first sight the Arinto has a little similarity to the Hock grape, as it is a small-berried grape, but it is dissimilar in other respects, particularly by its possessing a large bunch. It reminds me of the grapes on the south slopes of the Alps, and has nowhere the small size of the grapes indigenous to the Rhenish countries. Its wine somewhat resembles hock in preserving a little sweetness in good years, and, on the other hand, in being excessively sour in bad years. I have here various kinds of Bucellas wine, which I shall ask you to taste. Here, for example, is a specimen which I consider to be spoilt, as, though originally a fine wine, it has been mixed with boiled wine. In consequence of that it has a peculiar murkiness and false fluorescence, which does not go away for some years. It always tastes of having been boiled. That is an imperfect Bucellas, and yet many speculators at Lisbon prepare it, as they suppose, for the English taste. I do not believe myself it is the English taste, for it is rather like a bad imitation of bad sherry. This second specimen is a very beautiful wine, which I have had two years in bottle. I decanted it, and there were three tablespoonfuls of deposit left behind, showing that the wine was bottled a great deal too early. This is second-class Bucellas. But here I have now a perfect specimen of 1870 wine, which you see is brilliant. You will be able to appreciate the fine qualities, high flavour, and refreshing, acidulous wholesome nature of that wine, and you will agree with me that the reputation which the vineyard has acquired in the past was well deserved. Here is a specimen of wine sold in Lisbon, and here is a specimen which will show you how wine may be ruined by being mixed with boiled wine. You see a thick, brown crust deposited on one side of the bottle. That is caused by the wine having been mixed with boiled wine. The addition of arrobe, of whatever kind, whether compound or simple, of brandy and colouring matter, is hurtful to its quality; therefore, with those practices, I should make no compromise whatever. I should put them aside entirely, and I should say:—"You Portuguese have intellectual men in your country; you have a government commission, consisting of excellent botanists, clever mechanicians, accomplished chemists, and other men of science; they give you these excellent reports, full of information and good advice; follow their advice, and you will produce excellent wines, which all the world will be very glad to buy; if, however, you go on making these compounds, depend upon it the whole of your trade in white wine will go to ruin."

Wines of Torres Vedras.

This is a celebrated name in the history of the British army. A good many thousand pipes of wine are grown there, but owing to the disregard of the principles I have mentioned, and owing to the fact of the wine being made from mixed grapes, it acquires no particular quality, and though apparently good to drink in the first year or two, in the third year it falls off a little and loses its quality, although it does not spoil. Of the many names for which Portugal had a reputation in the vitilogical world, there remains yet to be mentioned Lavradio, which lies on the Tagus, nearly opposite Lisbon, and produces a mild though somewhat sweetish, but to some people very agreeable wine. It requires very careful keeping for several years, but afterwards acquires all the fine properties of the natural and finer Alto Douro wines. I have no doubt that if it were more scientifically treated, and if there was more of it, the Lavradio would soon acquire a high reputation.

General Features of Portuguese Wine Making.

In the Alto Douro, as well as in the Bairrada, and everywhere else in Portugal, all the wine is made in the lagars, peculiar troughs, made of stone mostly, but sometimes of wood, in which the wines ferment. They are very large, about six yards square, and, though in good years that entails no disadvantage, in years where the heat of the season is excessive, or where the harvest is interrupted by rains, the lagar system entails every disadvantage which injuriously affects the wine. Sometimes the lagar is partly filled, a quantity of grapes being heaped in one corner; then rainy weather comes, and the grapes are allowed to lie in the corner for a week; then, perhaps, the vintage is continued, and new grapes—perhaps more rotten than the first—are thrown in, and the lagar is filled up. During that time, if the grapes were ripe, a partial fermentation would set in. If the mass were heated, a portion would ferment, and the air having access, it would produce a process of decomposition. Then when the wine is made it has to be sulphured, not only for the purpose of preventing the acetification, which has begun already under these unfavourable circumstances, but to destroy those fungi which in every Portuguese white wine declare themselves almost from the moment it is made. The wines when made are not put into cellars, but are all kept above ground, in large casks or tonels, and these are never full. In a good year they may be three parts full, whereas in a bad year they may be only one-third or a quarter full, and there is always a greater or a smaller surface of wine exposed to the air. Then if in these sheds the temperature rises very high, the surface being covered by mould, a quick acetification takes place. At Bucellas, I was in the shed of a poor woman, whose only property consisted of a vineyard, and of a shed and tonel of wine, worth, perhaps, £60. She had not tasted it for a long time, and when I tasted it I told her it was vinegar. I shall never forget the face of the poor woman when she tasted her wine, and she said, "Yes, it is vinegar." So throughout the place, owing to the absence of underground cellars, where the wine can be kept away from the excessive heat in the summer, and owing to the omission of proper precautions in the making of the wine—owing, further, to the poverty of the people, who can only afford to buy one great vessel in which they keep their wine, being unable to buy new casks of a smaller size, which they could fill to the bung, and thereby prevent the air getting at the wine when hot and in a dangerous state—owing to these disadvantages, and to the peculiar climate, there are produced masses of fungi in all Portuguese wines, just as there are in the Jerez wines. These are called nube, and when these small microscopic fungi, visible only by the microscope magnifying 600 diameters, grow more numerous, the wine becomes at last thick and viscous, and is called "gordo." Then the wine acquires this horrid mouse taste, which is the destroyer of many of the most beautiful Jerez wines. The finest Jerez wines are liable to have this horrible mouse taste, and the merchants will tell you that if wine gets a mouse taste, it will become a good wine; but that is rather a paradoxical assertion. Out of 100 butts of wine having mouse taste, perhaps about 10 good ones are obtained, but a vast quantity never recover, and these the extractors send to the still. Here is a specimen of Carcavellos with the mouse taste, such as it is in perfection, so that any one who likes to acquaint himself with it may do so. It is filled with those nube. Here is a specimen of Torres Novas wine, which has the general appearance of all white Portuguese wines a few weeks after the vintage. When I was at Bucellas I saw in the cellars of the Marquis of Freixial twenty large tonels full of this thick, horrid tasting, sulphury, abominable liquid, which nobody could ever guess would in the course of a year or two transform itself into potable wine. When the wine merchant gets this wine he treats it according to his science, but in order to show you that it need not be wholly lost, I will show you some wine here, purified by chemical means. It is simply a process for taking out the dirt, bad colour, and fungi, and there is the result; so that you can see that although it is very unpromising at first, by means of a little chemical operation a perfectly nice clean-tasting fluid is produced, and all the mouse taste is gone.

The power of these fungi is so great that in some Portuguese vintages not only a portion of the must is concentrated to increase the sweetness, but the producer is actually obliged to put the whole of his must into the copper, and give it a boiling up, in order to kill the fungi. He does, in fact, on a large scale with his must that which M. Pasteur at Paris has proposed as a general principle for the purpose of preserving wines, namely, heat the wine so as to kill the spores, and thereby set up a healthy fermentation, whereas otherwise there would have been a diseased fermentation, and consequently a very bad product.

Now let us for a moment consider the result of the life of these fungi. Plants, as you know, live on carbonic acid water and ammonia and salts, and fungi are no exception to that rule. It is frequently said that fungi do absorb compound materials—that they are not dependent upon the carbonic acid in the atmosphere, as other plants, but that they do, as it were, like animals, devour compound food. That may be the case with regard to some which live in the air, but those which live in fluid do not do so, for I can show you that when the carbonic acid is withdrawn by other means than heat the fungi cease to live, sink to the bottom, and are inert: that is to say, they are killed or suffocated, and do not live much longer, and consequently it is proved that the nube fungi require for their existence the presence of carbonic acid. And it is for this reason evidently that they are present in the largest quantities in the youngest wine. The younger the wine the more nube, and the older the wine the less carbonic acid it produces and the quicker the nube goes down. Every Jerez merchant will tell you that any wine which succeeds at all cures itself. It requires no particular process for getting rid of the smell. The flor also cures itself, provided the wine has at least 29 degrees of proof spirit. This flor is a fungus on the top of the wine, which requires a large quantity of carbonic acid in order to live. Remove the carbonic acid, and what takes place? The fungus dies. That has not been understood, but the practice has been based strictly on that plan. Every wine merchant who knows anything about oenology will tell you that if the wine containing this nube be strongly shaken, the fungi condense, and sinks to the bottom. The portion of the carbonic acid escapes attention; however, if the wine, after shaking, be analysed, it is found that a large quantity of carbonic acid has been evolved. If you take that wine, and put it under an air-pump, and exhaust the carbonic acid from it, and allow no air to get to it, and then put the cork in, the wine will, in a very short time, be clear, and you may decant it clear, sound, and healthy from the deposit. I might go on and tell you a variety of observations which I have made, and which, no doubt, in the course of time, will, together with the communications of the highest importance offered by M. Pasteur, make the producer of wine independent of brandy. And what will take place then will be simply this, that those who like brandy can buy brandy in one bottle and wine in another bottle, and mix them, whilst those who do not like hot wine can drink normal wine without brandy. I shall now conclude what I have to say on Portuguese viticulture. The land in itself, poor, yet climatically highly endowed, is capable of producing a variety of the most beautiful grapes, and a variety of wines, which, if properly made, would not be surpassed by those of any other country. The people are good-natured, industrious, and hard-working, and they have what is very agreeable to a person who comes from this country, a great regard for an Englishman. If these good people would continue to plant their vineyards with particular sorts of grapes, such as have been proved in the great Alto Douro districts, in Bucellas, or Collares, to be so excellent; if they were to abandon that horrible practice of making sweet and cooked wines; if they were to study a little the conditions by means of which they might avoid the natural climatic difficulties which produce fungi and acidity, if they introduced a little more cleanliness into their sheds, and if they were to have their cellars underground, if they were to avoid these large tonels and adopt small casks, I have no doubt Portugal, one of the most essential English vineyards, would produce other wines besides port, which would be of the greatest use hygienically and socially to this country. We have a great trade with Portugal in other respects, taking there our manufactures, and bringing away in return large quantities of produce, cattle, grapes, figs, apples, and a variety of other articles too numerous to mention; and I have no doubt an improved quality of wine would find in this country a very ready and grateful market.

Note.—It has been stated in the *Food Journal*, that there is a peculiar affection of the wines of the Alto Douro, called the *agredoce*, or sweet-sour; and the Viscount De Villa Maior, in his work on wines, enumerates the vinagre disease; the amargo, or bitterness; the *gordura* (which, according to my opinion, is only a continuation of the *nube* disease); and then he gives, fifthly, the *agredoce*, which, he states, is a form of disease different from the first four, which spoils port wine. I do not think, from my inquiries, that the *agredoce* is a particular disease. I believe it is nothing but a transformation of a part of the alcohol into vinegar, in such port wine only as contains from two to three per cent. of sugar which was not previously fermented; thus a wine is obtained which tastes on the one side of vinegar and on the other side of sugar, in fact, a compound which, if it was a little sweeter, one might very well drink as people do raspberry vinegar. I have no doubt that is a parallel to it. It is not at all like the bitterness of Burgundy wines, which arises from a totally different cause. I therefore believe that the *agredoce* is a matter of no great consequence as affecting port wine; but we shall see in the next lecture that there are other influences of nature such as the *phylloxera*, that insect which now destroys millions of hectares of wine in the south of France, and the oidium which has destroyed the Carcavellos vineyards, and which is about to destroy those of Bucellas, as it has destroyed to a great extent those of Madeira. These are actual enemies, which destroy many vines in the ground, as nube and other fungi destroy the wine produced. When we come to consider the Gironde, we shall find there a particular pestilence which destroys the vines by thousands—a kind of tumour all over the bark. Here I have a specimen, which will illustrate the peculiar nature of that disorder which affects the vine stock.

We have thus made a complete survey of the vines and vineyards of Spain and Portugal, and in the next lecture we will pass on to a consideration of French wines, and you will then see what an agreeable and remarkably interesting contrast there is between the processes by which the wines are grown and made in the Peninsula, and the more inland countries of France and Germany.

EXHIBITIONS.

PARIS ORIENTAL EXHIBITION.

This exhibition, arranged by the Council of the Oriental Congress, is now open in the place of universal exhibitions, the Palais de l'Industrie, in the Champs Elysées. It is called Oriental, after the name given to the Congress itself; but it consists mainly of Chinese and Japanese productions, particularly the latter. It occupies the great central room, which used to form the *salle d'honneur* of the picture exhibitions, when, during the empire, the official works, with a few of the largest and best pictures, were collected here, and four other rooms of considerable dimensions.

The collection is very remarkable, consisting of selections from the rich stores of M. Cernuschi, and of contributions by Baron Meritens, M. Achille Chevrillon, and others, including several ladies; and it has this great recommendation, that instead of large masses of China and other articles, nearly the whole of the objects are choice specimens, and some probably unique.

The bronzes form the largest, and perhaps the most remarkable group. In the first place must be mentioned the great figure of Buddha, 20 feet high, and nine feet square at the base, from the temple at Mégouro; several large bronze lanterns, used outside the temples, great perfume burners, bells and other temple furniture, which, considering their size and elaborate forms, are marvellously fine examples of bronze castings. The smaller bronzes of the same character, such as sacrificial vessels, perfume burners, bells with prominent bosses cast upon them, which are played upon by means of a small wooden mallet covered with leather, small lamps in elegant carved wood frames, are all unsurpassed for the colour of the metal, the thinness and the perfection of the casting; there are, amongst other things, some bell-shaped lanterns for covering lights, which for delicacy in bronze work are as remarkable in their way as the famous egg-shell china; one or two of these, measuring perhaps fifteen inches in height, and pierced in ornamental patterns all over, seem little heavier than if made of wood, some, indeed, are so elaborately pierced that they look more like nets than metal work, and being lined with semi-transparent material, must have a very pleasing effect when lighted up.

An *ex voto* tablet, brought from a Japanese temple, is curious, with a large coiled snake in bronze and several smaller votive offerings attached to its surface; and there are several figures of gods and sacred personages of considerable size and great beauty as castings. The collection of vases is perhaps the finest ever brought together in Europe, and there are a number of *chauffrettes*, covered braziers for warming the hands, which are the perfection of decorative bronze work.

The chimeras form a remarkable class of bronzes. Amongst them is the Chinese kerin, with the "head of a unicorn, the body of a horse, and the feet of the stag," the unicorn itself, the tortoise with dog's head and flowing tail, somewhat resembling that of the cock, only laid flat. The chimeras at the exhibition are some of the finest possible examples of dark green bronze.

Trotting about amidst these grotesque brazen beasts is a beautiful little Japanese dog, like a King Charles spaniel, but with a little pug nose, which may well have been the original type of the caricature muzzle of these chimeras; it was a happy idea to introduce this elegant little creature amongst the fabulous animals in bronze. It is a curious fact, that while the Japanese reproduce leaves and flowers with the greatest fidelity, all their figures of animals are conventional and inartistic; there is no study of the muscles or bones—nothing but an approximate and most rude approach to the general proportions of the form, and a fair imitation of the ordinary attitude of the animal.

The second room is principally devoted to the smaller bronzes, chiefly objects of ornament or of general use, casts of animals, &c.; this is a very fine collection, many of the examples being of the highest character. There is a series of bronze bottles, as pure in outline as if they were cast in the period of the best Greek art, and a collection of exquisite table ornaments. Amongst other objects are two pairs of heavy bronze stirrups, beautifully inlaid with silver, and a number of beautifully pierced perfume burners and other objects of like character. The "sonorous plate" is a variety of the gong, a plate of fine bronze, with thickened and curved edges, suspended by silken cords, and struck with a very small covered stick, a gong for the use of sensitive people.

In this room is also a very good collection of illustrated Japanese and Chinese books, many of them comic in the highest degree.

There are also a few curiosities from Mongolia, including two "Sama's" head-dresses, one of which is in the exact form of a Glengarry cap, and is surrounded with something much like a small door-mat, arranged after the fashion of the horsehair crest of the Life Guards; the whole is of the colour of tow, and is a most grotesque object.

The third room contains some fine photographs of Indian notabilities; a series of fruits, full-size, whole and dissected, by a Javanese artist, admirably executed; a most extraordinary work in silk, representing the infernal regions after the Japanese idea, brought from the house of the late Tycoon at Ovens, destroyed a few years since; a few admirable specimens of the famous Satsuma faïence; a series of curious portraits of Buddhist ascetics and hermits; a collection of fine wood carvings; two cloissoné enamel jars, at least five feet in height, mounted on bold carved wood stands; a small collection of Canton furniture, massive carved wood chairs, with marble and alabaster seats and backs, cabinets, &c.; two superior Japanese screens, of many leaves each, with scenes in a royal palace and in the streets, admirably painted on a rich, solid gold ground, perfect in their way; a fine specimen of silk tapestry, the subject being a celebrated physician, who is receiving his patients under the trees in a garden; and a very choice collection of embroidered and other garments and fabrics. In this room is also a good collection of photographs, of Java and other scenes, temples, and personages.

In another room are two small aquariums, containing one, a specimen of the curious telescope fish of Japan, so called from the creature's eyes being mounted as it were on short tubes projecting from each side of the head; but this is not the only peculiarity of the fish. It is about four inches long, deep, and very chubby in the body, of an intense gold colour, with black fins, and with a double or divided tail, the parts of which are set at angles, forming a V reversed (Λ) when seen from behind. The other vessel contains specimens of the macropodes of China; these fish have all been bred in Paris and the latter are of the fourth generation.

Natural history is further represented by a collection of the Tussah yama maï and other silk worms, which feed on the oak, ailanthus, castor oil plant, &c., some of them alike; together with specimens of silk, yarns, and fabrics, contributed by the well-known naturalist, M. Guerin Méneville, and others, and showing the progress that has been made of late in spinning and dyeing these silks.

The collection of articles from India is insignificant as compared with those to which we are accustomed at home; but there are some beautiful specimens of fabrics, inlaid work, &c. There is, however, one set of Indian products which certainly should not have been admitted in an Oriental Exhibition, namely, tables, chairs, &c., of European design, executed in India, and honeycombed with carving and piercing. These horrible productions have too often offended the eyes of the admirer of Oriental art, and are here most specially out of place.

In 1867, a quantity of this decorated furniture was sent for exhibition in Paris, but was very properly placed entirely out of sight.

To conclude, the exhibition is completed by three cases of articles of the greatest beauty and rarity, lent by various private persons, and almost exclusively of Japanese origin. Here are small specimens of the most famous ceramic wares, red and other laquered articles, of the finest finish; jade, rock crystal, and other carvings, and other examples of the highest Japanese decorative art.

The Oriental Exhibition will remain open for some time, so that those who are devoted to, or only admire, the marvellous ingenuity of the art-workman of the Far East will have ample opportunities of visiting it, and will find an autumal day none too long for a careful examination of the collection.

Vienna Exhibition.—According to a Swiss paper, the diplomas obtained at the Exhibition bear the following proportion to the population of the several countries:—Switzerland, one per 108,000 inhabitants; Belgium, one per 250,000; Germany, one per 410,000; Austra-Hungary, one per 433,000; France, one per 462,000; Holland, one per 650,000; Sweden and Norway, one per 655,000; Denmark, one per 900,000; Great Britain, one per 1,222,000; Italy, one per 1,405,000; Russia (in Europe) one per 3,550,000.

In Buenos Ayres it is stated that 2,910 houses, or one-tenth the total number of the houses in the city, enjoy the water supply.

The new buildings of Owens College, Manchester, of which Mr. Waterhouse is the architect, will be opened during the next month.

Among the latest projects broached in America is that of taking oil in pipes from the petroleum regions to the sea-board.

The Commission of Enquiry on the proposed tunnel between Dover and Calais will be opened immediately, the necessary order having been sent by the French Governtent to the Prefect of the Department of Pas de Calais.

A system of tramways is to be constructed at Versailles. The network is principally intended to unite the stations of the Western of France at Versailles with the palace of the National Assembly and the Trianon.

The Glasgow Sewage Committee have reported to the Town Council that, after all their experiments, they cannot recommend any plan for the purification of the Clyde, so they suggest that a Royal Commission should be applied for in order to obtain the evidence of some eminent authorities.

HINTS TO COLONISTS ON THE CULTIVATION OF SILK.

By B. Francis Cobb.

(Continued from page 824).

In commencing a mulberry plantation it is imperative that the land should be well broken up and aerated, and that roots and stubble should be get rid of.

In virgin soils especially there are always a great many germs of different plants, and for the first year the land must be kept clean, so as to give the young mulberry cuttings every advantage. After the first year they can take care of themselves, and kill down most other things that grow about them. Wherever the "bush" grows thick, there is a certainty of the mulberry tree doing well, and a little extra labour in the beginning, in clearing, grubbing up roots, and preparing the land for the plough, is well spent, and will repay the labourer.

In cases where the mulberry is to be utilised for other purposes, as well as to yield leaves, such as to protect young coffee or cotton from strong winds, the mode of planting out must accommodate itself to the purposes for which it is required; but where a plantation is to be made, the land should be well ploughed first, and then furrows ploughed the length of the field, if possible, in the same direction as the prevailing winds blow. In countries where north-east and south-west monsoons blow for six months each way, of course the lines should be north-east and south-west; but, in other places, colonists must form their own opinions of the most prevalent winds. The object of this is to allow the air to permeate among all the trees, and in tropical or semi-tropical climates this is of great advantage, for where it is not so, the upper surface of the mulberry leaf has a tendency to acquire a horny consistency, which renders it unfit for food for the worms. On the slopes of hills it is a matter of lesser moment; but even there it is desirable.

The soil and locality must guide the planter to a great extent as to the number of trees he plants in an acre, but the two extremes may be taken at 400 and 1,000; in setting out the rows of cuttings what is called the "quincunx arrangement" * * * * * * * * * * * * is a very good one to follow; but in planting trees in rows, plant two or even three at six feet, and the next at twelve feet, the use of the twelve feet being to economise labour in the gathering the leaves, as well as to drive a plough through occasionally, and lighten the soil, besides the advantage, if made in the course of the prevailing winds, of letting the air through.

It should be borne in mind that it is not sufficient that the tree should flourish when left alone, it is placed in the position it occupies in order that it may be subjected to a most trying and severe ordeal, viz., that of having its lungs torn off—an operation which, if continued without respite, would destroy the tree.

There are three methods of propagating the mulberry—by seed, by layers and by cuttings: of these, the last is considered the best; but there are circumstances under which either of the others may be preferable. As regards propagating by seeds and nurseries, one must begin at the beginning and first catch one's seed, and this is not so easy as it at first sight appears. The Cape Government has gone to some considerable expense and trouble in getting seed from France; but our own experience coincides generally with the results of their experiments, and we would advise southern colonies to obtain seed from other southern colonies rather than from Europe, the voyage from colony to colony not having the same effect on seed generally as crossing the line has. It is difficult to say exactly when or how the loss of vitality occurs; but it is a fact that seeds like that of the mulberry appear to lose their power to germinate, and whether the voyage be shortened by a steamer's passage or not, the result seems to be the same. But there are colonies in the south where the mulberry seed is all that can be desired, and the means of sending it from colony to colony are simple. Natal and the Mauritius both send sugar to Australia, and both can supply the seeds of good descriptions of the mulberry tree. One of the simplest methods of preparing the seed is as follows:—

Choose the fruit of those trees which have not been stripped of their leaves that year, or even the year before, if possible. Mulberries, the seed of which is intended to be kept, should be gathered perfectly ripe, which may be known by the fruit beginning to fall from the trees, by its softness, and, if examined closely, by the kernel being completely ripened in the small shell which encloses it. It is a very good plan to shake the tree moderately every day from the time the fruit begins to ripen, until the best of the fruit is gathered.

These mulberries should be spread thinly on a clean table in some airy, cool place, in order that they should attain their full ripeness; they should be turned frequently to prevent fermentation or heating. After treating them thus for three or four days, let them be soaked in water until they break easily in the hand, and thus dissolve, so that the grain is separated from the pulp which mixes with and floats on the water. After being briskly stirred in several waters, the best seed will sink to the bottom, while the pulp remaining will float on the top, and may be poured off. The seed should then be spread on cloths or blotting paper, and dried in a shady, airy place, stirring and turning it frequently to prevent heating, which it has a tendency to do; and if by any accident it should do so, even to a small extent, it may as well be condemned at once, and thus save further disappointment and trouble. When thoroughly dry, it should be put into a moderately tight vessel, and kept in a dry place.

In propagating from seed, it is necessary to prepare a nursery for the young seedling; a rich alluvial soil, where it can be had, or a manured soil well watered, must be got ready for the reception of the seeds.

A method which saves much trouble, and rarely fails where it can be put in practice properly, is this:—Having prepared the nursery and dug a series of little trenches 3 to 6 inches deep, take a piece of old, rotten, untarred rope, or a small hayband, or something of the same rough and soft description, and, having cut it the same length as the trenches, take a handful of the ripe fruit and rub it up and down the old rope until it is smeared pretty equally with the ripe mulberries; now place it in the trench, and, having covered it up, keep it well watered for some days, and continue to do so in a lesser degree until the seedlings make their appearance above ground.

This is rather a lazy method, and, like most lazy habits, has its concomitant evils. The seedlings may come up too thick, and required to be thinned out. If the rope does not rot readily, it causes a difficulty in transplanting the young roots, which will be found entangled in the rope; but, for a colonist, it carries the great inducement of saving labour and time. The carefully dried seed, on the other hand, can be mixed with sand, and by this means the danger of sowing too thickly will be entirely avoided.

Planting by layers is the surest, but at the same time the slowest, of all methods; it may, however, be combined with the others, and where large plantations are to be raised with as great speed as possible, all methods should be used at the same time.

This method of bending a young branch into the ground, and staking it down, is so well known that it scarcely needs here a lengthy description: the objection generally raised against it is, that when the time arrives to sever the connection with the parent tree, it leaves the offspring weak and sickly, until it has recovered sufficient strength to get over the loss of the dependance it has hitherto had upon the parent main-roots, and this causes additional delay, as, until the plant has thrown out a full quantity of roots of its own, it will not bear stripping of its leaves.

The best method, especially for our colonies, is by cuttings. It really seems as if in most colonies the size of the cutting did not matter much, provided it had perfect wood formed, and contained either small branches with buds, or buds upon the cutting itself. The cuttings may be any convenient length, 12 to 20 inches, and should be planted two-thirds in the ground and one-third out. Once planted, it is of the greatest importance that they be watered constantly; indeed, so necessary is this, that when the watering is difficult to attend to, it is advisable to plant the cuttings in a moist, damp soil, and after the roots are developed, remove them with sufficient earth about them to prevent the roots being laid bare, or their position altered; even then it is necessary to water after the transplantation. Winter or before the rainy season sets in is the best time to plant out. In very dry, hot climates probably the system of layers may be better, for the reason that layers do not require so much watering; but local circumstances alter matters of this sort so much that in this, as in many other cases, the planter must be the best judge of what times and methods are the most suitable to his particular locality.

Another method of propagating the mulberry is by transplanting parts of the roots of old trees; but this is a system which colonists in new countries will have little chance of attempting, although a five year old tree will be found to part with a portion of its roots without injury to the tree, and in some cases, where the roots have become very extended from being in poor soil, and manure has been applied about that portion from whence the root was removed, the tree has appeared to be benefited by the operation. In dry, sandy soils the mulberry will send its roots great lengths in search of moisture, to the detriment, frequently, of adjoining shrubs; and so in coffee plantations, where the mulberry has been used as a protector of the young coffee from the prevailing winds, the time will come when the mulberry must be removed, or it will destroy the coffee. A root, if put into good soil, will sometimes send up three or four shoots, which may be allowed to remain for the purpose of obtaining cuttings when they are thinned out.

But a good cutting, which has taken kindly to the place it has been planted in, is generally a stronger and better shrub at two years than a seedling or rootling at three.

The following may be considered as general rules, subject to some modification from the effects of different climates and soils:—

The leaves of a full grown tree contain more silk-producing properties than those of a young one.

The largest sized leaves are from trees two to four years old, and these become smaller as the tree ages. Large leaves are not necessarily the best, they generally contain too large a proportion of water.

Leaves that are spotted or mildewed should be avoided; but where food is scarce, rust-spotted leaves may be given, as the worms will eat round these spots without touching them.

The worst leaves, and those which always injure the worms, are such as have what is called "manna" upon them, or are wet from dew or rain, or have been heated from having been packed in too great quantities, and left too long before being spread out.

Great care should be taken to prevent the leaves heating shortly after being gathered, as fermentation rapidly sets in, and quickly alters the saccharine and other component parts, consequently, leaves should not be allowed to remain long compressed in the baskets or sacks in which they are placed when gathered.

The colder the climate, the less frequently should the leaves be stripped, and care should be taken to leave the young trees sufficient leaves to keep up the circulation.

(*To be continued.*)

SPUN SILK.

The following paper was read by Mr. S. C. Lister, before Section G (Mechanical Science) of the British Association, on Monday, the 22nd inst.:—

The trade of Bradford has hitherto been almost exclusively confined to the manufacture of goods made from combed wool, technically termed "worsted goods." It has long been felt that it would be advantageous to the town if other trades could be introduced, as it is very evident that if the worsted business is not prosperous the whole district must suffer, since those towns which have the greatest variety of manufactures may always hope to have the greatest prosperity and stability, as, whilst one trade may be adversely affected, another may be prosperous, and so act as a counterpoise. It is for this reason amongst others that the recent introduction of spun silk, on a large scale, at Manningham mills, may be considered as highly beneficial to the town. It will also facilitate the combination of silk with worsted, whereby a higher class of goods may be obtained.

Some estimate may be formed of the difficulty with which this attempt is beset by reference to the character of the material when compared with wool, cotton, and flax, the treatment of which by mechanical means has been attended with so many difficulties.

Silk, which, according to the best authority, may be regarded as a gum exuding from the worm, is produced as a continuous film pressed through an infinitesimally small aperture, just as gutta-percha thread is produced by pressing that material through holes by the pressure of a die.

The length of fibre constituting a cocoon is stated by Count Dandrilo (probably the highest authority on this subject) as about 650 yards. Such a length of fibre cannot, of course, be dealt with as spun silk, for which purpose it must be broken down into convenient lengths. Some difference of opinion exists as to whether the thread of silk constituting the cocoon is, so to speak, cut or broken, or only pushed aside for the emergence or extrusion of the moth, but the experience of silk winders, that with care the same lengths of fibre may be obtained from the pierced as from the unpierced cocoon, leads to the conclusion that the thread is not cut or broken, but only thrust aside. Whether this emergence is or is not facilitated by a fluid emitted from the animal is a subject deserving the attention of the physiologist.

The cocoon, besides the continuous thread constituting its interior mass, has an external coating or covering of floss or waste silk, hitherto considered as refuse, and not treated by mechanical means. In the throwing or ordinary treatment of the thread of silk from the cocoon, waste silk is also produced, which, except as to the waste from the better description of silk, has generally been considered and dealt with as rubbish. From these two sources large quantities of waste silk may be obtained, which, though hitherto considered as rubbish, is now being successfully treated by mechanical means, so that waste silk, which a few years ago was sold at 1s. 2d. per lb., is now selling at from 2s. to 3s. a pound, and imported annually by thousands of bales.

Should the experiment now in progress at Manningham-mills be successful, as there is every prospect of its being, employment will be afforded to from 4,000 to 5,000 persons, in working up what has hitherto been a refuse into a useful and elegant manufacture.

We may also anticipate the establishment, or rather the re-establishment in this country of the velvet trade, and silk hat-plush trade, now carried on abroad by hand labourers, in places in which manual labour is very low-priced, and able to compete successfully with the imperfect machinery hitherto employed in those trades.

Returning to the contrast of silk with wool, cotton, or flax, it may be observed with reference to these last-named substances, that wool consists of serrated fibres of from 4 to 15 inches, having from 1,560 to 2,700 serrations in an inch, upon which its felting property depends; that cotton consists of fibres of from 1 to 1½ inches in length, not-serrated; and that flax strands consist of alternate fibres held together by gum, of from about one-eighth of an inch, as in the *Formium tenax* from New Zealand, to 2½ inches, as in the Belgian flax.

The mechanical treatment of these last three substances is known as combing, carding, and hackling. The shorter staples of wool are subjected to carding, as a preparatory process.

The use of the screw gill for a preparatory process in treating wool contributed much to the great success during the present century of wool-combing by machinery, the result of which has been to reduce the cost from 2½d. to ½d. in ordinary wool, and from 2d. to ¾d. per lb. in the best descriptions of Botany wool; to this, however, must be added the saving of loss due to pilfering, also the saving of the cost and labour of examining each lot of wool as brought back combed to the warehouse, from which it had been taken to be combed by hand-labour. This great economical achievement results from the fact that machinery admits of work of the lowest commercial value being made of nearly equal value with the highest; so that the wool of the whole world is now available for the worsted manufacture.

The process of treating the waste silk from the cocoon is as follows:—The waste silk is placed in large vessels capable of holding from 600 lbs. to 800 lbs. of the waste, which is saturated in dilute soap and water, at a temperature of about 170° Fahr. After a few days immersion, fermentation takes place, which is allowed to continue from 10 to 20 days, according to the nature of the silk under treatment. It is then removed from the bath, and passes through rotatory washing rollers (such as are used in the wool processes) and thoroughly scoured and cleansed. For special purposes, as for producing perfectly white yarns, the silk is boiled for three or four hours in soap and water, until the whole of the gum is effectually discharged. The silk is then thoroughly dried. The next process is that of preparation for the comb, by the use of screw-gills.

As waste is worth comparatively little, no effort is spared by the nett-silk producer to reduce it to a minimum. It is therefore evident that the spun-silk trade must be circumscribed to the quantity made; beyond that it is at present impossible to go, and for that reason it is the smallest of all the textile manufactures. For 4,000 years past silk has been treated by one process only, namely, that of winding from the cocoon. It is the natural course of things, as, by that means, although expensive and tedious, a continuous thread is obtained, which has a lustre and strength that cannot be equalled by any other system. Recently, however, efforts have been and are now being made by Messrs. Lister and Co. to grow cocoons to be treated altogether by spun-silk machinery, their idea being that for those to whom price is no object silk will continue to be treated as heretofore, but for the million, where price is everything, it will in future be produced by spun-silk machinery. How far they may or may not be right, time will show; but, if they should succeed, instead of being, as it now is, the smallest of our textile manufactures, it would, during the next half-century, in all probability, take rank in value next to that of cotton.

The machinery ordinarily used for spun silk is much the same as that for flax. The first process after the gum has been discharged, or partially so, is technically termed "dressing," which is synonymous to that of "hackling" in flax, and the machines used are similar. The material under process is held in "books," or other holders, and worked by teeth until sufficiently cleared from impurities. It is then taken to the drawing-frames, and roved and spun. These processes, as they are well understood and extensively practised, require no further notice here.

Messrs. Lister and Co. have, during a number of years, spent large sums of money (nearly a quarter of a million) in perfecting the various processes for treating silk-waste, and have taken several patents for the same. The most important machines are those used for combing, of which there are five, each adapted for special descriptions of work. It is well known that the combing of wool was a task of no ordinary difficulty, and engaged all the energy and talent of the trade for half a century before it was finally accomplished; but the difficulties of treating and working silk are a hundred-fold greater. Of this there can be no better proof than the fact that, whereas there are a dozen successful wool-combing machines, there are no silk combs, excepting those worked at Manningham. Although the sum expended appears to be large, still it is not so when we know that more than double the money was spent on wool-combing by various inventors and the trade generally.

At the present time we may consider the combing of silk an accomplished fact; still the semi-hand process of dressing is able to rival, and even, in some descriptions of silk waste, to beat the comb. This must always be the case where machinery supplants difficult and delicate hand processes, but eventually machinery must triumph, because manual labour is stationary, whereas mechanical contrivances are always progressive. It is the same with the patent velvet loom, another of Messrs. Lister and Co.'s specialities; it is making slow but sure progress, whilst the hand loom continues unchanged—it is now, as it ever has been, one of the most irksome and tedious machines conceivable. The patent loom has cost a considerable sum of money, but with patience and perseverance we believe it is destined to give us back the velvet trade, which we have almost altogether lost. Its mode of action is entirely different from that of the hand-loom, but I cannot possibly describe it satisfactorily without the aid of drawings. I may observe that the works at Manningham are perhaps not so remarkable for their extent (although by far the largest silk mills in Europe), as because they will be chiefly engaged in manufacturing articles that scarcely, if at all, are made elsewhere in England, such as velvets, hat plush, and ribbon velvets. Before closing this paper, a short description of these works may not be devoid of interest.

They will have a frontage of 350 yards on Heaton road, and 150 in depth, thus covering an area of about 52,000 square yards. The mill will contain 13,000 square yards, and the warehouse 15,000, together about 28,000 yards. There are eight engines, of about 3,500 indicated horse-power; and, when all the machinery is running, will employ from 3 to 4,000 workpeople. On the opposite side of the road, that is, on the east side, there is a large piece of vacant land, containing an area of 40,000 yards, upon which it is intended at a favourable time, that is, when building materials are cheap, and the present concern is organised and fully at work, to build another mill and weaving shed, capable of doing the work which is at present performed at Halifax and Addingham mills. This concentration of the business would increase the horse-power to about 5,000, and also increase the hands to 5 to 6,000. When the works are thus completed there will be room for 1,000 velvet looms, 8 to 10,000 plain silk, and 3 to 400 ribbon looms.

There will also be several hundred spinning frames, mules, doubling frames, combing machines, and other machinery.

In conclusion, I would remark that I have in vain sought for any description of the manner in which the silk is produced by the worm. I am quite aware that it is in the first instance in a state of gum, and that it exudes through two orifices by (I suppose) the mechanical pressure of the worm, but how the gum is converted into silk is, I confess, a mystery to me. I make these remarks hoping that some one who may have given his attention to the subject may be able to explain the manner in which it is accomplished. At the present time there are tons of silk noils too short for spinning purposes, and if it could be ascertained by what chemical agency the gum is converted into silk, we might then hope that means might be found to reconvert the silk noil into gum, and in that manner lead up to a new manufacture, and usefully employ that which is now of little value.

DR. SIEMENS ON FUEL.

On Saturday evening last, a lecture, "On Fuel," was delivered at Bradford, to a working-class audience, by Dr. Siemens. The lecturer divided his subject into five principal heads:—1. What is fuel? 2. Whence is fuel derived? 3. How should fuel be used? 4. The coal question of the day. 5. Wherein consists the fuel of the sun?

Fuel, in the ordinary acceptation of the term, is carbonaceous matter, which may be in the solid, the liquid, or in the gaseous condition, and which, in combining with oxygen, gives rise to the phenomenon of heat. Commonly speaking, this development of heat is accompanied by flame, because the substance produced in combustion is gaseous. But combustion is not necessarily accompanied by flame, or even by a display of intense heat. This was shown by numerous experiments, so that any substance might be called fuel which is capable of entering into combination with another substance, and in so doing gives rise to the phenomena of heat. In thus defining fuel, it might appear at first sight that we should find upon our earth a great variety and an inexhaustible supply of substances that might be ranged under this head, but a closer investigation would soon reveal the fact that its supply is extremely limited. Coal alone presents itself as carbon and hydrogen in an unoxidised condition. As to the source of fuel, the lecturer urged that it could only be obtained from the result of the sun's action on the earth. When our present stores were exhausted we might, perhaps, utilise the direct heat of the sun, but we could never expect electricity to supply our wants.

On the question of the proper use of fuel, Dr. Siemens illustrated this by three examples, which, he said, were typical of the three great branches of consumption, viz., *a.* The production of steam power. *b.* The domestic hearth. *c.* The metallurgical furnace. He showed how economy in the production of steam power was effected by improved mechanical arrangements, and illustrated this by reference to the Corless variable expansion gear in domestic fire-places. He showed how a similar effect might be obtained by the use of Captain Galton's stove.* In metallurgy he described his own furnace. These all exemplified methods of economising consumption.

On the coal question Dr. Siemens spoke as follows.—

> In taking the 105 million tons of coal consumed in this country last year for our basis, I estimate that if we could make up our minds to consume our coal in a careful and judicious manner, according to our present lights, we should be able to reduce that consumption by 50 million tons. The realisation of such an economy would certainly involve very considerable expenditure of capital, and must be a work of time. But what I contend is, that our progress in effecting economy ought to be accelerated in order to establish a balance between the present production and the ever-increasing demand for the effects of heat. In looking through the statistical returns of the progressive increase of population, of steam power employed, and of the increased production of iron and steel, &c., we find that our necessities increase at the rate of not less than 10 per cent. per annum, whereas our coal consumption increases only at the rate of 4 per cent., showing that the balance of 6 per cent. is met by what may be called our "intellectual progress." Now, considering the enormous margin for improvement before us, I contend that we should not rest satisfied with this rate of intellectual progress, which involved an annual deficit of £4,000,000, to be met by increased coal consumption, but that we should bring our intellectual progress up to the rate of our industrial progress, by which means we should make the coal production nearly a constant quantity for several generations to come, by which time our successors may be expected to have effected another great step in

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* For a description of this stove, see the *Journal* for April 4th of the current year.

advance toward the theoretical limit of effect, which, as we have seen, lays so far above any actual result which we have as yet attained to, that an annual consumption of 10 million tons would give more than the equivalent of the kinetic energy which we actually consume.

He lastly glanced slightly at the question of the regeneration of the sun's heat upon its surface, saying that the sun might be looked upon in the light of a gigantic furnace, in which the same materials of combustion are used over and over again.

SCIENCE TEACHING AT THE UNIVERSITIES.

The third report of the Commissioners on Scientific Instruction and the Advancement of Science is devoted to an examination of the resources now available for scientific instruction at Oxford and Cambridge, and the manner in which those resources are applied. As it is in the nature of such a commission to inquire and report, rather than to suggest alteration and reform, the chief interest in the recently-published Blue-book lies in the fact that it provides an exhaustive summary of the present condition of things. The proposals of the commissioners are, of course, of a tentative sort, and merely such as might prepare the way for future change.

Although they could not avoid touching, here and there, on various topics only accidentally connected with the subject of their investigations,—such as questions relating to the tenure of fellowships, the proposed scheme for the examination of first grade schools by the universities, and other kindred matters—the commissioners have, in the main, strictly confined themselves to the investition of the state of scientific instruction, properly so-called, mental and moral science, of course, being excluded. The following was the classification they adopted in collating and condensing the evidence submitted to them:—

I. The courses of study and the examinations.
II. The professoriate.
III. The scientific institutions within the universities.
IV. The colleges.
V. The relation of the universities to technical education and to education for scientific professions.
VI. The duty of the universities and the colleges with regard to the advancement of science.

With regard to the courses of study, the first question taken up, that of matriculation examinations, or the proposed substitute, an examination corresponding to the German *Abiturienten examen*, to be conducted by the universities at the schools, has no very special connection with scientific, as distinguished from literary culture. It may be sufficient to observe that the approval of the commissioners is, for various reasons, given to the "Leaving examination." As to the proposed arrangements for the scientific curriculum, one great point to be decided is this—should "arts" (*literæ humaniores*) and science be kept distinct, so that from his first entrance the student should fix upon his choice, and follow it separately to the end? The present idea—though the idea is perhaps a dying one—is that the students should be encouraged to make their range of work as wide as possible at first, and should afterwards devote themselves to one special branch. Till within the last few years—and this is more specially true of Cambridge—there were only two recognised branches of study, classics and mathematics. For the first year the undergraduate was expected to devote himself to both alike. For the two next years his time was to be devoted to that one subject which he found best suited to his powers and his tastes. Such was the scheme of both university and college examinations. The "previous examination" included both subjects, and so did the first year college examinations.

As the science of mathematics grew, it was found that those who hoped for the first place in the tripos must devote the whole of their university course to the one study, and this practically they did, though without encouragement from either university or college arrangements. Then the importance of physical science began to make itself felt, but only as an adjunct. Degrees in science alone are still looked upon as only a valuable addition to the old degrees in arts; they have not yet received their due appreciation, and until quite lately it has never even been suggested that science alone should qualify for a university degree. The opinions offered by those examined before the Commission were very various on this point. Some urged that sufficient general education might be expected from schools, and that for the higher culture the whole three years of the university course should be devoted to one branch alone; also, that work enforced on a student against his inclination was always unprofitable to him. Others argued that the university degree should be a mark of more than proficiency in one department of knowledge only. To this view the commissioners themselves lean, for, while declining to express an opinion as to the desirability of requiring from every university student of science a certain amount of Greek and Latin, they say that they consider it essential that some evidence of literary culture should be required by the university from every student; and, they add, "In the interests of science itself we should not be disposed to see the standard of literary attainment which is expected from the scientific student placed at too low a level. Rather, we regret that a principle so sound in itself should receive only a one-sided application; and admitting, as we do, that literary cultivation up to a certain point is indispensable for the scientific student, we are of opinion that, in like manner, evidence of corresponding scientific culture should be required from the student of classical literature or of theology." This might be effected by means of an examination like that of the "Previous examination" or "Responsions." The idea of a degree, to be called "Bachelor of Science," is naturally condemned on the ground that its mere novelty would render it inferior, at least in public estimation, to the well-known "Bachelor of Arts;" but the proposal for a Doctorate in Science is looked upon with some favour. A suggestion that university scholarships in natural sciences should be founded is of obvious utility, but it must also be remembered that the reason that existing university scholarships are so highly esteemed is that the competition for them is so great, and this competition arises from the fact that the subjects in which they are given are the same as those in which the highest university distinction is to be gained. It would be long before a natural science scholarship could take rank with the Hertford or the Ireland. The university prizes for special subjects never attract very large competition, highly as they are valued as distinctions.

It will not be necessary to say much on Part II. of the report, the Professoriate. The commissioners give a very complete analysis of the present scientific teaching staff at Oxford and Cambridge, and of the subjects taught both by the professors and in the colleges. They also give, for purposes of comparison, a similar schedule relating to the University of Berlin. They recommend the appointment at either university, of several new professors for various subjects now insufficiently treated, and the establishment of one entirely new chair—applied mechanics and engineering. They propose—without exactly stating how such an object is to be attained—that the professors should assume a larger share than they at present undertake of the teaching work of the university, nor would they agree to the separation of the duties of research and instruction. Some suggestions are thrown out as to the election of the professors by a special board of scientific men, and for the formation of an administrative council of science.

Part III. on "Scientific institutions within the universities," merely gives an account of such establishments, with hints for their improvement. They are, as it is needless to remark, utterly inadequate for the requirements of the universities.

In relation to the colleges, with which Part IV. deals, the attention of the Commission was principally directed to the following points:—(1) The scholarships; (2) The fellowships; (3) The organisation of the instruction given in the colleges in relation to the instruction given in the universities; (4) Contributions from the colleges to a fund for university purposes.

With regard to 1 and 2, it was evident that a fair share of the rewards for successful work was not allotted to science. An opinion is expressed that it was of great importance, with the view of promoting the study of natural science in the first grade schools throughout the country, that there should be an immediate, and ultimately a large, increase in the number of scholarships offered for this subject by the colleges.

The question of fellowships was a large one, and could hardly be treated from the scientific side alone. Ultimately the Commissioners put forward the following as the chief purposes to which, in their judgment, the fellowships should be applied:—

> "In the first place a certain but not a very large proportion of the fellowships will be always required as at present, for the payment of the persons entrusted with the management of the college estates, and with the government and administration of the colleges themselves.
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> "Secondly, a large number of the fellowships is at present employed, and probably a still larger number ought hereafter to be employed, in connexion with the instruction given in the colleges.
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> "Thirdly, a smaller, but still a considerable number of fellowships ought to be employed as Terminable Prize Fellowships.
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> "Fourthly, a certain number of fellowships ought, as we have already said, to be united with professorships in the university; the University professor becoming *ex-officio* a fellow of the college and a member of its governing body.
>
> "Lastly, it is, in our opinion, most important that a certain number of fellowships should be appropriated to the direct promotion of learning and research in various directions."

This is hardly the place to discuss the question of fellowship tenure into which the commissioners found it needful to enter. They had little to recommend, but they decided that what was to be desired in the interests of natural science students was not that the number of fellowships appropriated to them should be immediately increased to any very great extent, but that they should be bestowed with more regularity than at present, and that their number should increase proportionately with the number and claims of the students.

With regard to 3, they were not favourable to the proposal that each college separately should institute a laboratory for educational purposes. The better scheme seemed to be that of providing a laboratory for a group of colleges, and this they thought should be done, proper provision being made for the due apportionment of work between college and university establishments. Lecturers in natural science they would have at once appointed, but the plan of appropriating separate colleges to scientific students they could not approve.

As to Part IV., the commissioners could only urge that, whenever the time might come when the colleges should be called upon to contribute to the university chest, a large proportion of such contributions should be devoted to the aid of scientific study.

Part V, on "The relation of the universities to technical education, and to education for scientific professions," does not offer many novel views. The commissioners urge the necessity that the university should lay itself out to provide science teachers, a class now much required.

On the subject of technical education, they express themselves as follows:—

> "The principal professions for which extensive preliminary scientific studies are required, are, the profession of medicine, the professions of consulting and manufacturing chemistry, and of civil, mechanical, and telegraphic engineering in all its various branches. With regard to all of these the tendency of a great amount of the evidence which has been laid before us is to show that the Universities ought not to undertake to give direct professional or technical instruction. For example, the difficulties in the way of making either Oxford or Cambridge into a great School of Medicine are very considerable. It is sufficient to advert to the size of the towns, and the consequent smallness of the hospitals that could be placed at the disposal of the students, as one circumstance amongst many which would render such an attempt unadvisable. Nor are the difficulties less which stand in the way of any attempt to give a complete education in civil engineering at these Universities. According to the evidence which we have taken, so much of this education must of necessity be practical, that a complete technical education in engineering cannot possibly be given in a town in which there are no manufactures. On the other hand, the professions of medicine and of cival engineering both require, though in different directions, very thorough and very extensive preliminary scientific training; and in these professions the feeling appears to be growing that the highest possible development should be given to these preliminary studies. It is our opinion, therefore, that the universities should provide to the fullest extent for the theoretical instruction of such professional students.
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> "There would probably be no difficulty in securing this object, so far as the profession of medicine is concerned, if the department of biology in each of the universities should hereafter receive an adequate organization.
>
> "With regard to civil engineering at Cambridge, the Jacksonian Professor gives a course of lectures on the Principles of mechanism, and the professor of experimental physics gives courses on different branches of that subject, but there is no professor of civil engineering unless the Jacksonian professor can be regarded as such. The only preliminary instruction that is offered by the University of Oxford is that to be obtained in the Hyde Institute; and considering the great number of subjects which have to be taught in that institution, it would be too much to expect that a course of instruction could be provided there exactly suited to the wants of professional students. The first step towards meeting these wants would be to provide a professorship of civil engineering, and to place such appliances at the disposal of the professor as would enable him to give to students intending to devote themselves to that profession the same kind of assistance which is now given with so much ability and success in Scotland at Edinburgh and Glasgow, and in Ireland at Trinity College, and in the colleges of the Queen's University.

The subject of Part VI., "The duty of the universities and the colleges with regard to the advancement of science," is discussed at considerable length. The commissioners start by saying, that they regard as a main function of the universities the promotion of original work in science. They say:—

> "The proposals to which we attach the most importance with a view to the encouragement of original research at the Universities are —(1) The establishment of a complete scientific professoriate; (2) The appropriation, under certain conditions, of fellowships to the maintenance of persons engaged in original research. But, in addition to these main proposals, other suggestions are contained in the evidence before us, to which we would call especial attention:—(1) That laboratories should be founded expressly intended for research, and for the training of advanced students in the methods of research; (2) That scientific museums and collections should be maintained to an extent beyond what is required for purely educational purposes; (3) That a doctorate in science should be instituted."

Such are the main suggestions of the report, though it of course contains much for which no space can be found here. It is evidently a work of careful research, and the result of considerable thought. What now remains to be seen is the effect its propositions will induce in the universities themselves.

THE ROYAL NAVAL COLLEGE, GREENWICH.

The establishment of a naval college at Greenwich, recently only a suggestion for the utilisation of the vacant buildings so long recognised as the abode of our worn-out seamen, has now become an accomplished fact. It is a matter for congratulation that the fine range of buildings, identified for upwards of two centuries with the naval history of England, should now be used as a college for the higher education of the officers of the navy. For some time past about fifty sub-lieutenants have been located at Greenwich, and have been receiving education in matters relating to navigation, but the college will not be opened fully until the 1st of October, when some 250 officers will enter upon a course of study calculated to be of very great advantage to them in their profession.

The origin and aim of the college are briefly as follows:—Although at one time Greenwich Hospital was tenanted by as many as 2,700 pensioners, yet since the men have had the option of receiving their pensions and living with their friends, or of remaining in residence at Greenwich, they have mostly preferred the former alternative, and hence the number living within the walls of the hospital has rapidly decreased, until on the last occasion when the men were allowed to choose, in October, 1869, only 31 elected to remain, and these were mostly invalids, so that the corridors, dining-rooms, and dormitories became practically deserted. The insufficient provision for the thorough education of naval officers at Portsmouth prompted the suggestion that the buildings at Greenwich would be extremely well adapted for the establishment of a complete Naval University. This suggestion met with very warm support from the most influential quarters, and in 1870 the Admiralty appointed a committee on the "Higher Education of Naval Officers," and directed it to consider whether it was desirable to limit the place of study to the College at Portsmouth, or whether the vacant buildings at Greenwich could be utilised for the purposes of education. The evidence brought before the committee went to show that the scientific training of naval officers was exceedingly deficient, and that this deficiency was to a great extent due to a want of the necessary facilities for the systematic teaching of science; and as the committee believed that this branch of education is of very great and growing importance, it embodied in its report the proposal to add such opportunities and facilities for the instruction of officers in languages, chemistry, metallurgy, geology, mineralogy, and naval tactics as might be necessary, at the same time furnishing, as before, instruction in steam, mathematics, nautical astronomy, and field fortification. One-half of the committee, including the Director of Naval Education, were strongly in favour of establishing such a college at Greenwich. The matter however remained in abeyance until 1872, when another committee was appointed by the Admiralty to report upon the suitableness of Greenwich Hospital for a naval college. This committee consisted of Lord Camperdown, Admiral Tarleton, Dr. Woolley, Director of Naval Education, and Mr. Lovelace, as Secretary, and its report being favourable, the necessary alterations and changes in the buildings at Greenwich were proceeded with. These changes consisted in an almost entire reconstruction of the interior of the building, together with the formation of suitable lecture and class-rooms, two very fine and large laboratories, one for physical science and one for chemistry, and a museum for naval models, &c. These alterations are still not quite complete, although the work is being rapidly pushed on. The School of Naval Architecture, at present located at South Kensington, will be absorbed in the Greenwich College. A minute of the Board of Admiralty, published on January 12th, 1873, set forth the general scheme of the college, stating that the college at Greenwich shall be so organised as to provide for the education of naval officers of all ranks above that of midshipman, in all branches of theoretical and scientific study bearing upon their profession. The advantages of the college will also be open to officers of the mercantile marine. The number of students at the college will render it possible not only to carry out instruction by individual tuition, as hitherto, but to secure a staff of eminent professors to arrange lectures and classes, and to provide chemical and physical laboratories on a scale which has hitherto not been possible in any naval establishment. The proposed courses of study are divided into thirteen sections, consisting of the following subjects:—1. Pure mathematics, including co-ordinate and higher pure geometry, and differential calculus of variations. 2. Applied mathematics, viz., pneumatics, mechanics, optics, and the theories of sound, light, heat, electricity, and magnetism. 3. Applied mechanics, including the theory of structures, the principles of mechanism, and the theory of machines. 4. Nautical astronomy, surveying, hydrography, with maritime geography, meteorology, and chart drawing. 5. Experimental sciences; (*a*) physics, viz., sound, heat and light, electricity and magnetism; (*b*) chemistry; (*c*) metallurgy. 6. Marine engineering in all its branches. 7. Naval architecture in all its branches. 8. Fortification, military drawing, and naval artillery. 9. International and maritime law, law of evidence, and naval courts martial. 10. Naval history and tactics, including naval signal and steam evolutions. 11. Modern languages. 12. Drawing. 13. Hygiene, naval and climatic. The college at Greenwich will replace the one at Portsmouth, although gunnery will be taught on board H.M.S. *Excellent*, and practical surveying also at Portsmouth. The staff of the college will consist of a president and his assistant, a director of studies, and the various professors, together with such lecturers as may be necessary to make the course of instruction complete. Rear-Admiral Sir Astley Cooper Key, F.R.S., an officer of great experience, has been appointed President; Dr. S. Archer Hirst, Vice-President of the Royal Society and President of the London Mathematical Society, has been appointed Director of Studies; Dr. Debris, Professor of Chemistry in Guy's Hospital, has accepted the appointment of Professor of Chemistry; and Professor Reinold, M.A., of Oxford, the Professorship of Experimental Physics. Under such auspices, and with such a staff, the Royal Naval College will doubtless prove a very important element in the naval education of the future, and will be the means of placing within the reach of every officer a course of education second to none in the kingdom. The college, as above mentioned, is to open on Wednesday next, the 1st of October.

TRADE OF JAPAN.

A letter from Nagasaki, in the *Hamburg Correspondent*, says that the foreign merchants in Japan loudly complain of the stagnation of trade in that country. The enormous importation of foreign industrial products has reduced prices generally, and there are large quantities of goods in store for which it is impossible to find purchasers. In Japan itself the sources of production are not sufficiently developed to bring the exports to anything like an equality with the imports, and trade suffers accordingly. "The truth is," proceeds the correspondent, "that people in Europe are under an illusion as to the real state of affairs in Japan. There can be no greater mistake than to suppose that the masses in Japan have the same thirst for knowledge and desire to obtain the advantages of European civilisation as those Japanese who come to study in Europe. The reforms which the government has introduced after the European model have not given the natives any idea of European culture, or accustomed them to foreign goods. Hence the great majority of articles of European manufacture, and especially of fancy goods, with which the Japanese market is filled, do not attract the Japanese public, and things of this kind are, as a rule, only purchased by the foreign residents. Moreover, though Japan is a beautiful country, it is not a wealthy one. Tea and silk are almost the only articles of export. As for the copper mines which have been discovered in the interior, the Japanese authorities carefully watch them, and will not allow any foreigner to come near them. The Japanese themselves, on the other hand, have neither the necessary scientific knowledge nor the instruments for working these mines, so that at present they are practically valueless." "There is no danger," adds the correspondent, "of a commercial crisis; but there is very little prospect of the foreign merchants extending their operations, and any one coming out to Japan just now to open a business would find such a task under present circumstances almost impossible." The correspondent also warns persons who think of seeking employment in the country as engineers, teachers, or artisans, that they have not the smallest prospect of obtaining any employment, unless they make a fixed engagement with the Government before leaving Europe.

The exports of British railway iron to Peru in the first six months of this year were only 5,467 tons, as compared with 21,491 tons in the corresponding period of 1872.

INDIAN RAILWAYS.

Long since fought out in England, the battle of the gauges has yet to be decided in India. It is hardly possible to overrate the importance of a question which will affect the development of an immense empire, and consequently nearly touch the well-being of an enormous population; but in order to form any opinion on this fiercely-debated subject, it is absolutely necessary to glance at the Indian railway system as it exists at present, inasmuch as one of the chief arguments in favour of the maintenance of the broad-gauge is based upon the inconvenience that would be incurred in grafting a new narrow-gauge system on the great trunk lines already built, opened, and in full working order. At the present moment the railways of India open for traffic extend over 5,511¼ miles, distributed over the three presidencies with tolerable impartiality. Calcutta, Bombay, and Madras are brought into communication, and the peninsula may be crossed a third time by a line from Madras on the eastern or Coromandel side, to Beypore, near Calicut, on the western or Malabar coast. Starting from Calcutta by the East India Railway, the traveller may proceed *viâ* Allahabad to Jubbulpore, in the central provinces, and thence by the Great Indian Peninsula North-Eastern line, *viâ* Bhosawal to Bombay. Leaving Bombay by the South-Eastern line of the same great railway, he can get to Raichoor in the Hyderabad territory, and bending still further southward, reach Madras by the line of the same name, while from Madras he can, by the South-Western line, attain Beypore. In addition to these great arteries, the Indian line is continued from Allahabad by Agra to Delhi, whence the Scinde, Punjab, and Delhi Railway runs by Loodiana, Umritsur, and Lahore to Mooltan. It may be remarked, parenthetically, that the battle of the gauges commenced on the proposed extension of this line from Delhi to Peshawur, in the extreme north-west, and the construction of the Indus Valley Railroad from Mooltan, *viâ* Rohree and Kotree, to Kurrachee, with the object of ensuring unbroken communication between our great frontier post of Peshawur and Calcutta on the east, and Kurachee on the west.

An important consideration added to the difficulty of the question of break of gauge, as it was conceded on all hands that these lines in the north-west are to be constructed less for commercial than strategical purposes, and the necessity of bringing Peshawur into communication with the military centres of both presidencies was considered by many to entirely outweigh all financial difficulties.

The present 5,511¼ miles of open railway afford, of course, a very inadequate idea of the ultimate development of the Indian system. Large figures are spoken of, and it has been stated that an addition of at least 10,000 miles must be made before the resources of the vast peninsula of Hindostan may be considered as fairly stimulated by communications. The construction of 2,109 additional miles of railroad has already been sanctioned, the balance remaining in the condition of "proposed" lines, but at the present rate of progress the day at which the railway system of India will be fully developed is far off. Twenty years have been required to achieve the present mileage; and lest too great hopes should be raised of more rapid construction in the future, it may be well to remark that the rate of production has been very unequal. In 1853 only 21½ miles were open, and between that year and 1861 a gradual advance was made to 1,581½ miles, when a great bound was made, inasmuch as in 1862 no less than 770 miles were opened. Thenceforward a gradual rate again prevailed, bringing the open mileage up to 5,078½ in 1871, and to 5,383¼ in 1872. Thus only 304¾ miles were added in 1872, while during the first six months of 1873 but 127 miles have been completed. At this rate of construction it would take from thirty to forty years to cover India with the "proposed" network of railways.

Many causes, physical and political, have contributed to retard the development of Indian railways, and to swell their capital account to the enormous sum of £94,500,000. The East Indian Railway has in particular suffered severely from political disturbances. First came the Sonthal rebellion and then the mutiny. The loss entailed by these calamities is estimated at not less than £3,000,000, a heavy burden on a line constructed on the expensive principle of commencing operations simultaneously in various places.

Difficulties of a more permanent kind arise from the peculiar nature of the Indian rivers, which are subject to extraordinary vagaries. Rising in mountain ranges, some of which are thousands of miles from the sea, these streams literally cut their way through a soft and yielding soil, and often forsake their ancient channel for a new one, thus leaving tracts of land, once smiling with verdure, in the condition of arid and unprofitable desert. In the Punjab, a remarkable instance of this peculiarity occurred in 1790, when the river Bias, which once had an independent course to the Chenab, fertilising the country through which it passed, forsook its ancient course, and was diverted into the Sutlej, leaving its old bed a dry ravine, and ruining the country to which it once brought prosperity. Another desert tract, near Bhawulpore, dates its origin from the drying up of the ancient Saraswati, which once flowed through the heart of the country to the Indus. The ancient track is now a waste dry channel, with ruins of old towns dotted along its banks, half buried in sand-drift from the desert. All Indian rivers are subject to these wanderings and shiftings, but the Indus is the most eccentric of them all. This great river flows through an alluvial plain, almost every portion of which has at some time or other formed part of the channel of the Indus or its branches. These frequent shiftings are accounted for by the river building itself a species of causeway by constantly raising its bed. This slow but certain operation is due to the enormous quantity of silt brought down by the river and deposited gradually, on account of the comparatively low rate of velocity maintained across a level plain. Thus the bed and the banks of the Indus are continually rising above the level of the surrounding country. When a certain height is attained, the banks fail to withstand the pressure; a break in the natural level occurs; this is widened with inconceivable rapidity, and the whole river pours over and seeks another course. The Indus has worked its way from east to west. In 710 (A.D.) a Hindu dynasty existed at Alor, and the ruin of Alor was caused by the Indus moving to the west. The seat of government was then moved to Brahmanabad, the ruins of which are now forty-five miles to the east of the present channel of the Indus. Last year the Ganges displayed a dangerous tendency to shift its course, and it is at the present moment difficult to predict the future course of the river near to Bhaugulpore. Swollen with the heavy rains of last year, the river changed its course, and approached from a distance of two miles to within a few feet of the railway. Fortunately it went no further, but another heavy flood may convert what was once a railway into the new bed of the Ganges. Throughout the country great damage is done annually by floods. Disasters have occurred to several railway bridges, and have mainly arisen from the difficulty of securing proper foundations in a soil subject to a scour of 50 to 60 feet in depth. The bridges over the Ganges at Cawnpore and at Rajghat, and that over the Ramgunga at Bareilly, have given immense trouble. During the floods of last year the Sutlej-bridge, on the Punjab Railway, gave way, although the foundations of the piers had been laid at a depth of 40 feet below the bed of the river. Several more of the Punjab bridges were seriously damaged. On the Bombay, Baroda, and Central Indian Railway, the bridge over the Par river was swept away during the monsoon in September last, and the bridges across the Orunga and Damaungunga rivers seriously damaged.

Traffic was stopped for six weeks, but by the exercise of great energy temporary structures were erected, and all three bridges have since been restored. The absolute necessity for carrying the foundations to an immense depth, and fortifying them in almost Pelasgic fashion, has of course added considerably to the time and expense required to complete the bridges now in course of construction. The cost of the Punjab Northern Railway, for instance, is enormously increased by the bridges over the Ravee, Chenab, and Jhelum. These great rivers will have to be crossed by bridges amounting in the aggregate to 17,000 feet, erected at a cost estimated at £1,125,000. Many minor bridges must be erected, and before reaching Peshawur the Indus will have to be crossed below Attock. Touching this latter great work opinion is divided, inasmuch as it has been proposed to evade the difficulties of bridge making by the construction of a tunnel. The construction of the Indus Valley Railway, from Moultan to Kotree, is complicated by the necessity of crossing the Sutley near Bhawulpoor and the Indus at Rohree. This latter bridge will be a formidable undertaking, as one of its spans will be 600 feet in the clear, but on the other hand the foundations will be rocky, and the probability of the river undermining them will in this case be escaped. The Rajpootana Railway will also require some important bridges, the longest of these being that over the Jumna, at Agra, about 2,000 feet long, consisting of 16 spans, 142 feet between centres of piers founded on three wells 12½ feet in diameter, and sunk 60 feet below the low-water level of the river. The remaining bridges on this line will aggregate about 2,600 lineal feet, but one of the rivers, the Amanishah, is subject to an extraordinary scour, and will require special precautions.

In almost every case at least one mighty and treacherous river has to be crossed. The Holkar State Railway will be only 86½ miles in length, connecting Khundwa, a station 352 miles from Bombay, with Mhow and Indore, but has yet to cross the Nerbudda, a rapid river which rises in flood time 66 feet above its ordinary level. It is to be spanned by 13 openings, making a total of about 2,560 lineal feet. The consideration of these important facts would apparently lead to the conclusion that the high rate of construction so much complained of in Indian railways is due more to the eccentric course of Indian rivers than to the difficulties of the land portion of the route or the errors of engineers.

From a financial point of view the Indian Railway system can hardly be regarded with unmixed satisfaction. In the inception of the great schemes now carried out it was deemed impossible for the Government to undertake the work of construction itself. Recourse was had to the guarantee system, under which the Government has been obliged to pay a heavy amount to make good the difference between the nett earnings of the companies—about 3½ per cent.—and the five per cent. guaranteed. As the total capital which on the 31st March last had been advanced for expenditure on the guaranteed railways amounted to £91,686,025, the annual duty of making good the deficiency adds a heavy item to the liabilities of the State. In the year 1871 a sum of £1,740,720 had to be charged upon the revenues of the country, and in 1872 this charge declined very slightly, to £1,731,660. The net amount paid on account of guaranteed interest up to 1872 was £21,349,118, so that the present year will probably see a total achieved of £23,000,000 paid in differences between the earnings and guaranteed interest, with a probable continued outlay for several years of at least £1,500,000 per annum.

Of late years the State has itself undertaken the construction of railways on a large scale. Ten new lines are sanctioned, and many of these are in process of construction, three of the minor branches being already open. The chief State undertakings are the Punjab Northern, the Indus Valley, the Rajpootana, and the Indore railways, extending in the aggregate over 1,304½ miles. It was the proposition to construct these new lines on the metre, or 3ft. 3⅜in. gauge, that provoked the battle of the gauges transferred from India to England during last spring. As the 5,511½ miles open are all on the broad or 5ft. 6in. gauge, much unwillingness was naturally shown to incur the inconvenience of a break of gauge, especially in the case of the Lahore and Peshawur and Indus Valley railways. It was urged that as these lines were mainly for strategical purposes, a break of gauge at Lahore, on the one side, and at Mooltan on the other, would be fatal to the rapid conveyance of troops and *matériel* of war to Peshawur. The length of these two lines together was only 750 miles, an immense sum must necessarily be spent in bridges, and it was not worth while to forego the advantage of an uniform gauge from Calcutta through Allahabad, Agra, Delhi, and Lahore, to Peshawur, to effect a trifling saving on the last 270 miles of the line, which, passing through a thinly-inhabited country, holds out but little hope of immediate commercial success, the solitary item to be depended upon being about 100,000 tons of salt from Dindadaw-Khan. To secure even this, a branch line would be needed, and the opinion was strongly advanced that commercial and financial considerations weighed but little in comparison with the strategical importance of a through line to our great north-western frontier, just touching the Indus Valley line from Kotree to Mooltan. The advocates of the uniform gauge of 5ft. 6in. maintained that, as Mooltan already communicated with Lahore by a broad gauge line, and Kotree with Kurrachee by a similar line, it would be absurd to incur one break of gauge at Kotree, another at Mooltan, and a third at Lahore, while the expense of laying a third rail from Kurrachee to Kotree, and from Mooltan to Lahore would be at least £345,000. The Indus Valley scheme could not be defended on commercial grounds. Beyond the region of artificial irrigation, the country was poor and sparsely inhabited, while in the cultivated part native boats would compete with the railway for traffic.

On the side of the narrow gauge, strong reasons of a financial character were advanced. Narrow gauge lines could not only be constructed at a great saving—variously estimated at from £400 to £1,000 per mile—in the cost of primary construction, but could be worked at a much lower percentage on the earnings than the broad gauge. The present Indian lines open for traffic formed only a small proportion of the gigantic railway system that must one day prevail. The cost of differences in interest was enormous; it had reached over twenty millions, and showed no signs of reduction. Perseverance in a costly system of construction and working could only result in financial disaster. Recent experiments in various parts of the world had shown the economy and efficiency of the narrow gauge. Even the 3 ft. 3⅜ in. gauge was unnecssarily broad, as 3 ft., or perhaps 33 inches, would suffice to meet all the requirements of a poor country, where immense distances must be traversed in order to secure traffic at all. A mistake had been made in the first place, an annual deficit of a million and three quarters had been incurred, and it was manifestly dangerous to persevere in a system which had proved a failure. The proportion of working expenses—53 per cent.—to gross receipts, was cited as a proof of the desirability of a narrower gauge. 53 per cent., the average, hardly showed with sufficient clearness the state of affairs, inasmuch as this average was greatly affected by the low rate of expenses incurred by the East Indian Railway, which traversed the rich territory of Bengal. On the East Indian main line the expenses only reached 41 per cent. of the gross receipts, while on the Great Indian Peninsula, 58; on the Scinde, Punjab, and Delhi, 86; and on the Calcutta and South Eastern, 91 represented the percentage of working expenses. Finally, it was declared that the difficulties of "translading" had been much over-rated, and even were this not the case, it would be better to incur the first outlay of putting down a third line on existing railways, to perpetuating the initial mistake of the 5 ft. 6 in. gauge.

From the strategical standpoint the advocates of the broad gauge would appear to have the best of the argument, but the financial difficulties suggested by their opponents appear difficult to get over. Since the animated discussion last spring a compromise has been proposed. It has been suggested that the metre gauge might suffice for the Indus Valley, but that the continuity of the broad gauge should be maintained from Lahore to Peshawur. By this means communication with Calcutta would be unembarrassed, and in the construction of the Indus Valley line money would be saved. It can, however, be hardly overlooked that as the strategical *raison d'être* of the Indus line is direct communication between Kurrachee and Peshawur, a third rail would have to be laid down not only from Mooltan to Lahore, but also from Lahore to Peshawur, and that the question will arise whether the saving effected in the construction of the 480 miles of the Indus Valley on the metre gauge will or will not be counterbalanced by the cost of laying down a third rail over several hundred miles of track? But the adherents of the narrow-gauge, if they must rest content with half a loaf, will probably declare that the cost of construction is unimportant, when compared with the greater question of working expenses.

OBITUARY.

The Earl of Hardwicke.—The death of the Earl of Hardwicke took place on the 17th instant, in the seventy-fifth year of his age. The late earl entered the navy at the age of sixteen. Amongst the earliest active service which he saw was the bombardment of Algiers, as a midshipman in the *Queen Charlotte*. In 1825 he received a captain's commission, and ultimately attained to the rank of admiral. His lordship began his political career in 1831, when he sat in the House of Commons for Reigate. In the succeeding year he successfully contested the county of Cambridge, which seat he held until the 18th of November, 1834, when he succeeded to the earldom on the death of his uncle Philip. In the year 1843 the University of Cambridge (where he had graduated in 1835) conferred upon the earl the honorary degree of LL.D., and ten years later on, the sister university paid him a similar mark of esteem. In 1852 he was called by the late Lord Derby to act as Postmaster-General, and he held the post of Lord Privy Seal under the same statesman's second administration in 1858-59. Lord Hardwicke became a member of the Society in 1855.

Dr. Donald Dalrymple, M.P.—The death of Dr. Donald Dalrymple, M.P., happened on Friday last, at Coldecot, near Southampton, the seat of Count Montefiore. He died from an attack of diarrhœa. Dr. Dalrymple was a native of the city of Norwich, where he was born in the year 1814, and was educated for the medical profession. He became a member of the London College of Physicians in 1859, but retired from the profession about ten years ago. The deceased gentleman will be principally remembered on account of his persevering efforts to reduce the crime of drunkenness by the Habitual Drunkards Bill. He was a magistrate and deputy-lieutenant for Norfolk, and chairman of the Board of Governors of King Edward's School Norwich. Since the last general election he sat for Bath, but he had announced his intention of not again offering himself as a candidate. Dr. Dalrymple has only been a member of the Society since 1871.

The tunnelling of the Col di Tenda is at length fairly commenced at both ends; the works, however, are progressing more rapidly on the Tenda side than on that towards Limone. The rocks met with are said to be extremely hard and difficult to pierce.

GENERAL NOTES.

The Social Science Congress.—The programme of proceedings of the approaching Congress to be held at Norwich, under the presidency of Lord Houghton, is now complete. The business will open on Wednesday, the 1st of October, with a meeting of the Council, after which there will be a special service in the Cathedral, the Lord Bishop of Norwich preaching the sermon; and in the evening the inaugural address will be delivered by the president. On the following day the exhibition of sanitary and educational apparatus and appliances at the Drill-hall, kindly lent for the occasion, will be opened with an address by the High Sheriff of Norwich. The address of the president of the Council, Mr. G. W. Hastings, will follow, after which the departments will meet in their respective rooms, and in the evening a soirée will be given by the local Executive Committee in St. Andrew's-hall. On Friday morning Mr. Joseph Brown, Q.C., will deliver his address as president of the Department of Jurisprudence and Amendment of the Law; and after the meetings of the various departments for the reading and discussion of papers a working men's meeting in St. Andrew's-hall, at which the Mayor will preside, will conclude the business of the day. On Saturday an address on education will be delivered by Professor W. B. Hodgson, LL.D., and after the rising of the departments the President of the Congress will distribute the certificates and prizes to the successful candidates at the last Cambridge middle-class examination. The address of Captain Douglas Galton, C.B., F.R.S., president of the Health Department, will be given on Monday morning. The departments will meet as usual in their respective rooms, and in the evening a grand concert will be given in St. Andrew's-hall. Mr. Thomas Brassey, M.P., will deliver his address on Economy and Trade on Tuesday, and after the business of the departments a soirée will be given in St. Andrew's-hall by the Mayor. The concluding meeting, preceded by a meeting of the Council, will be held on the Wednesday. In connection with the congress there will be a conference on female education, and in the Exhibition short addresses will be delivered daily in the afternoon on the subject of the articles exhibited in the various classes. Excursions to various places, it is understood, are being arranged.

Expositors in Museums.—Mr. Hodgson Pratt, in a recent letter, referring to the success of the visits of the Working Men's Club and Institute Union to public museums or collections when there were such guides attending as Professor Owen, Dr. Birch, Dr. Sharp, and Mr. Fellowes, says that the experiment raises the important question whether the Government should not provide at every public museum of science, art, or natural history, similar means of enabling the public to apprehend the meaning and purpose of those collections. At present these most costly treasures render the greatest service to the regular student and the teacher; but why should not they be made instrumental in raising the tastes and pursuits of those large crowds who annually visit them, and come away as wise as they went? What would be easier than to arrange that at certain hours weekly each department should have an able expositor who should in clear and popular style indicate the range and value of the knowledge which such collection illustrated and founded? At the end of such exposition questions might be answered, and the names of books suggested for those who wished to pursue the great topics thus opened to their view. By the regular provision of these guides and teachers, the advantage to be derived by the nation from our public collections would be unspeakably enhanced.

Another New Motor.—A new motor has recently been patented in America, the operation of which is as follows:—Oil is sprayed into the cylinder behind the piston, and, being mixed with air, is ignited at the proper time by an electric attachment. The consequent expansion drives the piston forward, the momentum of the fly-wheel returning it to its former position. An ejector supplies the oil from the tank to the sprayer, the injector being connected to a piston blower driven by a crank attached to the main shaft. Street patented much the same thing in this country many years ago, using turpentine instead of oil.

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ANNOUNCEMENTS BY THE COUNCIL.

NATIONAL MUSEUMS AND PUBLIC EDUCATION.

A special Meeting of Council was held on Wednesday, the 1st October, to consider the subject of National Museums and Galleries, and their bearing on public education.

A Standing Committee was appointed for the purpose of bringing under Parliamentary responsibility the national museums and galleries, so as to extend their benefits to local museums, and to make them bear on public education. The follow- are the several objects in view for effecting this purpose:—

1. All museums and galleries supported or subsidised by Parliament to be made conducive to the advancement of education and technical instruction to the fullest extent, and be made to extend their advantages to the promotion of original investigations and works in science and art.

2. To extend the benefits of national museums and galleries to local museums of science and art which may desire to be in connection, and to assist them with loans of objects.

3. To induce Parliament to grant sufficient funds to enable such objects to be systematically collected, especially in view of making such loans.

4. For carrying out these objects most efficiently, to cause all national museums and galleries to be placed under the authority of a minister of the crown, being a member of the cabinet, with direct responsibility to Parliament; thereby abolishing all unpaid and irresponsible trustees, except those who are trustees under bequests or deeds, who should continue to have the full powers of their trusts, but should not be charged with the expenditure of Parliamentary votes.

5. To enter into correspondence with all existing local museums and the numerous schools of science and art (including schools for music) now formed throughout the United Kingdom, and to publish suggestions for the establishment of local museums.

6. Also to cause the Public Libraries and Museums Act (18 and 19 Vic. c. lxx.) to be enlarged, in order to give local authorities increased powers of acting.

NATIONAL TRAINING SCHOOL OF MUSIC, KENSINGTON.

The first stone of the building for this school will be laid in the month of November by his Royal Highness the Duke of Edinburgh, K.G., Chairman of the Committee of Management. His Royal Highness is expected to return from the Crimea about the 13th of November.

PRIZES FOR CABS.

The Committee of Judges, consisting of the Duke of Beaufort (chairman), Lieut-Col. Eardley Wilmot, R. A. (chairman of the Council), Lord Arthur Somerset, Capt. Candy, Mr. A. Cassels, Mr. H. Cole, C.B., and Col. Henderson, Commissioner of Police, report as follows:—

Sixteen competitors sent in vehicles to the International Exhibition for the prizes offered by the Society.

The judges, in the first instance, held three meetings for inspection, and at their second meeting made actual trial of all the carriages. The judges thereupon came to the unanimous conclusion that, although there were some of the carriages which exhibited considerable merit, there were none of sufficient merit to warrant the judges recommending any for reward, and a notification to this effect was communicated to all the competitors. The judges were, however, of opinion that there were six which were worthy of further consideration if certain objections could be satisfactorily obviated and suggestions for further improvement carried out; and, accordingly, to these six competitors a statement to the foregoing effect was made, with an intimation that if they were willing to send in further improved carriages the judges would take them into consideration. Accordingly the judges held a meeting on the 29th September, and inspected the further improved cabs sent in by the six selected competitors, and, after a careful examination, they arrived at the conclusion that—while there was no one carriage which was of such a character as to entitle it, above all the others, to the first prize—there were four which exhibited very great improvement on the cabs already in use, and they therefore recommended that the total amount offered—viz., £120—should be divided equally between these four, as follows:—

Two-Wheelers.	
C. Thorn, Norwich	£30
Forder and Company, Wolverhampton	30
Four-Wheelers.	
Lambert, 66, Great Queen-street	£30
Quick and Norminton, 8, Netherwood-street, Kilburn	30

Both the latter carriages admit of being used open or shut.

The judges desire to express their commendation of the four-wheeler sent in by Messrs. Standfield and Crosse; but, inasmuch as this firm had not been selected to send in a four-wheeler to the restricted competition, it could not be taken into consideration.

The judges cannot conclude their report without expressing their heartiest thanks to Captain Clayton for the ready assistance and facilities which he was so good as to afford them in carrying out their inspection.

(By order of the Committee),
P. Le Neve Foster,
Secretary.

COAL-CUTTING MACHINERY.

The following paper was read before Section G (Mechanical Science) of the British Association, by Mr. William Frith, on Monday, Sept. 22. He said:—

The object of the paper was to submit for consideration some matters touching the history of cutting coal in mines by mechanical means. There were now several distinct modes of doing the work, and doing it well; but it was not in the power of the author to give any reliable information upon the competitive status which the successful machines held towards each other, and he therefore confined himself more particularly to the introduction of coal-cutting machinery, driven by compressed air, and the results obtained from the invention now known as "Frith's machine," the first that ever succeeded in reducing to actual practice the cutting of coal in mines. When the severe nature of the employment of manual labour to the "hewing of coal" was considered, and the great dangers which beset that occupation were taken into consideration, it was not surprising that much sympathy should have been always excited in favour of the coal-working class. The statistics of the comparative longevity of the working classes showed that the duration of the lives of colliers—apart from special accidents—was lamentably low. The really hard work of a colliery fell upon the "hewers," and the effect was very often to stamp the men with the mark of their trade, and, through the constrained position of their daily toil, to alter and distort many of the more delicately-formed persons. In 1862 some experiments were commenced at West Ardsley, by the employment of compressed air, to actuate a cutting instrument in the form of a pick. It was to be moved on the face of the coal, striking in a line and with such force as would cut a groove deep enough to admit of its being easily taken out. In the early stages there were many and serious discouraging symptoms discovered, but on the whole it was believed they would be overcome by perseverance. Intelligence was what was required to manage these machines, rather than muscular development, and any youth of ordinary capacity would in a few days acquire sufficient knowledge to do so. In 1761 Michael Menzies, of Newcastle, obtained a patent for cutting coal in mines, and that was the earliest evidence of any attempt having been made to produce a mechanical coal-cutter. His plans, having regard to the time at which they were produced, were remarkable for their ingenuity. Menzies proposed to give motion to a heavy iron pick, made to reciprocate by means of spars and chains, carried down the pit, and with wheels and horizontal spars, on rollers extended to the working places, and there to "shear" the coal exactly as now. In the same patent Menzies included a "saw" to cut the coal, and although nothing came from his labours, he displayed so much mechanical knowledge as to have deserved success. During the hundred years that followed, more than a hundred other patents were granted, but not one that approached nearer to success than the invention of Michael Menzies. In compressed air, however, in so far as the moving power was concerned, every requirement was found, and from the date of the experiments at West Ardsley, in 1862, the question was undoubtedly settled. The elastic property of air under compression was an old and well-known power, but until these experiments had been completed, its value was but imperfectly understood, and, its future beneficial influence being dormant, it was unappreciated. The engine for compressing the air was generally placed on the surface, near the top of the shaft; a receiver was fixed in close proximity thereto, and the air was taken from the compressor to the receiver, thirty feet in length and four feet in diameter. The density was generally of about three atmospheres. Iron pipes of sufficient area were laid on from the receiver to the bottom of the shaft, and there, being split into smaller sizes, were led in every needed direction through the roads and passages of the mine, exactly as the gas and water services were laid on in our towns. At the entrance into the working places a screw-joint and stop-cock were fixed to the iron air-pipe, at which point an india-rubber hose, fifty or sixty yards in length (as the length of the "bank" might require), was screwed on; the other end of the hose was attached to the cutting machine, and when all was in readiness the tap at the receiver was turned on, and the air rushed down throughout the whole service of pipes. The air did not require to be forced from the receiver, for by its own elasticity it was carried forward at a velocity corresponding to its density. Apparently it lost none of its power by distance, except the frictional retardation, and machines were working nearly two miles distant from the air-engine, without any material loss of force. As to the cost of compressed air, although it is admittedly not a cheap power relatively to steam, yet there was no other available power so cheap or so good for the purpose of cutting coal in mines. With well-constructed machinery 45 or 50 per cent. of the steam power exerted would be given off in compressed air at a density of three atmospheres with the receiver, and that pressure was sufficient for effectually working the machinery. Some makers of air engines offered to guarantee a much larger product, but the author based his calculations upon the smaller yield. If the density were much higher than three atmospheres, there was a material increase in the frictional heat disengaged by the act of compression. The engines did not work with the same ease; and the result of experience was, that at 45 to 50 lbs. the maximum point of economy was attained. Calculating its cost, and taking a 40-horse power boiler to consume 10 lbs. of coal per hour per horse power, or two tons of engine coal per day of 11 hours, at 8s. per ton at the pit, the cost was 16s. per day. That boiler would drive an engine of sufficient power to supply four coal-cutting machines, being 4s. per day for each machine, and each machine would cut more coal in any given time, and do it in a better manner, in an ordinary seam, than 12 men; it followed, therefore, that the equivalent of a man's power exerted for a whole day in cutting coal would be obtained, out of compressed air, at a cost in fuel of but 3½d. At every stroke of the piston, the air was discharged from the cylinder of the coal-cutting machine at a temperature of about freezing point, compressed into one-third of its natural bulk, and it had been found that the working of only one machine had had the effect of reducing the temperature at the working face of the coal to the extent of two degrees of Fahrenheit. Occasionally, ice was formed at the escape valves of the machine, but without producing any inconvenience to their working. Now, anything that would reduce the temperature of a mine, was an inestimable advantage. It diminished the risk of explosion, and by increasing the velocity of the ventilating current, it rendered the occupation of a miner more tolerable and more healthy. There was another useful purpose incidental to the use of coal-cutting machinery in mines, and that was in the event of a pit being on fire. At West Ardsley a "blown out shot" ignited the gas and set fire to the goaf. It extended to the face of the coal, and had taken strong hold of it, and the whole pit was in the greatest danger. There was a large water tank at the surface for supplying the boilers and coke-ovens, and the manager promptly connected the air-pipes to the water-tank, and turned the water into the fire. In less than an hour the fire was completely extinguished without any serious damage. On a previous occasion the same colliery was on fire and had to be closed up. That fire cost many thousands of pounds. It happened before the introduction of the coal-cutting machinery. Compressed air was also becoming extensively used for "hauling" purposes, and with very great advantage. Small engines could be set up wherever convenience or necessity might require; they were portable, and removable at a trifling expense, and available where no other mechanical power for tractional purposes could be obtained. It was also valuable for pumping water and "drilling" the holes where the coal has to be "blasted," or broken down by the hydraulic press. The machine for cutting the coal had for several years been employed at West Ardsley without any interruption. Its weight was about 15 cwt. for an ordinary sized machine, its length 4 feet, its height 2 feet 2 inches, and the gauge 1 foot 6 inches to 2 feet. It was very portable and easily transferred from one bank to another. The front and hind wheels of the machine were coupled together in a similar manner to the coupled locomotive engine. The "pick" or cutter was double-headed, whereby the penetrating power was considerably increased. The groove was now cut to a depth of 3 ft. to 3 ft. 6 in. at one course, whereas, by the old form of a single blade, the machine passed twice over the face of the coal to accomplish the same depth. The points were loose and cottered into the boss, so that when one was blunted or broken it could be replaced in a few moments. It dispensed with the necessity of sending the heavy tools out of the pit to be sharpened, and was an immense improvement upon the old pick. When all was in readiness for work, the air was admitted, and the reciprocating action commenced. It worked at a speed of sixty to ninety strokes per minute, varying according to the density of the compressed air, the hardness of the strata to be cut, or the expertness of the attendant. As to the quantity of work in "longwall," a machine would, under favourable circumstances, cut twenty yards in an hour to a depth of three feet, but ten yards per hour was very good work, or sixty yards in a shift. This was about equal to the day's work of twelve average men, and the persons employed to work the machine were one man, one youth, and one boy, who removed and laid down the road, and cleared away the *débris*. The machines were built so strong that they rarely got out of working condition. Some of those working at West Ardsley had been in constant use for three or four years. At that colliery there were about eight machines in use. One of the seams was so hard and difficult to manage that it could not be done "by hand," and the proprietors had to abandon, and did abandon it, but now, by the employment of the machines, it was worked with perfect ease. It was a thin cannel seam with layers of ironstone, and the machines now "holed" for about 1,200 tons per week. The groove made by the machine was only two to three inches wide at the face, and one and a half inches at the back; whereas by hand it was 12 to 18 inches on the face, and two to three inches at the back. In thick seams worked by hand the holing was often done to a depth of 4 ft. 6 in. to 5 ft., and the getter was quite within the hole that he had made, and where the coal did not stick well up to the roof, or where there was a natural parting there was great difficulty and danger from "falls of coal;" but by machine "holing," with a perfectly horizontal groove, when the coal falls, it simply settles upon its own bed, and has no tendency to fall forward. For an outlay of £5,000 all necessary power and plant for the regular working of eight machines, with two in reserve, would be provided; and, estimating that each machine would cut 60 yards per day, the product in a four-feet seam would be 85 tons per day, or per week say 500 tons per machine, or 4,000 tons in all. At that rate of expenditure and work done, an allowance of 2d. per ton would in three years liquidate the entire outlay. But there was no reason why the machines should be restricted to a single shift daily; indeed, it was far more economical to work double shifts; there was no additional outlay of capital, and, so far as depended upon the machinery, the output might be easily increased to 8,000 tons per week. As to the relative costs of cutting the coal by hand and by machine, in the Middleton Main or Silkstone bed, where the depth of the mine was 160 yards, the coal four feet thick, and there were two bands of shale, with a thin layer of coal between them, by hand-labour 30 men would produce 60 tons per day, or two tons each, and by machine 17 men would produce the same tonnage. The saving in number, therefore, would be twelve men to every 60 tons, or upon a colliery getting 4,000 tons per week, the saving would be 132 men. The cost of dwellings properly to domicile one-half of this number would exceed the first outlay of capital in furnishing a first-class colliery with first-class machinery for cutting the coal, and it must not be forgotten that the equipment of the hand cutters in tools formed a considerable item in the first cost of fitting up a colliery. It had been generally supposed that the machines were not adapted for "pillar and stall work." That their locomotion "is not so easy as that of men" must of course be admitted, but they were removed from place to place with little more trouble than a full corve, and careful experiments proved that there was in "pillar and stall" about equal advantage as in "long wall." There were some advantages in the machine over the hand-working, which pertained to the general mine account, viz., the larger size of the coal brought out, and an increased average price, on sale, with a saving in timber and other stores. In conclusion, Mr. Frith observed :—"Considering the vast extent of the trade in coal, and the stupendous consequences of a short and insufficient supply, and believing that the speediest adoption of coal-getting machinery is desirable, I have myself made some efforts to stimulate that object by an offer of a premium of £500 for the best machine that could be produced, but those efforts have failed, and I now submit that the question is one specially entitled to the support and encouragement of the government, and that the British Association is pre-eminently the channel through which that object could be obtained in the best manner."

During the first few days of September, 23 ships, of an aggregate burthen of 46,880 tons, passed through the Suez Canal, yielding a transit revenue of about £20,000.

The great international bridge across the Niagara, between Buffalo and Fort Erie, is expected to be completed and opened in the course of this month. It was commenced in October, 1870, and its cost will be about £220,000.

The demand for Cape Breton (Nova Scotia) coal continues good. The quantity of coal raised and shipped from Nova Scotia, up to the middle of this year, was in excess of the extraction of the corresponding period of 1872.

The *Times* correspondent at Calcutta states that the Sirdar of Sanjoo and some Yarkund officers have arrived at Shidoola, with a firman from the Atalik, ordering an honourable reception to Mr. Forsyth's mission.

The Agricultural Department at Washington announces that in an average of 95 districts in the United States the wheat crop in quantity is equal and in quality superior to that of 1872.

The Turkish Ministry of Public Works has undertaken the construction of the Yamboli and Shumla road section of a projected line between the Philippopoli and Adrianople, and Varna and Rustchuk lines.

PRIZE LIST OF THE SOCIÉTÉ INDUSTRIELLE DE MULHOUSE.

The following is a translation of the list of the prizes offered by this Society. It is given here for the sake of comparison with the premium list of the Society of Arts.

It may be well to mention that the following prizes, with very few exceptions, are open to general competition. They will be decided in May, 1874.

There are three classes of medals, all of bronze, but differing in size:—Medals of honour; 1st class medals; and 2nd class medals.

SPECIAL PRIZES.

Emile Dollfus Prize (*medal of honour and a sum of* 5,000 *francs*), given every ten years to the author of the discovery, invention, or application which proves of the greatest value to the industries of the Haut-Rhin since the last granting of the prize. (To be given in 1879.)

Daniel Dollfus Prize, the same as the above, but to be given in 1874.

Galathé Prize, a sum of 1,200 francs a year, to be distributed under certain conditions among Alsatian workmen of good conduct and industrious habits.

GENERAL PRIZES.

Chemical Arts.

1. An essay on the theory of the manufacture of Turkey red. (*1st class medal.*)

2. A theoretical essay establishing the chemical constituents of the substance, or substances, which accompany alizarine in garancine, and which, in concert with this colouring matter, produce the dyes called garancine. (*1st class medal.*)

3. For the manufacture and delivery to the calico manufactories of Alsace of an artificial product, capable of entirely replacing the colouring matter of garancine, and which, both as regards price and quantity, is fitted for industrial purposes. (*Medal of honour.*)

4. For the preparation of vivid lakes from garancine, both red and violet. (*Medal of honour.*)

5. For a substance which can be used to thicken colours, sizes, or dressings, and which will replace, at a saving of at least 25 per cent., all the substances hitherto employed for these purposes. (*Medal of honour.*)

6. For a substance which can replace the dry albumen of eggs in the manufacture of printed calicoes, and give a large saving on the price of albumen. (*Medal of honour.*)

7. For colourless albumen from blood, which will not colour by evaporation. (*Medal of honour.*)

8. For an important improvement in the bleaching of wool or silk. (*Medal of honour.*)

9. For a method of bleaching which will remove from unbleached cotton all amylaceous substances, without injuring the tissue, and without any great increase of expense. (*Medal of honour.*)

10. Essay on the employment of resins in the bleaching of cotton fabrics. (*1st class medal*).

11. For an ink for marking cotton fabrics intended to be dyed with plain grounds, red, puce, and other dark colours. This ink must show plainly after undergoing all the operations required for these dyes. (*1st class medal*).

12. For an essay on the action of different kinds of cotton under processes for bleaching and colouring. (*Medal of honour.*)

13. For a blue which can be used for dyeing wools blue, and which will resist the action of steaming and light. (*1st class medal.*)

14. For any improvement in chemical products as regards purity and concentration—acids, alkalies, soaps, colouring matters, and decoctions. (*1st class medal*)

15. For one or other of the following colours:—Metallic red, dark metallic green, metallic violet, garnet, and a shade of the series from pearl grey to dark, capable of being printed by rollers with albumen as thickening. (*Medal of honour.*)

16. For a theoretical and practical essay on cochineal red. (*Medal of honour.*)

17. For a transparent green, resisting light and soap, whose brightness, intensity, applicability to cotton fabrics, and price, render its use possible in manufactures. (*Medal of honour.*)

18. For an essay on this question: Can indigotine be recovered from its sulphuric acid compounds? (*2nd class medal.*)

19. For the first who delivers to the calico manufactories of Alsace an artificial product replacing advantageously the blue colouring-matter of indigo. (*Medal of honour.*)

20. For the first who delivers to the calico manufactories of Alsace an artificial product replacing advantageously the sulphuric acid derivatives of indigo. (*1st class medal.*)

21. For a new process of fixing, by printing, aniline colours in a more complete way than by albumen. (*1st class medal.*)

22. For an aniline black, soluble in any vehicle, which can serve as a dye, and can resist the action of light and soap, as well as true aniline black. (*Medal of honour.*)

23. For a new black of the same intensity and the same solidity as aniline black, which will not weaken the fabric, and will bear contact with all other colours, especially those mixed with albumen, without itself injuring the shades with which it is associated. (*1st class medal.*)

24. For an essay on the composition of aniline black. (*Medal of honour.*)

25. For a scarlet red susceptible of applications similar to those of the aniline colours, which will not be more fugitive than them, and not dearer than a cochineal crimson. (*Medal of honour.*)

26. For any reproduction, by an artificial or natural alkaloid, of the reactions which, with aniline, toluidine, naphtylamine, produce red, blue, green, and black. The essay should be accompanied with samples, and will receive a prize even if industrially inapplicable. (*Medal of honour.*)

27. For a method of increasing the solidity of artificial colouring matters. (*Medal of honour.*)

28. For a certain and practical method of bringing aniline black, immediately after printing, to the maximum of oxidation, without having recourse to ageing, and without damaging the fabric or injuring the metal employed for printing. (*1st class medal.*)

29. For the introduction into manufactures of calicoes printed in a new colour, which is developed and fixed under conditions analogous to those under which aniline black is produced; which shall also be impervious to air and light, and resist the action of soap, alkalies, and acids. (*Medal of honour.*)

30. For a metallic alloy or other substance fitted to serve for doctors, and which unites to the elasticity and hardness of steel the property of not causing any chemical action in the presence of acid colours, or colours charged with certain metallic salts. (*Medal of honour.*)

31. For any great improvement in the engraving of cylinders. (*Medal of honour, or* 1*st class medal.*)

32. For the best practical manuals on one or other of the following subjects:—1st. Engraving printing cylinders. 2nd. Engraving printing blocks. 3rd. Bleaching cotton, wool, wool and cotton, silk, hemp and linen. (*Medal of honour of the* 1*st or* 2*nd class, according to the merit of the essay.*)

33. For an essay on this question—At what degrees of damp and heat does the decomposition of mordants act with most rapidity and most advantage? (*1st class medal.*)

34. For a new cylinder machine, able to print at least eight colours at a time, and offering some advantages over those at present employed. (*Medal of honour.*)

35. For introducing or manufacturing in Alsace cylinders of cast-iron, covered with copper by electro-plating, which are to be used in printing calicoes. (*Medal of honour.*)

36. For a series of new colours, with metallic bases, unchangeable by the action of air and light. These colours, specially intended for for use as plain colours, must be fixed otherwise than by albumen, and be able to bear washing. (*Medal of honour.*)

37. The best system of vats for dyeing and soaping. (*1st class medal.*)

38. For the discovery or introduction of a method useful in the manufacture of printed fabrics or chemical products. (*Medal of honour of the* 1*st or* 2*nd class.*)

39. For a method of recovering the sulphur contained in hydrosulphuric acid. (*1st class medal.*)

40. For an apparatus transmitting thermometrical indications to a distance. (*1st class medal.*)

41. For an apparatus marking automatically the temperature and the hygrometrical state of the air in the drying-houses of calico factories. (*1st class medal.*)

42. For a new method of treating the different kinds of oil used for lubricating machines. (*Medal of honour.*)

43. For an essay on the relative inflammability of the animal, vegetable, and mineral oils used in workshops for lubricating machines. (*1st class medal.*)

44. For an essay indicating some process by which mineral oils may be rendered less inflammable while their lubricating properties are preserved. (*Medal of honour.*)

45. For the production of carminic acid by synthesis. (*Medal of honour.*)

46. For introducing into manufactures artificial orcine. (*Medal of honour.*)

47. For the preparation of vermilion on cotton fabrics. (*Medal of honour.*)

48. For a blue, analogous to ultramarine as to shade and solidity, to be fixed on fabrics of cotton by a chemical process, without the help of albumen or any other thickening substance producing adhesion by coagulation. (*Medal of honour.*)

49. For a practical method of extracting from garancine the orange red colouring matter, the price of which will admit of the use of this product in printing cotton fabrics. (*Medal of honour.*)

50. For the first delivery to the cotton factories of Alsace of a pipeclay, either natural or artificial, in impalpable powder, which will serve to thicken the colours used for cylinder printing; it must be entirely free from the hard and sandy substances which nearly always accompany it. (*2nd class medal.*)

51. For the best system of vats for dyeing. (*1st class medal.*)

52. For the production of carminic acid by synthesis.

Mechanical Arts.

1. For an essay on the spinning of cotton, No. 80 to 200 *metriques.* (*Medal of honour.*)

2. For an essay on the spinning of combed wool, after the best system now known. The essay must be accompanied with detailed plans, and with descriptions of all the machines used in the spinning. (*1st class silver medal*)

3. For the invention and use in Alsace, with advantage over the systems now known, of a machine, or series of machines, preparing all kinds of long-staple cottons for combing, in a more convenient manner than that at present in use. (*Medal of honour.*)

4. For the invention and use in Alsace, with advantage over the systems now known, of a machine, or series of machines, for opening and cleaning all kinds of short-staple cottons, so as to

prepare them properly for the action of cards, preparing machines, and combing machines, if, at the time of the invention, any such machines exist for short-staple cottons, or for any analogous machines. (*Medal of honour.*)

5. For the invention and use in Alsace, with advantage over the systems now known, of a combing machine, or series of such machines, for the short-staple cotton used for spinning the ordinary numbers, and which may advantageously replace the carding, or one of the two cardings, and even, if possible, to a great extent, the beating and picking, or cleaning of the cotton, as the Heilmann and Hübner combing machines now do for the long-staple and the fine-spun cottons. (*Medal of honour.*)

6. For a method of winding the threads on bobbins or spindles, more economical than that now in use. (*1st class medal*)

7. For an essay on the motive power necessary to put in motion a series of machines, under various systems. (*Medal of honour.*)

8. For a simple and practical method of clearing the cotton from the cylindrical cards of the Heilmann and Hübner carding machines. (*1st class medal.*

9. For a complete well-grounded theory of carding, with a description of the different kinds of cards. (*Medal of honour and* 500 *francs.*)

10. For an exhaustive essay on the spinning of Indian cotton. (*Medal of honour or* 1*st class medal.*)

11. For the manufacture and sale of new fabrics in the department. (*1st class medal*)

12. For the dressing of fine-spun, above No. 70, on the sizing machine. (*Medal of honour.*)

13. For an important improvement in the method of weaving, such as a stopping motion, under the form of a simple apparatus, which will not interfere with the workman in his work, and will stop the loom every time that a thread of the warp breaks; the simultaneous weaving of two pieces on one loom; joining, while in motion, any broken warp threads; change of shuttle during motion, without stoppage and without flaw in the fabric; remarkable improvement in the arrangement of harness, &c. (*Medal of honour.*)

14. For the first who uses in the department of the Haut-Rhin a steam-engine on a new system, only consuming nine kilogrammes of steam per horse-power per hour, the motive power to be measured by a dynamometer on the fly-wheel shaft. (*Medal of honour.*)

15. For a new means of determining the quantity of water carried by the steam out of boilers. (*Medal of honour and* 500 *francs.*)

16. For a new improvement in the construction or arrangement of water-tube boilers. (*Medal of honour.*)

17. For the first builder who constructs and puts up in the department of the Haut-Rhin fixed boilers, other than water-tube boilers, which will give 75 per cent. of the heat given out by the coals burned in the furnace. (*Medal of honour.*)

18. For the best stokers of the boiler furnaces of stationary engines. (*Six silver medals, and five sums of* 100, 50, 25, 25, *and* 25 *francs.*)

19. For an essay, based on a sufficient number of experiments, which must be detailed in an accompanying note, on the relation which exists in the various sorts of steam engines between the indicated and effective horse-power. (*Medal of honour and* 1,000 *francs.*)

20. For an improved self-calculating steam engine. (*First-class medal.*)

21. For an essay, accompanied by a sufficient number of experiments, on the dimensions of the chimneys of steam generators. (*Medal of honour and* 500 *francs.*)

22. For a new system of economical heating of boilers, founded on the principle of the preliminary transformation of the combustibles into gas, and permitting, if required, the collection of the products of the distillation of the coal. (*Medal of honour.*)

Building.

23. For the best essay on the most convenient methods of constructing the buildings and machines for a cotton spinning-mill, or of a power-loom factory. (*Medal of honour and* 500 *francs.*)

24. For the manufacture and sale in the department of the Haut-Rhin of less expensive bricks than those now in use. (*Medal of honour.*)

25. For the best plan for workmen's houses. (*Medal of honour and* 500 *francs.*)

Machine Accidents.

26. For the industrial establishment in the Haut-Rhin which, under equal conditions, shall have applied to the arrangements of its machines the most complete precautions against accidents, or for the builders who have most sought to apply these precautions. (*Medal of honour.*)

27. For the invention and use in an establishment in the Haut-Rhin of an instrument or arrangement not yet employed in the department, fitted to avert from the workmen the accidents caused by the machines or belts, shafting, &c. (*Medal of honour.*)

28 Special prize for the directors of manufactories associated with the object of preventing accidents. The prize goes to the director who has taken the greatest precautions against the chances of accident.

MISCELLANEOUS PRIZES.

29. For new researches, theoretical and practical, on the movement and the cooling of steam in large steam pipes. (*1st class medal and* 1,000 *francs.*)

30. For a complete essay on the transmission of motive power. (*Medal of honour and* 500 *francs.*)

31. For a new method of treating the different kinds of oil proper for lubricating machines. (*Medal of honour.*) (See prize No. 42 for Chemical Arts.)

32. For an essay on warming workshops by the steam used therein; more especially spinning workshops (*1st class medal and* 500 *francs.*)

33. For the execution of a project for restraining water by means of dykes or weirs, applied to one of the water courses in the department of the Haut-Rhin, and capable of fulfilling the double object of preventing floods, and of forming, during dry seasons, a reserve of water for agricultural and industrial purposes. (*Medal of honour.*)

34. For the invention and employment of a new meter for water, applicable to steam generators (*Medal of honour.*)

35. For an essay on the motive power necessary to put in motion the various machines of a spinning-mill or power-loom factory. This essay should be based on direct dynamometrical experiments. (*Medal of honour.*)

36. For the best essays, in the form of practical treatises, résumés, or manuals, applying to one or other of the following industries, and intended specially to be put into the hands of heads of workshops, foremen, and workmen. Cotton-spinning; spinning of combed wool; spinning of carded wool; spinning of silk-waste; weaving of cotton; twisting of cotton, wool, or silk; manufacture of paper; construction of machines. In these various industries one or other of the following subjects may be treated by itself Erection of machines; lubrication in general; lighting workshops; heating; transmission of motive power; precautions against accidents due to machines; management of steam engines and boilers (2 *medals of honour*, 2 1*st class and* 2 2*nd class medals, according to the respective merits of the essays.*)

37. For a new machine for cylinder printing, capable of printing at least eight colours at a time, and offering advantages superior to those now in use. (*Medal of honour.*) (See No. 34 of the Chemical Arts' prizes)

38. For an alloy of metal, or other substance, fitted to replace advantageously, under all circumstances, the gun-metal employed in the construction of machines. (*1st class medal.*)

39. For the first baker in the department of the Haut-Rhin who offers for sale 40,000 kilogrammes of bread baked with coals. (*Medal of honour.*)

40. For a new method or apparatus fitted to give the air of spinning rooms and weaving rooms the degree of humidity necessary to facilitate the work. (*1st class medal.*)

41. For any important improvement in the method of using metallic belts for transmitting power. (*1st class medal*)

42. For the invention and application of a pyrometer capable of gauging the temperature of the gaseous products of the coal burned under steam generators. (*Medal of honour.*)

43. For various improvements in centrifugal machines. (*1st class medal.*)

44. For an improvement in the arrangement of wells or in the arrangement of pumps, affording better results than those hitherto obtained. (*1st class medal*)

45. For an essay—calculated from experiments—on the conditions required for making wells in Mulhouse or its environs. (*1st class medal and* 500 *francs.*)

46. For a rotary, forcing suction-pump, giving equal results with the best piston pumps in use in the department of the Haut-Rhin; the raising column must be at least 8 mètres, and the price, for the quantity of water raised, less by half. (*Medal of honour.*)

47. For a gas-motor presenting some advantages over those hitherto tried at Mulhouse. (*Medal of honour.*)

48. For applying to Mulhouse a tramway for the transport of merchandise, and specially coal, available for common roads. (*1st class medal.*)

49. For the first application to Mulhouse of a new means of transport, designed especially for short distances, and fit to facilitate communication in the interior of a large factory. (*1st class medal.*)

50. For the invention or introduction into the Haut-Rhin of a counting apparatus of revolutions or strokes, applicable to motors, shafting, and also pumps, &c. The price not to exceed about 20 francs. (*1st class medal.*)

51. For a new indicator, specially designed for the spindles of looms, and capable of registering up to 10,000 revolutions a minute (*1st class medal.*)

52. For a new burner for coal-gas, utilising more thoroughly than known burners the light produced by combustion; it must be simple and cheap, and grounded on a new principle. (*Medal of honour.*)

53. For a simple automatic method of regulating the admission of steam into bleaching or dyeing vats, so that the consumption of steam may always correspond with the desired result. (*Medal of honour.*)

54. For an essay determining the most reasonable proportions to adopt for the parts of the machinery which are exposed to friction, such as trunnions, pivots, tooth-wheels, &c., under the ordinary conditions of lubrication. (*Medal of honour.*)

55. For the introduction and employment in the industry of the Haut-Rhin of a machine or mechanical apparatus, the result of the use of which would be a great economy of hand labour, which would more than repay the cost of its erection and maintenance. (*Medal of honour.*)

56. For the introduction into a large industrial building in course of erection in the Haut-Rhin, single-storied or in stories, of a system of ventilation utilising the fresh air of the nights or of subterranean places, maintaining the interior air at a temperature of five degrees centigrade at least below the medium exterior temperature during the greatest summer heat, and that without injuring the working conditions of the establishment. (*Medal of honour.*)

57. For introducing into the Haut-Rhin a mechanical refrigerating apparatus, capable of maintaining, without much expense, in a room containing machines heated with steam or gas, a maximum temperature of 30 degrees centigrade during the greatest summer heat, and

that without injury to the working condition of the machines. (*Medal of honour.*)

NATURAL HISTORY AND AGRICULTURE.

1. For a geognostical or mineralogical description of a part of the department. (*1st or 2nd class medal.*)

2. For a classified catalogue of the plants of the arondissements of Mulhouse or Belfort, or of only one or two cantons in these arrondissements. (*1st or 2nd class medal.*)

3. For an essay on the fauna of Alsace. (*1st class medal.*)

4. For an essay on the cellular cryptogams of the Haut-Rhin. (*1st or 2nd class medal.*)

5. For a study on the subterranean water-level of the plains of Sundgan, and especially of the arrondissement of Mulhouse. (*1s or 2nd class medal.*)

PRIZES OF THE COMMITTEE OF COMMERCE.

1. For an essay treating of the different uses of alcohol in the industrial arts, and pointing out a new and practical way of "denaturalising" this liquid. The process indicated must reconcile the interests of industries with the demands of the excise. (*Medal of honour.*)

2. For the commercial house in China, Japan, Australia, or India, which first proves that it has sold, during one year at least, 100,000 francs' worth of the industrial products of the Haut-Rhin, and that at a sufficiently remunerative price to allow of the trade being carried on. (*Medal of honour.*)

3. For an essay giving an account of the commercial houses founded by the English in China and Japan since the conclusion of the last treaties of commerce between these countries and foreigners. (*Medal of honour.*)

4. For the tenant or proprietor who, breeding sheep in Alsace, perfects the race of sheep in the country as regards the firmness and evenness of their wool, by crossing it with the Champagne breed or other analogous French breed. The flock must consist of at least 500 head, born in Alsace. (*1st class medal.*)

5. For a sure and practical method of refacing the surface of copper or bronze cylinders which have been engraved for printing, so as to preserve their original circumference, without injuring the capacity of the metal for taking a new graving. (*1st class medal.*)

6. For researches made in China or Japan with the object of procuring from these countries raw material which will save at least 20 per cent. in producing certain chemical products, such as tartaric acid, citrate acid, borax or boracic acid, &c. (*1st class medal.*)

7. For any consul who, by means of information supplied to the Industrial Society, may have contributed or shall contribute to establish new commercial relations between Alsace and the countries to which he is accredited. (*Medal of honour.*)

8. For the Algerian planter who proves that he was the first to furnish, during three consecutive years, one or more Alsatian spinning-mills with cottons of his own growing, of regular quality, and, as far as possible, approaching the medium quality of long-staple Georgia in length, strength, fineness, and brilliancy. (*Medal of honour.*)

9. For an essay pointing out satisfactorily the influence which the rapidly increasing production of wool exercises over cotton industry. Point out in this essay at what rate the production of wool, especially of Australian, has increased during the last ten years; describe the light fabrics made of pure wool, wool mixed with silk, thread, or cotton; indicate approximately the respective quantities produced in France, England, and Germany, and their prices in the principal European markets. (*Medal of honour.*)

10. For an essay, written from a practical and financial point of view, discussing the establishment of a canal, drawing the water supply from the Rhine, by Huningue for example, which should descend to Strasbourg, traversing the departments of the Haut and Bas Rhin. (*Medal of honour.*)

11. For the person or society which introduces and practises the culture of madder in Algeria. (*1st class medal.*)

12. For the best essay on the utility to the commerce and industry of Alsace of having a complete system of transport by water-ways. (*1st class medal.*)

PRIZES OF THE COMMITTEE OF HISTORY AND STATISTICS.

Medal of honour of the 1st or 2nd class, according to merit, for:—

1. A complete history of one of the principal branches of industry of the Haut-Rhin.

2. Complete biography of one or more of the principal inventors or promoters of industry in the Haut-Rhin.

3. Statistical researches on the working population of Mulhouse; its history, condition, and methods of improving that condition.

4. Determine, by incontestable evidence, the variations, during the last century in the Haut-Rhin, of pay for a day's work. Show the price of a hectolitre of wheat, and other necessaries of life during the same period.

5. A map of the department of the Haut-Rhin during the Gallic-Roman period.

6. A map of the feudal divisions existing in the Haute Alsace at the beginning of the 17th century.

7. A list of the industrial establishments of the Haut-Rhin in 1789 and 1870.

8. History of the means of communication in the Haut-Rhin, with an examination into their influence on commercial prosperity.

9. History of the means of communication in Alsace, and their influence on commerce and industry.

10. Critical study, enumerating and estimating the archæological, historical, and statistical work done in Alsace since the beginning of the present century.

11. Value, in present French money, of the different coins current in Alsace from the 14th century; point out their connection with those of adjoining countries.

12. Same work for weights and measures.

13. Production of authentic documents relating to the existence of cotton industry in Alsace, from the 13th to the 17th centuries.

14. Practical guide for tourists in the Vosges. (To be written in French.)

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15. Short history of the town of Mulhouse until the period of its union with France, written with a special view to its legislation, and the customs and the habits of its citizens. (*Medal of honour and 100 francs.*) (To be written in French.)

16. A monograph or history of any particular place in Alsace, from the most ancient times up to the present; or an interesting historical essay about all or part of our province; or a collection of historical researches on the same subject. (*1st or 2nd class medal.*)

COMMITTEE OF PUBLIC UTILITY.

For a collection of at least 400 arithmetical problems, for the use of primary schools, and for adult classes in industrial towns. (*1st or 2nd class medal according to merit.*)

2. For a statistical essay on the food-supply of Mulhouse. (*Medal of honour.*)

3. For an essay on the principal improvements introduced during the last 10 years in one of the following points, as regards the working-classes:—1. Food supply. 2. Clothing. 3. Lodging and heating. 4. General hygiene. 5 Economy and providence. 6. Instruction and recreation. (*Medal of honour.*)

4. Prize for a study of the means of combating excessive heat in ground-floor or garret workshops, and storied buildings, whose aspect, large expanse of glazed surface, or inclination of windows, exposes them particularly to the sun during the summer.

5. Prize for an essay on the improvements in fire-engines, during the last ten years.

6. Prize for an essay, showing the best organisation for the fire-service in industrial establishments, and the precautions needed to avoid or lessen the risk of fire in the workshops where dangerous trades are carried on.

7. For an essay treating of the possible results in the Haut-Rhin, of working, by a society *par actions*, those industries which, since their origin have been in the hands of a society *en nom collectif*, and of the means of remedying the defects which this new state of things might have from some points of view. (*Medal of honour.*)

8. For any industrial undertaking, society *en nom collectif*, or society *par actions*, anonymous or *en commandite*, established since 1872, which shall have assured to its workmen by its statutes a part of its profits, to be dedicated to encouragements for economy and providence, or to aid them in any other way. (*Medal of honour.*)

9. For an apparatus to renew the air quickly in the drying-houses used to oxidise aniline black. (*1st class medal.*)

PAPER INDUSTRY.

1. For the production and use in France of a white pulp produced by the chemical disintegration of wood. The prime cost of this paper-pulp should be such that it can be used either alone or mixed, and replace rag-pulp advantageously, in white writing paper, or paper for printing of the usual kinds. (*Medal of honour and 4,000 francs.*)

2. For the best essay on the bleaching of rags. (*Medal of honour.*)

3. For the best essay on the sizing of paper. (*1st class medal.*)

4. For a method of neutralising or diverting the electricity which is often injurious to the manufacture of paper. (*1st class medal.*)

5. For a statistical essay on the condition of the paper industry in the principal states of Europe (France, England, Germany, Italy, Prussia, Spain, and Belgium) and in the United States of America. (*1st class medal.*)

COMMITTEE OF THE BEAUX-ARTS.

1. For an essay on the practical utility of drawing in connection with handicrafts, arts, and trades. (*Medal of honour.*)

2. Prize for a special history of styles, forms, and colours which have been most successful in printed fabrics, from the beginning of this industry in Mulhouse up to the present day.

3. Prize for a detailed memorandum of the styles of printing in vogue during the seasons 1872-73 and 1873-74, and their employment.

4. Prize for an analysis of the best methods used in teaching drawing at Paris, Lyons, Toulouse, and in the Schools of Art founded in England and Germany during late years. State also the best style of teaching for pupils designed for industrial engraving, who only remain at school for two or three years, and study drawing two hours daily.

MISCELLANEOUS PRIZES.

1. For any important improvement in any branch of the manufacturing or agricultural industry of the Haut-Rhin. (*1st or 2nd class medal or medal of honour.*)

2. For the introduction of any new industry into the Haut-Rhin, and for the best essays on industries which can be improved or be introduced into the department. If a new industry be in question, it must have been in active work in the department for at least two years. (*Medal of honour, or 1st or 2nd class medal.*)

PRIZES GIVEN BY THE ASSOCIATION FOR GUARDING AGAINST MACHINE ACCIDENTS.

1. A silver medal for the invention and employment of a means of preventing the numerous accidents due to the use of circular saws.

2. Silver medals for an essay grounded on the arrangements already existing or in use for preventing accidents to circular saws.

3. A silver medal for the invention of an arrangement for preventing accidents caused by circular combs in the machines for preparing wool for spinning.

4. A silver medal to the manager of any establishment who shall have applied automatic cleaning to 20,000 spindles, or, in establishments which only use from 10 to 20,000, to the whole number.

TECHNICAL EDUCATION IN FRANCE.

The following account of the present state of trade education and apprenticeship in France is given by a correspondent of the *Pall Mall Gazette*. If the view taken by the writer is correct, the state of technical education in France is, in many respects, little better than it is in England :—

The number of men who try to promote social reforms in France by other means than politics, and without invoking Government aid, is not large, but the few of this kind who have arisen from time to time have generally done much good; and it should be an encouragement to imitators that all the really useful French charities—crêches, convalescent homes for workmen, mechanics' loan societies, institutions for the deaf, dumb, and blind, and those admirable co-operative retreats, like the Hospice de St. Perine, where the aged of both sexes find a cheerful home for a sum which would scarcely suffice to keep them alive elsewhere—have all been born of private enterprise. The last institution due to the unassisted initiative of a few public-spirited individuals is that of apprentice schools, and these promise to render such valuable services to French trade that a few details concerning them may be of interest.

Since the first Revolution, which abolished all trade corporations, the position of French apprentices has been very unsatisfactory. The old guilds, with their antiquated rules, and their rage for public banqueting, were not perhaps, progressive bodies; but in their own rough way they kept an eye on apprentices, reproved and even punished the masters who were remiss in instructing them, and maintained among the apprentices themselves a wholesome emulation by means of frequent examinations, badges, and money prizes. There were, in fact, trade degrees like those in a university; and an apprentice, however rich he might be, could only become a master and set up shop after having obtained three certificates of proficiency. The first was bestowed after two years of apprenticeship; the second, with a coloured badge, at the end of the fifth year; and the third, with a silver badge, when the apprenticeship was concluded—in a brilliant manner. Those who declined submitting to these formalities might, indeed, establish themselves in country districts, or on the outskirts of large cities, but they were not admitted to the guilds; they enjoyed none of the privileges or protection extended by the State to those who plied their trades in the usual way, and their general situation was precarious and undignified. As a result of this system French mechanics were renowned the whole world over. If they went abroad, every country was ready to welcome them; and when it happened that they emigrated in large numbers, as after the Revocation of the Edict of Nantes, they soon founded prosperous communities, like that of the weavers in Spitalfields and of the watchmakers in Geneva. The Revolution should have confined itself to reforming the corporations by obliging them to be less arbitrary and exclusive. The sweeping away of all the guild rules in the name of freedom was a popular measure in that it multiplied enormously the number of master tradesmen, and brought into the cities thousands of peasants who under the old state of things would not have been able to earn a living there; but as an immediate consequence the reputation of French handicraft was lowered, and trades of which France had possessed almost a monopoly—the glove, feather-dyeing, and fancy furniture trades amongst others—became acclimatised in foreign countries. To remedy this evil, which was beginning to tell disastrously on the exports, Napoleon I. allowed the guilds partially to reconstitute themselves under the name of associations; but, owing to repeated wars, which drafted all able-bodied men into the army and rendered apprenticeships useless, these societies had no fair chance of acting till the Restoration, when they blossomed out with some force as political agencies, and were suppressed as a nuisance. Since then trade syndicates have been formed, and also trade unions; but the object of these has been only to further the pecuniary interests of men or masters. The task of developing the artistic or scientific excellence of trades has been left to chance or to a few technical schools for adults, which, after perfecting workmen at a great cost, mostly had the satisfaction of seeing them depart to America or England, where the best wages were to be had.

Apprentices meanwhile have had no one to look after them. A French mechanic's son is generally bound apprentice at haphazard, his special aptitudes for the trade he is to exercise being in no manner consulted. Either his father has been brought up to the trade in question before him, or if the boy be one of a numerous family, the sole point considered has been which trade called for the smallest premium. Now in the guild times premiums never varied, and care was taken that every tradesman who accepted apprentices should be thoroughly qualified to teach them. Nowadays, no qualification being needed, it is naturally the most incapable tradesmen who are keenest in trying to secure apprentices by low premiums. They take in a boy as pupil and treat him as a servant, send him out to carry parcels, make him sweep the shop, wash up plates and dishes, and let him pick up many more bad habits than good lessons. On the other hand, if a master does his duty conscientiously, he risks seeing his apprentice bolt as soon as the latter can earn paid employment; and as the law of 1850 relating to indentures gives a master no assistance in recovering an absconding apprentice except with the parents' consent, the parents are often the first to advise their sons to break away, especially if the sons bring any of their earnings home. The system is thus bad at the core; for, setting aside the cases where an apprentice serves his time fairly under a good master and becomes a first-rate workman by the age of twenty, most boys either grow up to be lazy and ill-conditioned young vagabonds, only fit for soldiering or street rioting, or go out into the world as half-trained mechanics, artisans of *camelote*, or shoddy, and bring the national workmanship into disrepute. On this last point the experience of recent years is but too eloquent—for nine-tenths of the journeymen tailors, shoemakers, upholsterers, carriage-makers, and watchmakers in Paris are Germans, Belgians, and Swiss. Yet there is no natural reason why this should be so. The Frenchmen of the last century made better coats and boots than the rest of the world, and their descendants might continue to do so still, were apprenticeships properly conducted. If twenty or thirty thousand Parisians famish in chronic misery in the slums of Montmartre and Belleville, while as many Germans earn their bread comfortably in the better quarters of the town, it is not that French masters are unpatriotically anxious to employ German labour. The Germans are better taught, that is all. They beat the French in war by education, and they are defeating them in peace by the self-same weapon.

Apprentice schools, of which two are being founded, one at Havre and the other at La Vilette, in Paris, purpose to cope with this state of things by giving boys a trade education at a cost but little higher than that of the primary education in communal schools. The special aptitudes of boys will be taken to account, and the mechanics set to teach them will be the best that can be procured; the boys will also be admitted very young, so that their training may begin two or three years earlier than a usual apprenticeship. Originally, the committee of gentlemen who started this scheme intended to manage the schools privately by the aid of voluntary contributions; but the Havre and Paris town councils having taken the whole plan under their patronage, and voted funds for the support of the schools, it is probable that the first scheme will be much extended, and that a special school will eventually be set apart for each sort of handicraft. Meantime, the National Assembly will be appealed to that the apprentice laws of 1850 may be rendered more stringent, and that it may provide inspectors to see that apprentices are better attended to by their masters. If these reforms succeed—as one must certainly hope they will—in rendering the working classes of France more industrious and contented than they at present are, a greater step will have been made towards regeneration and *revanche* than any of the distracting projects of restoration or consolidation at present under discussion can ever compass.

THE ORIENTAL CONGRESS IN PARIS.

The first session of this new institution in Paris has terminated, after twenty-one meetings.

A full report of the proceedings, and papers read, will be drawn up and printed for circulation amongst the members of the Congress, but this operation will require considerable time, and, moreover, the report will probably not be published.

In the first place, it may be mentioned that the second session of the Congress is fixed to take place in London.

The address of his Excellency, Samé-Sima, the Japanese Envoy in France, naturally created great interest, especially as he spoke in excellent French. He expressed the great sympathy which his Government felt in an undertaking which, amongst other important results, would, it was hoped, lead to the formation of a European linguistic alphabet, applicable to the publication of Japanese works.

The following are extracts from the Minister's speech:—

"Your presence here to-day, gentlemen, is the first public illustration in Europe of the entrance of Japan into a community of object and views for the future, with the Western nations. We have already established political and commercial relations, but this is the first creation of an intellectual connection, and I doubt not that education will some day attain in Japan a power which will enable us to establish with you, in our turn, those social relations which alone really unite nations, because they alone dispel ignorance and prejudice.

"I beg leave to draw your attention to a question which may have a very useful bearing: Japanese writing has, in practice, ceased to be purely alphabetical—it has become to a considerable extent ideographic. In this mixed form it answered our purposes until we came into communication with foreign nations, but now that we begin to employ European ideas and words, we find that it is almost impossible for us to write them. It is therefore absolutely necessary that we should reform our system of writing. We are already engaged in the study of this important subject, and I take upon myself to point out these facts, in the hope that you will aid us with the light of your intellects.

"We are laying here the foundations of a mutual association for the benefit of all; but you will not, I am sure, accuse me of national egotism when I declare frankly that I hope my country will profit more than Europe by your labours, for we have more need of your assistance than you have of ours."

In reply to this appeal it was announced a few days later, at a meeting of the Congress, that what the Ambassador desired had been accomplished in a most satisfactory manner, and the President, Admiral Roze, announced that the task of transcribing Japanese texts in European letters had been accomplished.

It is almost unnecessary to state that the formation of an alphabet of Roman characters, and an orthography, raised many difficult problems; the alphabet alone presented great difficulties, for nearly the whole of the immense Chinese vocabulary has gradually been introduced into the Japanese language. The Japanese declensions also presented great difficulties, as they form at the present time six or seven cases, while, according to a critical examination of the different grammatical categories of the Nippon idiom, they really should only form two.

The new alphabet was formed in the bosom of the Congress itself, by the representatives of France, England, Italy, Switzerland, Prussia, and Holland, and has received the sanction of most of the known Japanese in Europe, and Dr. Richard Lepsuis, of Berlin, assured the Congress that he should be pleased to adopt it in his universal linguistic alphabet.

Several Japanese savants assisted in the drawing up of this alphabet, one of the greatest inducements being that with the innumerable signs at present in use in Japan it is almost impossible to establish good newspapers, for which the Japanese have a great desire; with a well-conducted press they hope to be able to contend at once with the corruption and faults of the local governments and the ignorant prejudices of the people—and, we may add, of the old Damios. A curious story is told respecting the editor of a Jeddo journal lately suppressed, after repeated warnings, who, instead of being imprisoned and heavily fined, as he would have been a short time since, was appointed by the minister to a post of great importance in the government.

Amongst the subjects treated by the Congress was that of the political, social, and industrial organisation of Japan, introduced by M. Ed. Mudar de Montjan, who had resided for a long time in the country, and that of the religion and morality of the people, the latter relative to the curious fact that the Japanese seems to reject on principle the notions of modesty accepted by other nations. The majority of the speakers maintained that the Japanese were remarkable for high morality, and the president, Admiral Roze, declared, after long sojourn in the country, that the "Japanese woman was in all respects an Eve before the fall."

M. De Rosny, the originator of the Congress, described the religious changes which are going on in Japan, describing the characteristics of the new form as Neo-Buddhism; while a Japanese savant, M. Imumurer, who spoke French fluently, followed in the same subject, and lamented the unfortunate influence of the doctrines of Confucius. Finally, it was announced that a religious congress, on a basis of eclecticism, was to be held at Yeddo shortly.

The vexed question of the ethnography of the Japanese naturally occupied much of the time and attention of the congress, but the discussions were far too long and too involved to be capable of analysis in this place; one of the most remarkable assertions, however, may be mentioned:—M. De Bosny, professor of Japanese in the College of France, stated that the system of cuneiform writing was identically the same as that of the Japanese, and that the language of the latter people presents the greatest similarity in the orthography, and grammar, not only with the Manchou, Mongul, and Thibet idioms, but also with the Turkish, Magyar, and Finnish languages.

The subject of silkworm rearing and breeding was of course not forgotten, and M. Guerin Meneville gave the result of his long studies of the true silkworms of Japan, as well as of the *Yama-maï* and other silk-yielding insects.

Mr. Robert Douglas, of the British Museum, introduced the interesting subject of the ancient history of China, and succeeded in obtaining the promises of many of the Oriental scholars present to assist in a translation of the official annals of the dynasty of the Han.

M. Ducaurier, of the Institute, communicated the results of his long researches on the origin of the oceanic races, from Madagascar to Easter Island, in Eastern Polynesia, and from Formosa and Hawaii to the southern limits of New Zealand; and a Dutch *savant*, the Abbé Langennof, recounted the ethnographical results of his journeys in a central district of the island of Borneo, where, as yet, the Abbé is said to have been the first explorer.

M. Chalvet de Rochemonteix read to the Congress an account of his researches into the relationship of the ancient Egyptians and the Berberes, and the affinity of their idioms. Other and very important communications related to the ideas entertained by the ancients of the immortality of the soul; the necessity for a new translation of the Scriptures; the history of the literature of Syria; the epoch of Zoroaster; the date of the Zend-Avesta; the origin and peculiarities of the fire-worshipers.

A long discussion occurred on the origin and literature of the ancient people of India, and especially of the French possessions there.

The last sitting of the Congress was devoted to Neo-Greek and Arminian literature.

Taking all the difficulties into account, the first Oriental Congress has achieved great success, and if, with the exception of the formation of a series of Roman characters for the writing of Japanese, no very practical result has been effected, a large number of important subjects has been broached, and in the spirit of the Japanese it may be said that the public intellectual intercourse of the far East with the West has been inaugurated.

HINTS TO COLONISTS ON THE CULTIVATION OF SILK.

By B. Francis Cobb.

(Continued from page 850*).*

At present there is but one silkworm that is worth a colonist's attention, viz., the bombyx mori, or mulberry silkworm of Europe and China. The many other description of oak-feeders, ailanthus, perni, cynthia, and even the beautiful yama mai, may be dismissed as a delusion and a snare, to colonists.

The most useful of all is the yama mai,* and from this can doubtless be obtained one of the most valuable silks known. Let us, therefore, consider why this is not worth a colonist's attention.

The Japanese reel this cocoon, and work it into beautiful fabrics; but they are the only people that do so, and consequently the only market for the cocoons would at present be in Japan. A consignment of these cocoons to Japan would not only result in the loss of the cost of production, but would most probably entail a claim for a balance on the account sales, the proceeds not being sufficient to pay freight, insurance, and charges. If, then, this would be the result of the yama mai, what would follow from the inferior descriptions?

It is not sufficient that the castor-oil plant grows in many of our colonies wherever the soil is ploughed, without being sown—that the *Ailanthus glandulosa* may thrive luxuriantly with little or no care. Until there is a market in Europe for these tussah cocoons, which at present there is not, colonists can employ their time better than in rearing them.

The only market at present for tussah cocoons is in India, where the natives, with the most perfect indifference to the value of time, slowly "reel" them upon their knees, feet, or small bamboos. It is true that in Western China we find garments made of a wild silk, produced by a species of oak feeder, but this does not help the colonist, whose object must be to produce that which is convertible into more money than it has cost him to produce, and the only description of silkworm which has any chance of doing this is the bombyx mori.

M. Guérin Méneville may be able to demonstrate the feasibility of rearing certain oak-feeders on the Continent, and Lady Dorothy Neville has exhibited silk made from the cocoons of the ailanthus in England, but neither her ladyship nor M. Méneville has ever demonstrated how a commercial success was to be obtained from rearing the ailanthus worm.

Interesting and praiseworthy in the highest degree as these attempts and experiments have been, they tend but to prove beyond all doubt that the same labour and capital expended upon the mulberry and bombyx mori would produce an infinitely greater monetary result; and colonists must remember that this is the final test to which all their results must come; and whether they rear sheep, plant sugar or coffee, or "educate" silkworms, the operation must be a commercial success as well as an experimental one, to be continued. Attention is drawn here strongly to the commercial view, because, should attempts be made, and prove to be labour lost, so far as the culture paying the colonist, it would then be more than ever difficult to get persons to try again, however convincing the arguments might be that a different culture would succeed better.

As assisting materially in giving hints to colonists, subjoined are extracts from a "Report on Silk Culture in the State of California," by Mr. William Baldwin.

To the efforts of the late Mr. Prevost, a Frenchman, residing on the Guadaloupe River, near San Jose, in this State, California is mainly, if not entirely, indebted for the introduction of this great industry. He was its earliest pioneer, and a perfect enthusiast in its cause, not sparing himself, his time, or his money, in promoting its advancement.

Mr. Prevost's attention was first attracted to the subject by observing how peculiarly favourable the climate was for the prosecution of this industry; the freedom from rain, thunder, and lightning during a great part of the year, more particularly during the months of May, June, and July, when the worms are being fed, and the absence of electrical disturbances in the atmosphere—a matter of paramount importance.

In 1854 he procured some mulberry seed from France, that grew up with a rapidity and luxuriance truly surprising. He then had some eggs imported from China, and some also from France. They all arrived in the spring of 1860. The Chinese were not very good, but the lot from France hatched out finely. They produced superior cocoons, the samples of which forwarded to France were pronounced to be of first-rate quality. From 1860, however, until 1866, very little interest was taken in the new industry. But in this year, through the efforts of Mr. Prevost, the attention of the State Legislature was directed to the subject, and its action has been the means of giving an impetus to the pursuit, and of placing it in its present position.

The policy of the United States generally, and of California in particular, has been to foster by aid, monetary and otherwise, her native industry of every description. Acting in this spirit, and considering the importance of the subject, the Legislature in 1866 passed a Bill entitled "An Act for the Encouragement of Silk Culture in California." In the Act it is provided that "there shall be paid the following sums for each of the articles herein enumerated, grown within the State of California, for the term of four years from the passage of this law:—

"First—For each plantation of five thousand mulberry trees of the age of two years,—two hundred and fifty dollars.

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* A fine specimen of this silk is exhibited this year at the International Exhibition, and takes the highest class among Japans.

"Second—For the production of each one thousand silk cocoons,—three hundred dollars."

The assistance thus offered by the State proved highly advantageous in promoting the development of the young industry. Public attention was directed to it. The State Agricultural Society lent its powerful aid; many persons were induced to enter into it; and thenceforward the culture of silk in California progressed steadily, if not rapidly, and its permanency became secured. Thousands of trees were planted in 1866, and the numbers were still further increased by cuttings in 1867, in which year there were 400 lbs. of seed imported from France as well. In the year just ended, it is calculated there were upwards of four millions of mulberry trees in the State. The industry, however, was by no means successful throughout the State during the year 1869. Then, for the first time, the production of the worm ended in partial failure, in many localities.

That this unhealthiness of the worms of 1869 was local, the result of circumstances easily explainable, I have little doubt. I have looked carefully into the matter, and think the disease may be explained in the following way:—The season of 1869 was a most unfavourable one. Again, artificial processes injurious to the worms had been adopted, with the view of checking their early hatching. The spring was cold, and the growth retarded beyond the usual time; and not only was the vegetation backward, but the leaves of the trees were found to contain a large quantity of watery fluid. Now, one of the great characteristics of Californian vegetation is the absence of such moisture, and it is this fact, amongst others, that makes the State so admirably adapted to the pursuit of silk culture; for the more gluten and the less acid contained in the mulberry leaves, the stronger and healthier are the silkworms. There was yet another reason. The coldness of the latter portion of the spring had been preceded by some hot, sultry weather, and it was found that many of the eggs had begun to be hatched before the supply of food was ready. To prevent this, the eggs, in many cases, were placed in ice boxes,* and where this was done the failure was almost universal. Everybody knows that in the culture of silk the health of the eggs is a matter of the first importance. They must be healthy eggs, the produce, that is to say, of healthy worms; but they must also be preserved in a healthy condition. For nine or ten months of the year, therefore, the eggs of the animal are kept in some dry, cool place,—generally in a cellar free from damp. But the mistake made last year, to which in a great measure may be attributed the severe loss amongst the silkworms of the season, was the placing the eggs in refrigerators, after the hatching had once commenced. The experience gained by the silk-growers was, however, dearly bought. With a little caution and some consideration they might have known that, once the embryo was formed in the eggs, the exposure of these afterwards to a very low degree of temperature was certain either to impair the strength or destroy the life of the young worms. It is needless, perhaps, to pursue the inquiry further. I have, I think, said sufficient to show that the disease was local—the result of exceptional causes. I may, however, add, as confirming this view, that I have just returned from a visit I paid to the largest silk cultivation in this State, where I saw upwards of three millions of silkworms in their several stages,—from that of hatching to the spinning of cocoons—and all were healthy, vigorous, and free from disease of any kind.

The climate and soil are, of course, deserving of our first and greatest consideration. If the climate is unfavourable and the soil unsuitable, to attempt the culture of silk would be mere folly, and end in a complete failure. As a general rule, it may be laid down that the drier the climate the better.† The less rain there is, in moderation of course, the healthier will the leaves of the mulberry be—the more gluten and sustenance will they give the worms. The mulberry, when subjected to excessive rain or moisture, secretes in its leaves a sort of watery poisonous fluid, and this affects the worms with a kind of diarrhœa, which is most fatal to them. But wherever the mulberry thrives, the worms thrive also. The mulberry thrives wherever vines grow well; indeed it has been found that the cultivation of the former is pretty well limited by that of the latter. Both grow well where the average temperature does not fall below 49°. Perhaps the best temperature for the worms during the periods of hatching, feeding, and spinning, is from 65° to 75°.* When the thermometer falls to 50° they then refuse all food. But let it be understood that in these latter remarks I refer to two, or at most, three months of the year, the remaining nine or ten being comparatively unimportant. For instance, in Canton I find the winter averages about 44°, and the summer 80°; again in Milan the winter is only 36°, and the summer 72°. But the great desideratum is the absence of electricity. From the time of hatching to the third age, thunder or lightning proves very injurious; but in the last stage, when the worm is about to spin the cocoon, electricity in any quantity proves fatal.

In California, as elsewhere indeed, a stiff clay or a gravelly soil is not well adapted to the growth of the mulberry tree, the best soil being a rich, loose, dry loam. The rich low bottom lands, too, have been found favourable to its growth; but I think, in a climate like New Zealand's, where the moisture is greater than in this country, the drier hilly lands would answer better for planting; and from the experience I have acquired since my visit to California, I am quite satisfied there are many provinces in New Zealand where the culture of the silk can be carried on successfully and profitably. As a rule, any soil where fruit trees thrive well answers also for the mulberry; but the successful culture of the peach is the surest test. The peach is very sensitive, its foliage being very subject to atmospheric influences; and its healthiness and production of fine-flavoured fruit seem to indicate the soil and temperature where the mulberry flourishes and the silkworm thrives.

The different varieties of mulberry trees are very numerous, but in the State of California three kinds only are used in the culture of silk.

The varieties refered to are, the *Morus multicaulis*, the *Morus alba*, and the *Morus moretti*.

The *Morus multicaulis*, or Chinese mulberry, is a very rapid-growing tree, producing a great quantity of large, soft, tender leaves, which have hitherto been most commonly used here for feeding the worms until the third age; but, as I shall hereafter explain, experiments made by the manager of the plantation I have recently visited seem to show that even for this purpose it is inferior to the other two varieties. It produces, however, a larger quantity of leaves than either the *Morus alba* or the *Morus moretti*, and it possesses this advantage also, that it grows readily from cuttings; but its leaves absorb water more readily, and for this reason it is less adapted for moist climates.

The *Morus alba*, or white mulberry, is the tree principally used in European countries and India, where, it is said, the worms fed upon its leaves produce the best quality of silk. The experience of California, however, goes to prove that the third variety, the *Morus moretti*, is better adapted to its climate and soil, growing, as it does, stronger and hardier, and producing larger leaves and with more sustenance than the *Morus alba*. But the habits and appearance of the *alba* and *moretti* are somewhat similar, the former bearing white and the latter purple berries, however. In most of the large mulberry cultivations I have seen in the state, all three varieties are planted in about equal numbers, the trees making very rapid growth, some of the cuttings of the *multicaulis* being eight or ten feet high within the twelve months. It is said that three years' growth of the trees in California is as much as five years' in European countries.

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* A fatal error—germination had already commenced.

† Not necessarily so; the silk districts of the north of China are certainly not very dry, but the drainage is good, which is of more importance.—Ed.

* M. Roland says a lower temperature. (See paper read at the Society of Arts, 23rd April, 1873.)

(*To be continued.*)

ENGLAND AND CENTRAL ASIA.—THE KASHGAR MISSION.

The *Daily News* of Saturday last published an extract from a private letter written by Mr. Ashton Wentworth Dilke, who has been for twenty months travelling in Russia and Central Asia, which shows the dangers which menace the Atalik Gazee from the side of Russia, and the possibility of serious misunderstanding between England and Russia if we should undertake the defence of Yakoob's neutrality. The *Daily News* further remarks that Mr. Dilke, who is living with Russian officers, writes evidently with a strong bias in favour of the Russian view of the conduct of the Atalik Gazee. Mr. Dilke's letter is dated from longitude 81 E., and latitude 42.30 N. He was, in other words, in the Thian-Shan Mountains, one hundred miles east of Lake Issyk-kul, and one hundred miles north-east of Aksou, the place where the Atalik Gazee was living, which is two hundred and fifty miles north-east of Kashgar and Yarkand.

MUSART, August 11.

Some 150 miles south of Kouldja, in the Thian-Shan Mountains, lies the port of Musart, formerly on the Russian and Chinese frontier and the head of the pass to Aksou, in the territory of Cashgar, where Yakoob Beg is now living, a pass now almost entirely superseded by the Nayrn Pass, on account of its great difficulty. However, last year, when all the preparations had been made for taking Cashgar, the Kouldja force of 1,500 men would have marched over this pass to Askou. At the same time, the force on the Naryn or Upper Syr-Daria, generally a small one, but then reinforced by the 10th battalion, sent from Vernoe, under pretence of road and bridge making, and by the 1,500 men stationed at Karakol, on lake Issyk-kul, were to have fallen on Cashgar itself, which can be reached in four days' march from the Naryn, and which, of course, could have offered no valid resistance to so unexpected an invasion by 5,000 men. Though Yakoob Beg then averted the danger by timely concessions, and though his ambassador has been received by the Emperor, it is probable that the Russians will soon demand great concessions in trading matters, and, if they are not granted, will use force. The present position of Russia here is not enviable, and can hardly be allowed to last long. The Sart merchants, from Cashgar, trade freely with the Kirghis, crossing the frontier without hindrance, and gaining enormous sums from the poor Kirghis, who have but an indifferent idea of the value of money, by exchanging cloth for sheep at the rate of a rouble a sheep, while sheep in the markets of Margilan and Namayan cost six and seven roubles each, and by lending them money to pay the yearly Russian tribute. Among the Kirghis they can always gain the upper hand of the Russian traders by their knowledge of the language and manners, by the proximity of their markets, and by the fact that the Kirghis will not buy European cloth, and if they cannot get it from the Sarts, will go ragged. Now as these Sarts cross the frontier and trade without passport or permit, and can sell all they will at Cashgar and Kokan, it can easily be seen what an advantage they possess over Russian traders, who, when once the few military and officials are supplied, must seek a market in Siberia or Russia, thousands of versts away, and are burdened with onerous taxes and formalities. Yet it must not be imagined that the Sarts are at all thankful for this; they merely laugh at the simplicity of the Russian officials as manifested in their tendency to favour the native rather than the Russian, a tendency far too strongly marked here among the higher officials. An Ambassador from Yakoob Beg has lately been received by the Emperor, and assurances and promises will be exchanged liberally; but, what is really more important, a Russian trading caravan is now at Cashgar, and the Russian policy will be greatly influenced by the reception with which it meets. This reception entirely depends on Yakoob Beg himself, who is so intensely feared at Cashgar, that he has only to lift his finger and not a hand will be laid on the Russians, whereas in Bokhara or Kokan not all the well-known favourable tendencies of the rulers can save Russians from insult and even violence. Though the Kirghis cannot live without the Sarts, yet they dislike and despise them greatly, much as the Poles despise the Jews, but are at a loss what to do without them, for the Kirghis are essentially an aristocratic race, and their chief objection to the Russians arises from the fact that they are now all equal; that the nobles, the "white bones" in Kirghis, have lost all their old titles and privileges, and that the meanest of their tribe can call them before a Russian court of justice. The Kirghis, like all Orientals, are extremely litigious, and though the Russians have allowed them to keep their native courts in cases arising among themselves, yet as the loser invariably appeals to the Russian court, they are beginning to resort chiefly to the Russians, who are quite overwhelmed with their complaints, generally most trifling. Horse stealing is a universal offence, and is looked on lightly unless the horse happen to be Russian, when the punishment is taken by the Russians into their own hands, and is very severe. However, as they are a cowardly race, they seldom touch Russians, and two Cossacks will pursue a dozen Barantachis, or horse stealers, without a shadow of fear as to the result.

CORRESPONDENCE.

SCIENCE AND TECHNISM.

Sir,—The consistent and persevering efforts the Society of Arts has ever been foremost to make in any plans which gave promise of developing the material resources of the country, and extending the knowledge of the people, have naturally culminated in schemes and objects of instruction and education.

From statements which have appeared in the *Journal* during the last twelve months or more, it seems that an effort is to be made to ascertain and reward such learning as is comprehended in the term "Technology." On page 734, "Technological Examinations" are stated to be arranged, of which the "Programme is in preparation, and will be published shortly."

Now it may be said to be more than probable—indeed, actually certain—that the public, as a body, are not instantaneously receptive of new terms. The number of such terms amongst the pioneers of intellectual and handicraft development is really alarming. Much has been said and written of "science teaching," "natural science teaching," "technical knowledge," and now we have "technological examinations." Would it not be well to make an endeavour to describe what each of these is intended to convey, or to show, if possible, that there is a needless mutiplication, and therefore necessary confusion in terms? Accept this letter as a first approximation to such an end.

A few years ago, the term "science" was generally restricted to mental, moral, and metaphysical work; recent times have introduced social and political sciences. There seems, however, now a tacit acquiescence in the view that, when the word "science" is used alone it is intended to comprehend all that is known in physics and chemistry. Although botany, geology, zoology, &c., are "natural" sciences—and when first the compound name was used they were comprehended in it—yet it is not so now. The expectation is a reasonable one, that the prefix "natural" may soon be omitted, and then "science" will retain the meaning which custom seems to have assigned to it.

"Technological examinations," which the Society of Arts proposes to introduce, seem to comprehend both the knowledge which might guide the development of a special branch of industry, and the handicraft skill of the artisan. If this view be correct, then the terms seem not well chosen. "Technology" is a description—a verbal description of arts—"a treatise on arts." A person may be able to write such a treatise and have no handicraft skill—he need not be an artisan. Judging from the whole tenor of the action of the Society, those who could thus pass an examination in "technology" are not those whom the Society aims to improve. On the contrary, in the intended examinations, the handicraft skill, as well as mental knowledge of the examined, are to be investigated. Therefore a wider range is given than the word "technology" expresses.

Instead of "Technological examinations in cotton manufacture, paper manufacture, silk manufacture, steel manufacture," there might be "Examinations in the technics of cotton, paper, silk, and steel."

These, however, are very minor considerations in the questions which the heading of this letter suggests. It might, sir, be worth a place in the pages of the *Journal* if those who are so competent and who so zealously promote this important branch of national welfare would put clearly forth what should be done and what should be left undone by those who would hopefully and successfully develope "instruction in science and technics." This might perhaps be divided into the two parts, "instruction" and "examinations." The Society is an examining body, but it must examine in accord with the plans of those who instruct. There must be a thorough understanding between the instructors and examiners. Such an understanding is in England generally wanting. That is no reason why the Society of Arts should perpetuate either this or any other of the numerous anomalies of our social state.—I am, &c.,

A. J. T.

GENERAL NOTES.

Naturally Coloured Silk.—In the *Chronique de la Société d'Acclimatation*, M. Ruimet states that by feeding silk-worms on vine-leaves he has obtained silk of a fine red colour; and that by giving the worms lettuce-leaves, they have produced cocoons of an emerald-green colour. M. Delidon de St. Gilles, of Vendée, has also, by feeding silk-worms—during the last twenty days of the larva period—on vine, lettuce, and nettle-leaves, obtained green, yellow, and violet cocoons.

The Duplex Telegraph.—The American Institute of New York has awarded "the Great Medal of Honour" to Joseph B. Stearns, for the invention of the duplex telegraph, which has made a revolution in telegraphy in the United States, and has been adopted by the postal telegraphs in this country. The American Institute is a very old and eminent society, and is understood to have made the present award after a most careful and exhaustive examination as to the novelty and value of the invention. Only two other medals of this class have been issued by the Institute since its foundation, the conditions upon which they are awarded being such as to exclude all inventions and improvements except those of the highest importance—viz., first the machine or process must have superseded all others previously employed for a like purpose; second, it must have created a revolution in the art or business in which it is employed.—*Times.*

Naphtha as Fuel for Locomotives.—The Russian Steamship and Railway Company announce that they have found naphtha, for steam generation in locomotives, very advantageous. The material employed by the company is the crude oil from the Caucasian and Volga regions, and, compared by weight the amount consumed was about one-half that of coal. The arrangement for burning naphtha is stated to be of such a nature that no difficulty will be experienced in substituting one for coal consumption in place of it, should it be found desirable to do so.

Indicator for Carriage Wheels.—A device for indicating the distance run by a carriage has recently been patented by Messrs. Durham and Hupton, of Lowestoft. It consists of a small measuring apparatus concealed in a box, which can be fitted within an ordinary patent axle-cap. To all appearance, an axle thus fitted precisely resembles any other axle, but on taking off a small lid or cap an index is disclosed, showing the number of miles run since the index was set. Its primary object is to provide job-masters and letters of carriages with some means of ascertaining the distance run by their vehicles. The mechanism is of the simplest character, and not likely to get out of order. The apparatus is of course applicable to any carriage whatever.

New System of Pneumatic Telegraph.—Two French engineers propose to substitute ammoniacal gas for compressed, or rarified air, in despatch tubes. The cylindrical boxes are, in this system, forced along the tube by means of the gas disengaged from its solution in water by means of heat at one end of the tube, while at the other end the gas is absorbed by water. By this arrangement the same gas serves continually, and as the two operations proceed simultaneously the tubes are always filled with the gas. The apparatus at each end of the line, as well as at each intermediate station, consists of two boilers, one of which is partly filled with a saturated solution of the gas, heated sufficiently to disengage the gas, which compresses itself in a receiver. The gas, before entering the tubes, passes through a long cylinder filled with quick-lime, which completely dries it. The other boiler contains a certain quantity of water, at the temperature of the atmosphere, to absorb the gas in front of the dispatch box, and produce the necessary draught. The two boilers invert the action successively, but it is not stated how the cooling of the water in them is managed.

Cultivation of Beet in Canada.—Before very long, says a Canadian paper, the attempts which are now being made to establish a new industry in Canada, the cultivation of the sugar beet, will have proceeded so far that some idea may be formed of the probabilities of success. Those who speak with authority on the subject say that the soil of Canada is highly favourable to the cultivation of this plant, the alluvial sandy soils, clay lands, and calcareous clays of the St. Lawrence valley being just such soil as the beet thrives in in Europe. The climate, too, will suit the beet well, so far at least as may be judged from the fact that meteorological observations as made at Montreal show the conditions of heat and moisture to be perfectly fulfilled. Last year trials of actual cultivation were made at Montreal, Quebec, and St. Hyacinthe, which furnished results of the most promising nature. The low degree of temperature in winter is said to favour very greatly the preservation of the root, which is liable to ferment with a sudden rise of temperature and so lose its saccharine qualities. The greatest drawback to be found is an insufficient supply of raw material; but there can be little doubt but that the company will succeed in securing the amount required, between ten and twenty million pounds weight of raw material, unless they should be very unfortunate in their first harvest.

NOTICES.

CANTOR LECTURES.

The publication of the fifth lecture of Dr. Thudichum's course, "On Wines; their Production, Treatment, and Use," is postponed in consequence of the author's absence on the Continent.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

GENERAL EXAMINATIONS, 1874.

The Programme of Examinations for 1874 is now ready, and may be had gratis, on application to the Secretary.

These Examinations, in 1874, will be held on the evenings of the 21st, 22nd, 23rd, and 24th April. The Time-table has been arranged as follows:—

Tuesday, April 21, From 7 to 10 p.m	Wednesday, April 22, From 7 to 10 p.m.	Thursday, April 23, From 7 to 10 p.m.	Friday, April 24, From 7 to 10 p.m.
Arithmetic. Logic. Floriculture.	Theory of Music. English History. German. Spanish.	Political Economy. French. Fruit and Vegetable Culture.	Book-keeping. English Language. Italian.

Friday, April 24, 6 to 7 p.m.—Dictation.

The rule which formerly prevented a candidate who had once obtained a first-class certificate in a subject from being again examined in that subject with a view to gaining a prize, has, in accordance with the wish expressed at the Conference, held on the 27th June, 1873, been rescinded. In future, therefore, a candidate who has obtained a first-class certificate in a subject may be again examined in that subject, but not more than one first-class certificate in any subject will be counted for the Prince Consort's Prize, or for the Council Prize to Females. A candidate having taken the first prize in any subject cannot again take a prize in that subject, nor can a candidate take a prize of the same grade twice in any subject.

The Elementary Examinations, held by the District Unions and Local Boards, for which papers are furnished by the Society, are fixed for the 10th, 11th, and 12th March.

Full details in reference to the Examinations are given in the Programme, copies of which should be applied for to the Secretary of the Society of Arts, by all intending to come forward as candidates, or otherwise interested in the Examinations.

TECHNOLOGICAL EXAMINATIONS.

The contribution of one hundred guineas from the Worshipful Company of Clothworkers, which has already been announced in the *Journal*, will be offered as a Scholarship in the subject of cloth manufacture, upon conditions to be stated in the programme. The clerk of the Company, Mr. Owen Roberts, in a letter to the Society's Educational Officer, says:—

"The Company will avail themselves of the proposition of the Council of the Society of Arts in regard to the nomination of an examiner, who will undertake the next year's Technological Examinations in the subjects connected with cloth manufacture; and the Company have voted the sum of one hundred guineas towards prizes, &c., in connection with the special addition of cloth manufacture to the programme of next year."

THE EMPLOYMENT OF WASTE SILK.*

By P. L. Simmonds.

One of the characteristic features of the age is the great attention given to the working-up of waste and residues from manufactures. The wastes of the principal textile industries, cotton, flax, wool, and jute, have been for some time largely utilised, but it is only of late years that much attention has been given to the working-up of waste silk, although this is one of the scarcest and highest-priced of the fibres we employ. There were difficulties, however, in the way of its utilisation which required the erection of special machinery, and it was only the greatly enhanced price of silk that gave an impetus to invention, and has led to the more general employment of waste silk in different countries. In the silk manufacture there is a considerable waste made, of from 30 to 33 per cent. in the various preliminary processes, which is only worth about one-fourth of the value of the raw silk. One of these inferior products, called, on the Continent, "frison," which consists chiefly of the rough, loose silk on the outer coat of the cocoon, may, by care and attention, be considerably reduced, and the short waste is now extensively utilised.

It is difficult to arrive with any precision at estimates of the quantities of waste silk available. The late Mr. Winkworth, in reporting to the Society, ten years ago, on the silk trade of Italy, from personal investigations, set down the waste or refuse of cocoons, after reeling, in Italy, at 984 tons per annum besides 197 tons of double cocoons, which are also a species of waste, as they cannot be reeled in the same manner as single cocoons. Among our imports of silk there is a very considerable item under the head of "silk waste, knubs, and husks." From 1857 to 1860 the average annual import of this was about 20,000 cwt.; from 1861 to 1865, 30,000 cwt. The next four years the imports were somewhat lower, averaging 28,000 cwt.; but of late years more has been received. In 1871 as much as 38,594 cwts. were imported, and last year 3,260 bales of silk waste were shipped from Calcutta. The short fibres of waste silk have little intrinsic value; but when carded with intelligence and accuracy, and spun very evenly, they serve, either alone or mixed with other silk, wool, or cotton, for the manufacture of goods of such beauty as to appear entirely made of silk. The fibre is made into shawls, spun silk handkerchiefs, and other mixed goods. The Italians and Swiss have given much attention to this branch of industry. The silk is carded, spun, and manufactured into threads on the same principle as raw cotton is converted into yarn.

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* This article was in type before the paper on the same subject (published in the *Journal* of Sept. 26) was read by Mr. Lister before the British Association. Although it goes partly over the same ground, it in many respects supplements the information given by Mr. Lister.—[Ed.]

The spinner cuts it into short lengths of somewhat less than an inch, and will produce as even a thread from this short fibre as the reeler from his continuous thread of raw silk from the cocoon.

At the Dublin International Exhibition in 1865, Lanzani Brothers, of Milan, showed silk waste, carded by hand and power, illustrating the recent progress that had been made in this utilisation. Silk carding in the city of Milan is carried on by a dozen manufacturers, who employ upwards of 2,000 operatives, men, women, and children. The annual production there is set down at over 250 tons.

For every pound of raw thrown silk produced, wound direct from the cocoon, there are left from 12 to 14lbs. of waste, technically known as "frison," "galetta," pierced and double cocoons, "bassinas," &c. By the use of machinery for softening, dressing, and combing this raw waste, extensive spinners in England and some of the European countries prepare and spin it into yarn, which, being much cheaper, and possessing even greater evenness of thread than that from raw silk, enters largely into competition with the latter. It is extensively used for the finest ribbons and velvets, and also in the manufacture of piece goods and sewing silk. Silk waste consists partly of noils from floret silk manufactories and partly of thread waste from spinning mills and silk works. It is spun on machines made for the purpose, by the application of the carding system in some and combing in others, and appears in the trade on the Continent under the name of "bourette" silk. Dr. Grothes, of Berlin, states that it was formerly only used for the manufacture of stuffs for gun cartridges. Later, F. Pasquay, of Wasselheim, produced closer textures and webs, which were used for forage haversacks and tents in the French army. Pasquay, in the meantime, had made from the same material very pretty dyed burl yarns, which have, however, been again supplanted by change of fashion. The firm of D. J. Lehmann began first, in 1867, to use these yarns as warp for waterproofs, and with increasing success, as the burling properties of the texture lent a peculiar effect to the cloth. The present proprietors of the manufactory belonging to Grelling Brothers, at Berlin, applied this material to the manufacture of satin plush, by making a texture with bourette silk on one side and raising it by carding. By this mode of treatment also, the lustre of the silk showed itself to perfection. In Lyons bourette silk has lately been used for closer stuffs with twill face, and these stuffs are printed with steam colours, with large patterns, for furniture coverings, which is a very durable material. This article is also fit for dyeing, but it must be previously washed and dried. The treatment is the same as in dyeing ordinary silk, proper care being taken to preserve and attain as great a lustre as possible. Another use of waste silk is that adopted by Messrs. McLintock and Sons, of Barnsley, for silk-down clothing, toralium quilts, under-shirts, ladies' and gentlemen's dressing gowns and jackets, ladies' and gentlemen's vests, smoking caps, chest protectors, etc., interlined with silk down and quilted throughout.

The scarcity and increased price of raw silk has given enhanced importance to that obtained from double cocoons. This quality, formerly only used for secondary articles, has been greatly improved in reeling and cleaning, and now enters largely into consumption; one silk firm in Paris takes the first rank in working this speciality.

At first, it was thought that the cocoons of the castor oil and ailanthus feeding silkworm could not be reeled; but in 1859, Dr. Sacc reported to the Society of Acclimatisation, at Paris, that at Grubwaller, Mr. Henry Schlumberger, one of the most skilful spinners of Alsace, had worked up the silk obtained from them, like that from the pierced cocoons of the ordinary silkworm, into various fabrics; and he valued them like ordinary waste cocoons, at 2s. 6d. to 3s. 4d. the kilogramme. In the condition of short tangled silk for carding, it enters into the category of floss silk and fabrics; and mixed with wool, cotton, and other materials in spinning, it adds much, by its brilliancy and solid qualities, and is also appreciated for its abundance and moderate price. But the naturally open cocoons of the *Bombyx Arrindea* and *Cynthia*, can now be reeled as readily as those of the ordinary silkworms.

Owing to the great demand made of late for the supply of silkworms' eggs (seed or grain), in Europe, a much larger quantity of pierced cocoons have been thrown upon the market, from which the moth has been permitted to make its way in order to supply eggs. These waste cocoons have hitherto had but a small value. But from these refuse cocoons, as well as from empty coccoons, the silk can now be reeled and utilised, under the processes of the Countess Cornelian, Dr. Forgemol, and others.

M. Aubenas, silk spinner, of Loriol (Drome), in 1864 presented to the Society of Acclimatisation of Paris, a collection of specimens of silk from the cocoons of *Bombyx Arrindea* and *Cynthia*, reeled mechanically with an apparatus of his invention. The moth, in leaving the cocoon, reduces the weight of the latter by five-sixths. The dry skin of the larva, and the envelope of the nymph which remain, weigh also about 12 per cent. of the empty cocoon.

The average yield of raw silk from 100 kilogrammes of four different races of French cocoons, experimentalised on by M. Guerin Meneville, was about 8·568 per cent., and 2·567 per cent. of floss or waste silk. It also appears that there is a loss in working of 3·489 per cent., caused principally by evaporation and by the extraction of various residues which have no value.

The following table shows the relative waste in the cocoons of the ordinary silkworm and that of the Ailanthus:—

	Mulberry worm. Kilos.	Ailanthus. Kilos.
Fresh cocoons	100·000	100·000
Weight of chrysalis	83·334	83·154
	16·666	16·846
Weight of husk	2·042	4·549
	14·624	12·297
Loss in spinning	3·489	2·934
	11·135	9·363
Weight of waste silk	2·567	2·158
Raw silk obtained	8·568	7·205

Silk reeling is limited to the unwinding of the cocoons and to the twisting of from 2 to 30 of the single and very fine threads, which cannot be used alone. The reeling of waste silk is similar to the spinning of other fibres, the object being to clear the raw material and prepare it in a proper manner, so that strings or filaments may be formed which can afterwards be twisted into threads. The process of treating waste silk is comparatively a new one.

Cocoons containing the chrysalis are reeled by placing them in basins of boiling water for a certain time, to remove the gum which binds the silk threads on the cocoon. They are shaken about with a small heath brush, and the threads adhering to the broom are stretched and united together in number agreed upon (six or more) to form a united thread, which are attached to a hook, twisted and passed on to the reel. These cocoons are entirely closed and contain the chrysalis, which has been first stifled or killed, to prevent its emerging. The cocoons dance about madly in the boiling water in the basin, revolving until the whole of the silk—which may consist of from 500 to 1,500 yards, according to the size and breed of the worms—has been wound off the husk. But open cocoons cannot be treated in this way. The water would enter at the aperture, and cause them to sink in the basin, and if they are beaten, or moved with the broom, to get at the ends of the threads, they become flattened, and mixed up in an inextricable manner. The raw silk cannot, therefore, be obtained from them in a similar manner to that pursued with closed cocoons. Dr. Forgemol, in reeling double cocoons, has a particular scouring or cleaning process for each kind of cocoon, and a special kind of reeling, according to the nature of the cocoons.

If they are closed, they are placed in receivers; if open, they are fixed on needles. Hot water and basins are rendered unnecessary, the cocoons being reeled simply moistened. The process was patented in December, 1861.

At the Paris Exhibition, in 1867, Dr. Forgemol, who had already received many gold and silver medals for his discovery, showed a fine collection of raw silk, of first and second quality, reeled from pierced cocoons of the silkworm moth and the various oak-feeding moths, *Yama mai, Pernyii* and *Mylitta*, from double cocoons of the ailanthus and castor-oil worms, and from *B. Faidherbii Hesperus* and *Cecropia*. Specimens of the silks were also shown dyed, twisted, organzined, and in the shape of sewing-silk, with silk pieces, and dresses made from the silks.

The working of waste silk necessitates a greater number and more complicated machines than those which operate upon raw silk. Some of the waste, known as "frisons," resulting from the first process of reeling from the cocoons, requires to have the gum removed first. Other wastes and residues, from ulterior operations of spinning and weaving, can be directly transformed. These differences, easily perceived, necessitate two classes of machines, suited for either carding, combing, &c.

The principal spinning mills for waste silk are in England, Switzerland, and France, although Italy and Germany also give some attention to this industry.

The several kinds of silk waste are—1. Husks and knubs in the gum. 2. Husks and knubs discharged of the gum. 3. Dressed waste, discharged and cut to a uniform length for carding. 4. Dressed perforated cocoons. 5. Dressed husks and knubs. 6. Dressed China gum waste. Waste silk as imported is worth about £20 per cwt., whilst raw silk is worth six times as much.

Switzerland made a great display at Paris, in 1867, of the utilisation of waste silk; especially interesting was the collection of threads of waste silk shown by Bale. This collective exhibition was very remarkable as a whole, as well as for the superiority of each of the specimens contributed to it. It occupied the first place as regards this branch of industry. Among the exhibitors were—A. Bell, Kriens, Lucerne, who showed spun floss silk; Morganti and Co., Lugano, Tessin, carded waste silk; the Rothen Floss Silk Spinning Company, Lucerne, spun floss silk; Viellon, Mivelli, and Co., of Bale, spun floss silk; D. Taddie, Faudria, Tessin and Torricelli and Lurati, Lugan, Tessin, carded waste silk.

An engineering contemporary states that the collection of machinery shown at the Vienna Exhibition for waste silk spinning has never before been equalled. Since the invention of the mechanical preparation and working of waste silk by Hollinweger, of Kolmar, astonishing progress has been made in this branch of industry, especially in Switzerland, Alsace, and Baden; whilst Thomas Greenwood, of the firm of Greenwood and Batley, of Leeds, has taken a prominent place in the improvement of the machinery used in this industry. The carding machines for waste silk shown by Messrs. Theodore and Frederic Bell, of Kriens, Lucerne, are on Greenwood's system with only a few alterations. The firm of Bell is well and favourably known for the construction of silk combing machines, having but lately put up the most extensive silk mills now in existence—those of Messrs. August, Villey, and Co., of Amplepius, near Lyons; whilst the firm itself possesses extensive silk mills. Messrs. Bell exhibited at Vienna a beater for the treatment of macerated cocoons and waste silk, an opener, and a combing or hackling machine for tearing asunder the raw material and cleaning it afterwards. Besides the two large machines already mentioned, Messrs. Bell have erected similar ones at Mailaud, Turin, Chiasso, Bene, Vagienna, and several places in Switzerland. The exhibition of waste silks of all sorts at Vienna was also very rich and well arranged.

At the present London International Exhibition, Marsden Brothers and Holden, of Lily-lane-mill, Halifax, show yarns made from waste silk, called spun silk; and Mr. H. Tucker shows in operation in the machinery court, Greenwood and Batley's beautiful combing machinery, in operation, for preparing and spinning waste silk, and the uses of such silk. The mechanism of this machinery was very fully described by the Rev. Arthur Rigg, at page 558 of this volume of the *Journal.*

The re-working up of old silk pieces has not yet attained to any commercial importance; but when we find old woollen and cotton rags so extensively re-worked, it is not at all improbable that the higher-priced and less-worn material silk may be ere long re-converted by chemical and manufacturing appliances. Attention was publicly drawn to this fact at the Paris Exhibition in 1867; and in the jury reports mention is made of a process adopted by Mr. John Hadwen, of Kebroyd, near Halifax. The jurors observed that while it was found difficult to obtain the waste raw material of silk, such as spoiled cocoons, knubs, and husks, at seven or eight francs the kilogramme (and these lose from 26 to 30 per cent. in cleaning and preparing), old dyed silk fabrics and waste sewing-silks have been procurable for many years, at something like half-a-franc to a franc the kilogramme.

One great obstacle to the utilisation of old silk fabrics is the present injurious practices resorted to in dyeing, to give weight to the silk, by adding gambier and other drugs to the dyes, which tan the fibre, and necessarily deteriorate it for wearing.

In China, a tenacious sort of packing paper, as strong as linen, is made from silk waste. The lower class of Chinese use it instead of pocket-handkerchiefs.

When Europeans took the first samples of endless paper to China, and defied the Chinese to manufacture a like article without the expensive £3,200 machine which had just been invented by Léger Didot, these industrious artisans, whom no difficulty deters, offered the English merchant to furnish him with as much as he required, of any width and length. They did this, as they had promised, by replacing the £3,200 machine with one of £1 12s.

The following is their process:—They grind and divide the silk waste, and then put it in a large trough, which they expose to the sun. The silk, which is lighter than water, gradually rises to the surface, and forms a pellicle, to which the sun promptly gives a sufficient consistence to enable it to sustain a small traction. A workman adroitly seizes an extremity of this kind of cream between two small pieces of wood, and gently draws it out of the trough, the water in which is kept level with the top; as he takes out this sheet, other particles of silk rise to the surface, and join themselves to the end, and this continues until all the paper material is withdrawn from the trough. Usually, the sheet is only twenty feet long and three broad, according to the size of the trough or vat. These sheets are spread out upon the grass to dry, but care must be taken to turn them. The enclosures used for this purpose resemble bleaching fields. When the Chinese wish for an endless sheet (which they themselves consider useless) they roll the silky pellicle upon a cylinder adapted to the trough, by joining dried sheets to the one then being made. This yellowish paper is used for packing stuffs and hardware. It is not very equal as regards thickness, but it is so strong that a small piece easily sustains the weight of two pounds without breaking. This strength is owing to the threads of silk, some of which are, after the manufacture, two or three inches long.

The waste silk from the cocoons was so great in France some years ago, that a celebrated chemist advised its being used as manure, but a better employment has now been found for it—the uses which I have specified.

HINTS TO COLONISTS ON THE CULTIVATION OF SILK.

By B. Francis Cobb.

(Continued from page 869.)

"When I want to hatch my eggs," writes Mr. Prevost, "I simply take the papers on which my eggs are from my cellar to my garret, and there the heat caused by the sun through the roof makes them hatch promptly, which they generally begin to do on the third or fourth day." Then commences the real business of the silk-grower, the feeding and careful management of the worms.

When it is ready for spinning the cocoon the worm ceases eating, and is observed to move about uneasily, and trying to ascend to carry on its spinning; its neck, too, becomes wrinkled, and its body soft. It is now necessary to prepare some place in which the cocoon can be fastened. Boughs of willows or other small bushy twigs are used for this purpose, as is also straw.* The cocoon is generally spun in four or five days; and in six or seven days after this—that is to say, in about six weeks from the time of hatching—the cocoons are gathered, and such of them as are not required for hatching purposes are exposed to the rays of the sun for four or five days, until the chrysalis inside is killed.

Whatever eggs are required for use the following year or for sale, must be produced from the moths or butterflies which emerge from the cocoons. Before destroying the chrysalis, it therefore becomes necessary to calculate what quantity of eggs will be required, and, as a basis for doing so, it is said the female moth lays 300 eggs; there are 40,000 eggs to the ounce, which will therefore require 140 pairs of moths for production. The best cocoons are always selected for this purpose—such cocoons as are large, firm, and bright in colour. They are selected, too, in equal numbers, male and female—the former being easily known by their smallness, length, narrowness, and sharp-pointedness at both ends—the female being larger, rounder, and more like an egg in shape. Having being first stripped of the outside floss, the cocoons are next laid, in single layers, in open paper boxes or baskets, and then put away in some dark, warm, but airy place. About the twelfth day after the cocoon has been formed, the moth emerges from it in the form of a butterfly; the male generally appearing first, and being known by its smaller size and the fluttering of wings; the female is larger, and seldom moves. If the eggs be of the annual variety, the papers on which they are laid are deposited in tin boxes perforated with holes; the lids are carefully fastened, and the boxes put into some dry, cool place, and there kept until the following May. This is the plan adopted in California. If, however, the worms be of the bivoltine or trivoltine species—that is to say, if their eggs hatch twice or three times during the year—the eggs, instead of being laid aside in the manner just described, are put in some warm place, and in about eight days they will hatch, the worms going through the stages mentioned previously.

There are three varieties of silkworms in California: the annuals, which hatch only once during the year; the bivoltines, whose eggs hatch twice in the season; and the trivoltines, three times; but the annuals are principally, if not entirely, used by the silk-growers of the state. They allege, as a reason for this, that besides the question of labour, the one crop from the annual is better than two from the bivoltines, or three from the trivoltines. The cocoons of the two latter are much smaller, and, therefore, so much the less valuable than those of the annual species, for the longer the silk threads the higher the price it fetches. Mice are very destructive to eggs, worms, and cocoons.

The Davisville Silkworm Nursery.

In order thoroughly to understand silk culture in all its different stages, and to enable me to report upon its details from practical experience, I considered it necessary to visit one or two of the principal magnaneries in the state. This I accordingly did, and shall now proceed to give an account of this visit. The largest of these nurseries is situate near Davisville, in Yolo County, and about eighteen or twenty miles from Sacramento. This property consists of five hundred acres of fine undulating land of a rich friable soil, and was purchased two years ago for thirty dollars an acre; it was afterwards taken over by a company of five or six gentlemen, one hundred acres of it being planted with the three different varieties of mulberry trees, and the remainder with apples, pears, vines, and other fruit trees. Its estimated value now is 140 dollars—say £36 the acre. At the time of my visit there were about 700,000 young mulberry trees growing on the grounds. Passing through these plantations, I reached the cocooneries and men's dwelling, pleasantly placed on the higher ground, and shaded by clumps of the large native oak and of the cotton tree. There are two cocooneries on the property; one of them being rented to four Frenchmen, who are supplied with eggs and mulberry trees, and return half the gross proceeds to the proprietors; the other contained upwards of three millions of worms in their different stages of development, and was a scene of busy activity when I entered it. The cocoonery itself is a long narrow building, supplied with three ventilators on the top of the roof, and built of wood; it is 100 feet long by 30 feet broad, but 15 feet by 30 is partitioned off for a hatching-room and a room to cut the leaves in, each of these being 15 feet by 15; the space, therefore, in which the worms are fed is 85 feet by 30, and the height of the walls of the building is 16 feet. The building is also ceiled and floored; has sixteen windows, which slide in grooves lengthwise, eight in the bottom and eight in the top, and eight in each gable-end, four below and four above, having thus forty-eight windows in all, besides four doors, one in each end and side. The windows were all open, and are so left during the whole time the operations are carried on, unless when very cold or wet, the rays of the sun being prevented from penetrating by coarse canvass screens placed against the windows. The internal arrangements were as follows:—Lengthwise along the feeding-room ran eight rows of slight posts fastened to the ceiling and floor; each two of these rows were 5 feet 6 inches wide, and at every twenty inches were battened across throughout. There were thus four rows and four walking spaces along the room, and each row had nine tiers, rising one above the other, 20 inches each in height; on the fourth tier there is a platform, ascended by a ladder, as a man on the ground could not reach higher, to attend to the worms. Between each of these tiers the worms are placed on sheets of paper 2 feet 9 inches by 2 feet, the paper lying loosely on a wooden frame of the same size, made of laths or other narrow pieces of wood. Underneath the building, and entered from the outside, there is an excavation about 15 feet square and 7 high, where the mulberry leaves are put and kept fresh until required for use. There is a stove in the hatching-room for use, if required, which seldom or ever happens; and in the other small room are two machines, something like chaff-cutters, used for cutting up the mulberry leaves. It must not, however, be supposed that buildings such as this I have attempted to describe are in general use, or that they are necessary in carrying on this industry. A garret, a cool room, a barn or other shed, may, with a little fitting up, be made to answer every purpose. There must be no smells nor closeness; purity and plenty of air and warmth are the only essentials.

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* Not to be compared with Roland's system of echelletes coconniers, as described in above paper.

Chinese are employed in the establishment, as being cheaper, and generally understanding something about the management of worms. Under the guidance of Monsieur Blanc, the able manager, and Mr. Reed, the obliging managing director of the company, I carefully examined the various details of the operation, remaining in the cocoonery the whole day. To commence with the hatching-room:—The worms are here hatched, and, at the end of the day, every day's hatching removed on to the paper trays previously described, which must be then marked with the day of the month. This keeping of every day's hatching separate is absolutely and essentially necessary, otherwise the worms on the same paper would moult at different times, and some would require feeding, whilst others would require to be left alone undisturbed. The manner of removing the young worms is this:—Long, narrow strips of the mulberry leaf are laid upon them, on to which they immediately climb, and the strip of leaf is then placed on the paper tray which is intended for use. The process is the same throughout, except that, after the first age, young mulberry twigs are substituted for the leaves. The tray, dated, and thus filled with worms, but not too closely, or so as to overcrowd one another, is then carried into the feeding-room, placed upon one of the shelves or tiers, and food placed upon it. During the first age the worms require little food, but that food must be finely cut up. The food is coarser the second age, and coarser still the third age, when, indeed, the leaves are sometimes given entire, as they always are during the fourth age; branches are supplied to the worms of the fifth age. After each moulting, the remains of leaves and skins are cleaned off the papers, the worms being meanwhile removed in the manner already explained. There is a fifth cleaning, too, between the fourth moulting and the commencement of spinning the cocoon. Monsieur Blanc has the worms fed four times in the twenty-four hours, namely, at 5 in the morning, 10 in the forenoon, 3 in the afternoon, and at 8 at night. The worms of the fourth and fifth age, especially the worms of the fifth age, are fed day and night. During this latter age they eat more than they do all the rest of their lives together, and must never be allowed to want; for the more they eat, and the faster, the greater will be the quantity of silk they spin. The worms which were ready to commence their cocoons had dried branches or twigs of oak placed upright along two sides of the paper trays, bent at the top, along the bottom of the shelf or tier above. Bugs and mice had begun to be destructive to the worms, but, to prevent this, deep tin bowls were being placed underneath the uprights, and filled either with water or lime. The floor of the cocoonery, too, was sprinkled twice or thrice daily with water. M. Blanc was making some very interesting experiments, at the time of my visit, in crossing the Californian annuals with the French and Japanese, and seemed very sanguine that the result would give a larger worm and a much hardier one, which would produce a more valuable cocoon than is now produced in either of these countries. An ounce of eggs produces from 38,000 to 40,000 worms; 80 oz. had been hatched by M. Blanc, and the result was about 3,000,000 of worms. By keeping the eggs back, he expected to hatch altogether about 8,000,000 worms, which would give him about 22,000 oz. of eggs, all of which are already ordered at 4 dols. an ounce, making the returns about £19,125 for the season. One thousand six hundred pounds of leaves are required to feed the worms hatched from an ounce of eggs; that is to say, 38,000 worms. A tree two years old generally produces from five to seven pounds of leaves; consequently, it would take 250 trees to feed this number. Here the young trees are plucked when they are 12 months old, but M. Blanc is opposed to this, and never touches the leaves of the trees at Davisville until they are two years' growth. A tree five years old, if not picked before, produces 40 lbs. of leaves; if so picked, 25 lbs., increasing the quantity of its leaves as it grows in age. For persons entering into the business at a distance, trees one or two years old are recommended. They are safely transported, having been sent from California to Europe. The propagation by layers and cuttings is safer than by seeds; the industry, too, can be entered into at once, without having to wait a couple of years. The cost of the trees is from 75 dols. to 100 dols. the thousand.

There have been no cocoons exported hitherto except perhaps in a few instances, where some have been sent to France or Italy; but these were only samples, and therefore limited in supply. The reason of this is that the supply of eggs raised in California has hitherto been insufficient to meet the demands of foreign countries; and as the production of these is much more profitable to the growers than the raising of cocoons, silk growers have confined themselves exclusively to the former. There is no practical experience to be obtained upon the matter. M. Blanc, however, informed me that the silk should not be wound off in this country, as it can be done much cheaper and better at home; and for this reason the cocoons unwound are preferred by the manufacturers. He intends exporting some this year as an experiment, and the plan he proposes to adopt is, to dry the cocoons by steaming them, and afterwards pressing them. The process is very simple.

A box of sheet iron is fitted up with a false bottom, say eighteen inches above the real bottom, made of wire cloth, and the space between a little more than half filled with water. The box is then laid upon the fire until the water boils, when the cocoons are laid upon the false bottom, and there kept for ten minutes. They are then removed, and thoroughly dried in the atmosphere, when they are pressed in a hydraulic press, and ready for export. In carrying out the process the greatest care must be taken in seeing that the cocoons are entirely dry before putting them in the press.

I have, in a previous part of this report, casually referred to the fact that one of the cocooneries at Davisville was occupied by four Frenchmen, who, as an experiment, had been supplied by the proprietors with 25 ounces of eggs, and food for the worms, the gross returns from the transaction being equally divided between the men and the proprietors. The Frenchmen, of course, found all necessary labour, and defrayed all other expenses. The following estimate of the profits was supplied to me by Monsieur Blanc:—

25 ounces of eggs × by 38,000, number of worms in 1 ounce, = 950,000; 950,000 worms, allowing for casualties, produce 900,000 cocoons; 900,000 cocoons, divided by 350, the usual number of cocoons in a pound weight, give 2,285 lbs.

2,285 lbs. cocoons, at 4s. 2d. per lb. ..				£476	1	0
Half of this makes the proprietors' share...........................				238	0	0
The Frenchmen's expenses will be—						
Their keep for six weeks, say	£18	0	0			
Six extra men for ten days	8	10	0			
				26	10	0

Giving them a net profit of £212 for six weeks' work.

The quantity of leaves required to feed these million worms will be about 45,000 lbs., 1,600 lbs. being the quantity allowed for an ounce of eggs, or 38,000 worms. If we allow 5 lbs. of leaves to each tree, and this is a low estimate, we find that 9,000 trees, two acres say, give a gross return of £476. This, however, I am inclined to think high, my own opinion being that from £120 to £150 an acre may be expected, and that the expense of cultivating and attending the worms may be put down at from £25 to £35 per acre, leaving £100 an acre as the clear profit. This is certainly an estimate, erring, if at all, in placing the return below that actually obtained.

This year it is supposed upwards of 20,000,000 of cocoons will be exported, when a more accurate estimate as to the profits can be obtained.

(*To be continued.*)

SILK SUPPLY.

The following correspondence illustrates the progress recently made in sericiculture in Western Australia:—

From C. Brady, Esq., F.L.S., to the Hon. the Colonial Secretary.

New South Wales, 25th January, 1873.

Sir,—I have the honour herewith to hand you, for the information of the Governor of Western Australia, some printed matter having reference to the establishment of silk culture in Australia. I beg you to be good enough to direct his Excellency's attention more particularly to statements in regard to features in the management of silkworm establishments which are calculated to render the industry peculiarly suitable and profitable to Australians.

First, to the circumstance that we are in possession of the finest and most profitable brood-stocks in existence, of silkworms newly imported, as well as others, now for several years successfully acclimatised, and special to this country, both of which are recognised by the higher European authorities as not only unquestionably healthy, but of varieties most appreciated and desiderated in the leading grain and silk-purchasing countries.

Secondly, to the remarkable and important experience gained in the colony, proving at once the practicability and the advantage of rearing silkworms (of truly annual races) more frequently than once a year—a plan which admits of several crops a-year being raised by any individual establishment having inexhaustible supplies of food leaf, and of three crops being raised at any time in one season, at the will of the proprietors, from eggs laid by moths during the preceding season.

The brood stocks and the improved methods of rearing, &c., are the fruit exclusively of my own study, experience, and labour.

I submit for your inspection a sheet of specimens of cocoons (reared at my place, Curl Curl, Manly), a glance at which will convey to your mind that which no amount of writing can do, namely, the least difference, in quality and in quantity, of the produce of different varieties of silkworm.

This view will enable you to explain to your government the difficulty of imparting to others ideas which shall serve the avoidance of unprofitable exertion (which has hitherto been a material impediment to success), and and of impressing inexperienced persons with sound useful knowledge on this subject.

I much regret it is not in my power to furnish you with printed copies of various notices in Europe, as well as in America, regarding experience developed in the long, arduous, and expensive operations carried out by me in this colony, while introducing, experimenting upon, and acclimatising valuable kinds of silkworms (both in-door and out-door feeders), and in rescuing many important races perishing (and since utterly lost in Europe) from disease.

The papers are nearly all out of print, and I have copies only of part myself for reference, but should circumstances at any time induce me to reconstruct my own notes, and the comments of others thereon, I will take care to furnish you with copies.

I am not in a position to undertake any fresh enterprise which will materially interfere with the conduct of my own establishment (now removing to Antony, on the Tweed River, N.S.W., *viâ* Brisbane, Queensland), but I would beg you to do me the favour to express to Mr. Weld my desire to do anything in my power to further his design to make this valuable industry practicable in the colony, under his government, and to place my personal services as far as they may be available at his Excellency's command.—I have, &c.,

Charles Brady.

The Honourable E. P. Barlee,
Colonial Secretary of Western Australia,
At present in Sydney.

Manly, New South Wales, 13th February, 1873.

Sir,—With reference to my letter to you, dated 25th January, and to subsequent conversations and correspondence, I have now the honour to submit the following for the consideration of your government.

To introduce and establish the economic culture of silk on a rational basis in any country where it is new to the manual working portion of the population, it is manifestly expedient at the beginning, by sound instruction and the force of actual example, to set people at once to work in the right way. On this head I need not do more than ask your attention to the printed matter in your possession, and only allude to the productive value of silkworms when their rearing is a general occupation and carried on in a systematic manner.

The money value of the silk crops of the world is enormous, and the financial operations they give rise to between widely different communities immensely affect and facilitate trade in general. The instance of Japan is a notable example. A demand for silkworms' eggs alone has not only created a vast and entirely new trade, but has in a marvellously short time completely upset the traditions and revolutionised the character of a population said to be as large as that of Great Britain and Ireland; it has infused a ferment which has already wrought immense effects; introduced or created elements which have not only powerfully influenced progress in Japan, but materially affected the commerce and prosperity of other countries.

It may be that these phenomena, as regards Japan, may not retain their present form, and it is quite certain that if any other country could supply the commodity (silkworms' eggs, or grain, which has wrought the wonderful revolution referred to) so largely wanted in Europe, of a quality superior to that of Japan, and more suitable to European requirements, a portion at least of the trade may be diverted, and, if judiciously managed, gradually extended. You are aware that the Japan grain, even the best of its kind, by no means satisfies the exigencies of Europeans as to quality, though, such as it is, this last season has seen the transfer of about £700,000 sterling in hard cash, independent of other trade, from European silkworm rearers into the hands of the tillers of the soil of Japan.

This significant fact should be considered in its many bearings; and if it should appear to your government politic in the interests of your colony to take measures to place within reach of your colonists the advantages of this particular industry, I would suggest that proper steps should be taken at the outset to afford to settlers proper knowledge, example, and experience with art of rearing silkworms, together with opportunity to obtain food-plants and profitable brood-stock.

I am fully convinced that silkworms and their various food-plants will thrive in Western Australia. I know you have special advantages in position, as well as climate, to make the industry profitable if properly understood; and I shall be glad to contribute to its success to the utmost of my power, both in the conduct of a government establishment, and also by myself settling and residing at least a portion of the year in the colony. I am prepared to supply your government with suitable healthy brood-stock of silkworms for the general benefit of the colony, and, at the same time, to establish farms and factories on my own account in approved localities, if satisfactory arrangements can be made to induce and justify me in so doing.

It appears to me that a government establishment for public purposes in regard to silk should co-exist with private silk farms and factories. The farmer should employ all otherwise waste labour of a superior class, in farming plantations on public property, in keeping them in order, and in constant extensions, so that in a few years a considerable amount of food-leaf may be available for silkworms. The director should impart instruction to all persons employed, so far as may be practicable, and in particular he should train a number of apprentices or others; these latter should pay the government for the advantages they get, and be dealt with as individuals who may be expected in due time to take independent and useful action in carrying the industry into various parts of the colony,

A private silk factory would be expedient, in view of the necessity of bringing private interests to co-operate in establishing markets for the produce, whether silk or grain, particularly the latter, which could only be realised under guarantees, and especially to provide that obvious requirement—a market in the colony for small quantities of produce.

I am so entirely unacquainted with Western Australia, and its social condition, I am quite at a loss to form estimates as to expenditure. I must therefore restrict myself to indicate in a rough way what may be wanted for a government establishment. First, a suitable tract of land should be set apart for the culture of silkworms, both indoors and out. Secondly, this land must be first thoroughly cultivated and planted with appropriate kinds of food-plants, and then constantly maintained clean and in good tilth. Thirdly, buildings must be provided which, though as inexpensive as may be, should yet be sufficiently well constructed, and of materials to keep in good order, without frequent repairs or renewals. Beyond these items, and what they necessarily imply, tools, fittings (of the simplest character), utensils, instruments, &c., no great outlay need be incurred; the silk could at once be disposed of in the form of cocoons, and the "graining" effected by an arrangement with skilled persons, who alone could make it profitable, or, indeed, sell grain at any price.

If I am made to understand that my personal presence in Western Australia would be agreeable, I could, upon timely notice, proceed thither for a few weeks, and do my best to assist your government to initiate operations, and afterwards devote a portion of each year to personal superintendence and direction, should my services be so desired. Further, I would, while absent from Western Australia, attend to matters that would have to be attended to, such as the maintenance of fresh and constant renewals of brood-stock, already acclimatised, and properly hybernated, wherewith to raise silk and grain for use in Western Australia and export thence to Europe.

I now reply to your inquiries *seriatim*:—

1st. The extent of land required for a public silk establishment?—This is nearly a matter of choice. So long as there is sufficient acreage (say twenty acres and upwards) to produce a substantial amount of leaf of one kind, and one quality of that kind, the extent is immaterial; but I would recommend a considerable scope of land to be reserved, both to provide for future enlargements, and to avoid intrusion, though, perhaps, strangers would not be so objectionable to a public establishment as detrimental to the management of private affairs.

2nd. The nature, cost, and extent of buildings required, inclusive of fittings? (I understand exclusive of dwellings).—These would be best of the humblest materials. Lower walls of rammed earth or dry stone, to form a basement of an even cool temperature; an upper story of the same, or of studs at appropriate distances, to hold a light, strong, textile fabric (common "cheesecloth" answers extremely well), stretched all round; roof of thatch (grass tree, so abundant about Sydney, makes an admirable as well as durable cover); floor, however, should be of good timber, with both balcony and verandah all round, the former enclosed with rough matting, tatty, or trellis, to partially break the force of the wind, which yet should be free to pass in and out through the cheesecloth walls. The extent of each building should be from 60 or 100 up to 200 or 300 feet in length, by 20 or 30 wide. It is expedient not to rear more than ten ounces in any building at one time; less is decidedly preferable. Silkwormeries should be numerous rather than extensive, as I will explain by word of mouth rather than make this communication more lengthy. The fittings required are plain tables, racks, and so on. The whole may be of common bush-stuff, the work rustic in the truest sense.

3rd. Probable outlay for tools and the nature of them?—By tools I mean axes, hoes, ploughs, and so on, of common husbandry and horticulture, and (to add to your query) by utensils I mean hurdles, trays, leaf-cans, knives, thermometers, and such like, or materials and labour to make them.

4th. Amount of land to be granted to me as an inducement to settle in Western Australia?—Four sections (square miles) of good land.

5th. What period of each year I should propose to spend there?—It would be absolutely necessary for me to be on the spot some time beforehand to direct preparations and get ready for rearing; to conduct and explain the mode of hatching silkworms' eggs; to conduct and discipline the rearing; to watch and control, as well as provide for the cocooning; to direct the sorting of cocoons and selections for silk and for grain, together with preparation (if necessary) of cocoons for market. The strain of this work on one individual, who would for weeks be necessarily occupied night as well as day until some learners were qualified in a certain degree to relieve him, would at first be very great but unavoidable.

6th. Would the period embrace the whole process to be learned?—Yes, it should embrace the whole process (perhaps including graining, also, to a select few, if suitable for this particular work), and should include what is necessary in outdoor work, as to cultivation, &c.

7th. The amount of salary I should deem adequate to the services given?—Under the circumstances I would accept £360 a year, fixed salary, for a term of years, with percentage on proceeds of silk and grain.

8th. The per centage on sale of silk?—Twenty.

9th. The per centage on proceeds of grain?—Fifty.

This last item, however, is one requiring a good deal of explanation. In my own affairs I pay fifty per cent. for the hybernation and realisation of grain in Europe, I myself being responsible for the quality of breed, quality of grain of breed, and its proper preparation for export—thus, for every ten shillings, practically I guarantee and am personally liable to the extent of one pound. Of the ten shillings pertaining to Australia I should claim five, leaving five as the net result for the rearing. To exemplify—suppose ten ounces yield one thousand ounces of grain, worth £1 per ounce, £500 would be absorbed in the expenses of hybernating, retailing, and realising in Europe, £620 to the farm and £250 for my share.

To resume No. 2 and 3 queries, as to cost. The expenditure contemplated being principally labour, I cannot estimate the cost, having no experience and no data as to Western Australia; but £200 ought to suffice for such tools, materials, light, utensils, instruments, &c., as would have to be purchased.

In conclusion, I must guard you from supposing that I here refer to more than rearing (at any rate at first), unless you see fit to add out-door silkworms to our efforts, in which case I should be very desirous to do the needful other than annual mulberry silkworms (and these indoors only). The operations which you may have understood I have carried on for so long in acclimatizing and naturalizing many different kinds of worms involve researches and provision in many ways quite unsuitable for a government to undertake; they are such as can only be carried out by private individuals, and only by private individuals who are not constrained as to localities for separate rearing and isolation of the various insects, as well as of the different plants for their support.—I have, &c.,

CHARLES BRADY.

The Honorable F. P. Barlee,
Colonial Secretary of Western Australia,
At present in Sydney.

SILK FROM JAPAN.

The silk season of 1872-73 has been, to say the least an unfortunate one throughout for the exporters. The prices at which it opened left, with very few exceptions, severe losses against the rates that were ruling at home; nor had the buyers any opportunity of making up for those losses, because the foreign markets exhibited, from and after September, a continuously falling tendency without any intermission or rally, until last May. At one time only would there have been a possibility of obtaining a reduction of prices, viz., after the holidays in January last, when the natives, tired of holding on, began to show symptoms of giving way, although not yet enough to leave a sufficient margin. But, instead of waiting still longer, some of the foreign houses threw away the advantage of their position, and, yielding to the desires of the dealers, did, as we have said above, accept considerable quantities of silk for consignment to Europe on account of the latter, under what turns out now to have been unreasonable advances. Having thus had their pressing wants unexpectedly relieved, the Japanese resumed their firm attitude, and the opportunity of establishing a fall was irretrievably lost for all.

Unquestionably the severe losses of the exporters are much to be deplored; but for those who have dispassionately and maturely considered the subject, a useful lesson has been taught which should serve as a rule for the future. The course of business of the last season brought out a fact, on which too little stress had previously been laid. The foreign houses in the East were lately in the habit of looking too much to the past, and not enough to the present, wants of the European consumers. Whilst they were overlooking the fact that the production in Europe has almost entirely recovered from the disease of the silkworms, they, at the same time, paid too little heed to the increased imports of Asiatic silk into Europe. The home markets have become gradually glutted. The consumption is now, and has been for some time past, unable to cope with the production, and so much is this the case that many people consider the recent check to the crop in France and Italy to be rather a stroke of good fortune than of ill-luck.

Enough has been said here and elsewhere to show that the stocks of old China and Japan silk existing at this time on the home market are sufficient for a whole year at a moderate average rate of consumption, such as the present; and if we add to them the estimated exports for the season 1873-74, the disposable quantity will be vastly in excess of the wants of the manufacturers. And what consequences may be looked for? That prices may fall again even below the present point. It is a truth, which we are loth to repeat, that an article becomes depreciated in proportion to its abundance, and *vice versa*, and such is now precisely the case with silk. It is quite clear to us that unless the exporters pay moderate prices this season, they will sooner or later find out their mistake. The Japanese dealers, like the Chinese, have heard of the late frosts in Europe, and are trying to force the rates up. But they are, or affect to be, ignorant of the state of stocks at home; they rely besides upon the usual eagerness of buyers to secure the earliest arrivals of the new produce at almost any price, as was done quite lately in the tea market.—*Japan Mail.*

ANNUAL INTERNATIONAL EXHIBITIONS.

NATAL PRESERVED FRUITS.

The Messrs. Jameson, of Durban, exhibit a somewhat interesting series of preserved fruits at the International Exhibition of the current year, which they are endeavouring to make articles of export from Natal to England. The circumstances which favour this enterprise are abundance and cheapness of the two prime ingredients—the sugar and the fruit; some speciality in the vegetable productions of the colony; and the comparative compactness of the production for sea transport—a by no means unimportant consideration, as a freight of 35s. a ton means, under the circumstances, an addition to the selling price of only three-quarters of a farthing the pound.

First and foremost in the series stands the amatungulu (sometimes called Natal plum) jam, which is mainly notable as being preserve from a really wild indigenous fruit, the berry of an apocynaceous plant, the *Arduinia grandiflora*, which grows in great abundance all along the Natal sea-coast. This jam is firm, and nearly like that of the quince, and has a rough acid flavour, immediately suggestive of uncompromising wildness. It is a curious and agreeable preserve. The "gooseberry jelly" is not a true *groseille;* it is produced from a solanaceous plant, the *Physalis pubescens*, which grows as a coarse weed pretty well over South Africa. The fruit, in its ordinary ripe state, has a strong, rank, not altogether agreeable flavour; but this is very much subdued, and indeed almost eradicated, in this preserve, only remaining in the form of a faintish smell. The jelly is pleasantly sharp, without having the rough metal-like acid of the amatungulu. The guava jelly has the full taste of the West Indian preserve, and the pine-apple jam has the rich, almost too luscious taste for which the Natal pines are famed, and which leaves the penalty of a slight soreness on the tongue after too free an indulgence. The "loquat" is a very sweet and firm preserve, slightly resembling quince marmalade, but with less pronounced individual flavour. It is made from the fruit of a plant of the apple tribe, namely, the *Eriobotrya japonica*, which is very delicious in its unpreserved ripe state, having the flavour of the apple grafted upon the flesh of the melting peach, with large apple pips taking the place of the stone, and ripening in massive bunches. Like the melting peach, the fruit is almost too delicate for a preserve. Its most refined and exquisite qualities do not survive the bath of boiling sugar. The roselle is the preserved bract of a mallow-like plant, the *Hybiscus sabdraffa*, which makes a most estimable substitute for red currant jelly. There are three Natal fruits which do not appear in this contribution from Messrs. Jameson, but which are of such high capability and excellence in the preserved state, that it is to be hoped their absence is but a temporary and passing incident in this early attempt to establish a Natal fruit export. These absentees are the granadilla, the fruit of a passion flower, the *Passiflora edulis*, almost without a rival for delicate fragrance and perfume; the Kei apple, the fruit of an indigenous ebonaceous plant, that furnishes another very good substitute for currant jelly; and the St. Helena peach, which resembles in the preserved state a very excellent yellow plum. The shadock marmalade of Natal might perhaps also be spoken of in similar terms of regret, as it is a worthy substitute for the Seville orange marmalade.

The Messrs. Jameson contributes two very good specimens of Natal chutney, with the preserved fruits; one made from the tamarind and the other from the banana. The specimen from the banana is especially excellent, and well deserving of all that can be said in its praise. Advantage has been very skilfully taken of the comparatively tasteless and farinaceous pulp of the banana to make it the vehicle of flavours borrowed from other indigenous productions of more pronounced taste and higher quality. The chutney is so sweet that it may be very appropriately used as an adjunct for venison or haunch of mutton, but it is, at the same time, agreeably sub-acid and warm with choice carminatives, among which the Natal ginger stands prominently in the foreground. This delicate and piquant chutney is semingly as harmless and wholesome as it is tempting to the palate, and may certainly be welcomed to the English table as an established and staple article of colonial supply.

The Governor-General of India has appointed a committee to take steps to have India more worthily represented in arts and manufactures at the forthcoming International Exhibition than it has been hitherto.

EXHIBITIONS.

VIENNA EXHIBITION.

The Society of Arts and Manufactures in Vienna have periodically distributed, for the last thirty years, a number of silver medals and diplomas to well-deserving managing foremen, artisans, and operatives. On the occassion of the Universal Exhibition the Society resolved to extend this distinction to the foreign countries represented at the Exhibition, and to distribute a number of their large silver medals and diplomas to operatives specially recommended by their employers through the respective commissions, as being worthy of that distinction.

There were in all 134 examples of the great silver medal, with diploma, of the Society, awarded to Austrian and Hungarian industrial foremen and head journeymen, and one hundred medals, with diplomas, were reserved for foreign countries. Of that number ten were allotted to Great Britain, and the persons to whom this exceptional distinction was awarded, on the special recommendation of the firms by whom they are employed, are the following:—

1. Mr. Charles Frederick Lewis, for 12 years in the employ of Messrs. Hancocks and Co., jewellers, London.
2. Mr. Henry Fellows, for 25 years in the employ of Messrs. Elkington and Co., electro-plate manufacturers, Birmingham.
3. Mr. William Kershaw, for 53 years in the employ of Messrs. S. Lawson and Sons, machine manufacturers, Leeds.
4. Mr. Charles Lord, for 10 years in the employ of Messrs. R. W. Winfield and Co., brassfounders, Birmingham.
5. Mr. Henry Garland Matthews, for 6 years in the employment of Messrs. James Gibbs and Co., chemical manure manufacturers, London.
6. Mr. John Leete, in the employment of Messrs. Crosse and Blackwell, manufacturers of vinegar and preserves, London.
7. Mr. Francis Henk, for 10 years in the employment of Messrs. Mintons, china and majolica ware manufacturers, Stoke-upon-Trent and London.
8. Mr. Thomas Wells, for 9 years in the employment of Messrs. Piesse and Lubin, perfumers, London.
9. Mr. Patrick Mackillan Graig, for 12 years in the employment of Mr. James Aitchison, jewellers, Edinburgh.
10. Mr. Thomas D. Wanzer, in the employment of Messrs. R. M. Wanzer and Co., sewing machine manufacturers, Hamilton, Canada.

The medals and diplomas awarded to Austrian and Hungarian foremen and operatives were distributed at a special meeting on the 27th of last month.

The French exhibitors at Vienna have been remarkably fortunate. There were 4,764 exhibitors in all departments, and nearly one half of these, or 2,800, received an award of one kind or another.

Philadelphia Exhibition.—The managers of the American Centennial Exhibition intend to appoint agents, who are to proceed to the several islands and colonies in the Pacific, and to the whole southern coast of Asia, from the Philippines to the head of the Persian Gulf, for the purpose of securing for the Exhibition of 1876, a complete display of the products, the wealth, the industry, and the resources of that part of the world.

PUBLIC INSTRUCTION IN ITALY.

The annual report published by the Minister of Public Education gives the following particulars respecting education in Italy during the scholastic year 1872-73:—

The number of students registered at the Royal Universities was 5,614, and in addition to this number 1,333 persons were allowed to attend the course of lectures, making in all 6,497.

At the Universities of Camerino, Ferrara, Perrugia, Urbino, 284 students and 22 non-students, in all 806, attended the course of lectures.

At the Royal Institute of high studies at Florence the number of students was 214.

The Literary and Scientific Academy of Milan numbered 26.

At the Royal School of Application for Engineers the number of students was 173, and at that at Naples 185. The Technical Institute of Milan was attended by 209 students, and the Normal School of Pisa by 41.

Two hundred and ninety-five students were registered at the schools of Veterinary Science of Milan, Turin, and Naples.

The royal lyceums are 79 in number, with 4,228 pupils; the royal gymnasiums 104, with 8,462 pupils. In the royal colleges, which are 26 in number, there were 2,208 pupils.

The following schools received subsidies from Government:—

			francs.
32	schools in	Piedmont	67,290
19	,,	Lombardy	49,810
10	,,	Venetian provinces	16,550
24	,,	Emilia	52,800
14	,,	Tuscany	31,200
17	,,	Marshes, Umbria, and Roman provinces	20,800
54	,,	Neapolitan provinces	90,350
5	,,	Sicily	6,200

The number of elementary schools throughout the kingdom was 41,713 (being 3,413 more than were opened during the previous year). Of this number 21,353 were for boys, and 16,280 for girls. 33,556 were public and 8,157 private schools. The number of pupils attending those schools during the scholastic year 1872-73 was 1,723,007, showing an increase of 145,853 on the number of the previous year; of this 960,517 were boys, and 762,490 girls. The total number of pupils attending the public schools was 1,545,820, and those of the private schools 177,187. The total number of teachers in these schools was 43,423, being an increase of 3,102 on the number of the previous year. Of these 23,212 were teachers in the boys' schools, and 20,211 in the girls' schools; the public schools being conducted by 34,309 teachers, and the private by 9,114.

There still remain 90 communes without boys' schools (38 less than during the previous year). The number of communes without schools for girls is still larger, being 603, or 160 less than last year.

During 1872 the public libraries of Italy were frequented by 853,991 readers, against 757,734 in the previous year. The number of books given out to read were 1,218,889 in 1872, against 1,098,104 in 1871. The total number of books purchased for these libraries in 1872 was 13,872, against 12,290 during the previous year.

NICKEL MINES.

Most of the nickel of the world, until within a few years, came from Germany, but the discovery of mines in America has entirely driven the foreign article from the market, and considerable quantities are now exported to Europe. But one deposit is being worked in America, and is believed to be the largest yet discovered in the world. The mine lies in Lancaster county, Pennsylvania, about three miles south of the Gap Station, on the Pennsylvania Railroad. It is on the high land separating Chester and Pequea Valleys, a region rich in minerals; for, besides the copper found in connection with the nickel, there are large deposits of iron and limestone a short distance south. The existence of copper there was known many years ago; indeed, it was taken out 70 years ago, but the mining was never prosecuted with much vigour, and afforded little profit.

The copper was impure, but about the year 1856 the material mixed with it was discovered to be nickel, and as the depth of the mine increases so it predominates. The ore is very hard, and the mining is carried on altogether by blasting. There are a few Cornish miners to take the lead, but the rest are Americans. A Cornish pumping-engine, of 75-horse power, draws half a barrel of water at every stroke from the mine, which is 240 feet deep, and another brings the ore to the surface. The ore, in appearance, is iron grey, very heavy, and in some pieces the bright copper ore is very prominent. The amount taken from the mine varies from 400 to 500 tons per month. The mining and manipulation of this amount requires 175 hands employed here and at the furnace. The ore has to be hauled in waggons about half a mile to the furnaces, which are situated on very high ground, and overlook the beautiful Pequea Valley. This situation was chosen partly that the wind might carry away the noxious smoke and gas, and partly because of the stores of limestone and flint in the neighbourhood.

The process adopted is first to throw the ore between the jaws of a ponderous iron breaker, by which it is reduced to small fragments weighing about half a pound each. Thence carts convey it to the kilns, which are constructed very much like the old-fashioned lime-kilns, except that these have a very tall smoke-stack, to increase the draft. A kiln, holding 80 or 90 tons, is filled with ore and kindled with a little wood. It burns for about six weeks, its own gas supplying the fuel for burning out the impurities. This first step towards purification is followed by a process almost precisely similar to that to which iron is subjected. There are three large furnaces, and into these the ore is put, mixed with powdered flint and limestone (the former predominating) and coke. About three draws are made in 24 hours, for the work does not stop either night or day, two sets of hands being employed. The product of the furnaces is passed through iron rollers and crushed to powder, in order that it may be more easily transported to Camden, New Jersey, where the final process of separating the nickel and copper, and preparing each for the market is effected. No waste is allowed. The ore dust, large quantities of which are made in drilling and blasting, is mixed with flux and clay, baked in square bricks, and reduced in the furnaces, just as is the rest of the ore.

The pure nickel commands a high price, varying, of course, according to the demand, but averaging over two dollars per pound. Not only does this mine supply all of the material for the nickel coins, but nickel is being extensively used in plating iron and other metals and in various compounds. The whole property is owned by a Philadelphia gentleman, who has, by his energy and capital, not only opened up a new branch of industry to the American artisan, but has taken another step towards making the American independent of other nations.

Thus it is that Pennsylania, through her valuable mineral deposits, is increasing her wealth by mining and manufacturing interests, as well as by working her most valuable agricultural territory.—*Iron.*

MEAT FROM THE ANTIPODES.

The following letter appeared in the *Times* of Wednesday week:—

Sir,—On this side of the world we have heard of people in England being in great straits through the scarcity and high price of butcher's meat, and we have endeavoured to feed our hungry brethren from the abundance of our bleating flocks and lowing herds, by sending them our preserved meats in various forms; but as we are told that it is too much cooked, and not what they are used to, one of our clever men has hit upon a plan which will enable us to send whole carcases of beef and mutton, and to land them in England or any other part of the world in the same condition as that in which they were shipped. By the *Norfolk*, which sailed from Port Philip on the 23rd of July last, the first shipment of our Australian beef and mutton in their natural state was made. The process by which Mr. Harrison, the inventor of the scheme, proposes to preserve the meat is by freezing it into ice, or as near an approach to that condition as meat can be brought to by intense cold. The meat will remain as a lump of ice all through the tropics, and till the voyage is over, and when taken out will be exactly in the same condition as when put into the ship's hold, with this difference, that it must be hung up to thaw for about 24 hours before being cooked.

There is a mistaken impression existing with regard to frozen meat—that is, that it will not keep long after being thawed, but that decomposition at once sets in. This may be the case with meat that has only been covered with ice, and the temperature of which is barely 32 deg., or just a little above freezing point. Decomposition goes on at this temperature, though slowly, as the juices of the meat are still in a liquid state. But this is not the case in Mr. Harrison's system. Every particle of moisture in the meat is converted into ice, and the little spicules of crystallised water can be seen scattered through the meat when it is cut with a knife. By carefully conducted experiments it has been proved that meat frozen by this system will actually keep longer than meat in the same relative position as regards the time of keeping before being frozen. Nor is there any disintegration or rupture of the elastic fibres of the meat by the freezing or thawing.

People in England may be doubtful at first, as I was, Sir, but when they eat, as I hope they will be able to do soon after you receive this letter, a slice of a good Riverine merino saddle of mutton, or a juicy steak off the carcass of a Gipps Land grass fed bullock, they will, I am sure, cast aside all doubt, and agree with me, that at last the right plan has been discovered.

Before making this shipment by the *Norfolk* a number of experiments were made to ascertain various points of importance, such as the quantity of ice required for the voyage, and the best and most economical non-conductors of heat for the protection of the ice. The result was that articles which are shipped from here in large quantities every year were found to be the best possible substances for this purpose. These are wattle or accacia bark for tanning purposes, and tallow. A greater thickness of this latter substance is, however, required to produce the same effect.

The cold is applied to the meat in something of the same way that heat is applied in cooking, but as everything Australian is just the reverse of everything at our antipodes, so the ice is put on the top of the vessel instead of under it. Heat has the property of rising, from the expansion it causes in fluids, while cold sinks from the contraction caused by it. You cannot boil a vessel of water by putting the fire over it, and likewise you cannot freeze a vessel properly by putting the ice below it. The ice with a proportion of salt graduated to the temperature required is put above the iron tanks containing the meat, and the brine resulting from the mixture is intensely cold, and trickles over the sides of the tank, keeping it at a temperature which can be regulated by increasing or diminishing the proportion of salt. Around the whole a protecting envelope of tallow and bark is put, which keeps the outer air from melting the ice.

At the farewell luncheon to Mr. Harrison, meat which had been frozen by this process for eighty-five days was eaten by all present, and pronounced to be undistinguishable from the fresh butcher's meat. I need not point out to you, Sir, what a boon it will be to the poorly fed millions in the old country if the flocks and herds of Australia can thus be brought to their doors; nor need I say for myself, and all other Australian squatters, that we shall be too happy to be the means of affording them a good dinner, not, perhaps, without the motive that carries the flag of England's merchant navy to every port. The benefit arising from this new industry, if it be successful, will not be confined to the consumer and producer, but will be shared by shipowners, merchants, iron and coal masters, and all the many ramifications of trade springing from these important interests.

I enclose two circulars which will explain the circumstances of this experiment, and I am sure you will join with me in wishing every success to the enterprise.

I am, Sirs, yours very truly,
Samuel Wilson, Chairman of the Committee
for exporting Frozen Meat.
Oakleigh-hall, East St. Kilda, Melbovrne,
August 12.

OUR TRADE WITH THE GOLD COAST.

The trade between this country and the Gold Coast, though inconsiderable in amount when compared with that of many of our colonial possessions, is still larger than the trade between this country and either Sierra Leone or Gambia. It is also worthy of notice that, since the year 1860, both the imports from and exports to the Gold Coast have very considerably increased, the former being risen from £51,577 in 1860, to £399,654 in 1871; and the latter from £106,069 to £477,168 in the same year. The foregoing amounts are exclusive of the value of bullion and specie. The trade between the United Kingdom and Gambia and Sierra Leone, on the other hand, remains almost stationary. The chief articles imported from the Gold Coast in the year 1872, were palm-oil, oleaginous nuts and kernels, raw cotton, skins, and ivory, the most important article being palm-oil, the value of which exceeded a quarter of a million sterling. The principal exports of British produce, in the same year, were cotton piece goods, apparel, and haberdashery, hardware and cutlery, iron and firearms, gunpowder, stoves and empty casks, and cotton yarn, the chief article being cotton piece goods, the value of which amounted to £276,000 sterling, out of a total export of £418,000 sterling. There is also a small re-export trade from this country to the Gold Coast, consisting, in the year 1872, of spirits, tobacco, wine, rice, and beads, the whole amounting to the value of £28,730 sterling. The employment afforded to shipping in the above trade in the year 1872, was as follows:—Entered with cargoes in the direct trade, from the Gold Coast, 21 vessels, of 3,739 tons, of which three vessels, of 591 tons, were foreigners, and cleared with cargoes in the direct trade to the Gold Coast; 40 vessels, of 7,227 tons, of which eight vessels, of 1,358 tons, were foreigners. Next to the trade with the mother country, the most important commercial transactions that the Gold Coast has with foreign nations are those carried on with the United States of America. The trade with Germany, France, and Holland, is very insignificant.

THE RAILWAY SYSTEM IN TURKEY.

The railway, whose establishment in Turkey has just been inaugurated by the opening of the line from Constantinople to Adrianople, is based on a projected railroad to Novi, of which the above line forms a part. This line will pass through Roumelia and Bornia, and be connected at Novi with the Croatian lines. It will unite by the shortest roads the four largest towns of Turkey—Constantinople, Adrianople, Philippopolis, and Sophia, which are the centres of the industry, commerce, and civilisation of the country. In the south the lines from Uskuss to Salonica, and from Adrianople to Enos, has been opened for public traffic during the past twelve months. Both of these lines terminate in harbours of the Algian Sea. The principal Turkish merchants are now endeavouring to induce the Government to build a line to Gallipoli, so as not to make Enos the only outlet of Turkish commerce, and it is probable that the Government will accept this proposal. There are also the lines from Varna to Rustchut, and from Kustendjie to Czemavoda, which have been opened for the last two years, but have hitherto, owing to their isolation, not paid their expenses. The total length of the railways now open for public traffic in Turkey is about 1,350 kilometres. Of the other lines which are about to be constructed by the Government out of public funds the most important is that from Saremberg to Sophia, which was commenced a few weeks ago. This line will be connected by a short railroad to Nish-Ilesinacz with the Servian lines. The line from Adrianople to Shoumla, which is also in course of construction, would connect the Turkish railways with those of Roumania and Transylvania. The Bornian lines, from Sophia to Kostendil and from Kostendil to Banialuka, are now being surveyed. Nearly all the above lines will be of great strategical as well as of commercial importance.

OBITUARY.

Sir Edwin Landseer.—There is no need to reproduce in these columns any lengthened notice of one whose life has already been so fully chronicled in the daily press, and that more especially as the deceased baronet was not a member of this Society. To the Society, however, must be allotted the honour of having been the first public body which recognised the genius that afterwards delighted so many thousands of the artist's countrymen. In 1814, the "Silver Isis Medal" of the Society was given to "Master Edwin Landseer," for "a drawing of a hunting horse."

Cornelius Varley.—By the death of Mr. Varley, on the 2nd inst., the Society lost its oldest member. Since 1814, when he first joined it, Mr. Varley took an active and energetic part in all the Society's labours. For some years the Transactions were illustrated by his drawings, and it is only within the last year that he ceased to be a regular attendant at the Society's meetings. As a draughtsman and a painter Mr. Varley possessed considerable merit, and was the last survivor of the founders of the Water Colour Society. Science is indebted to him for various improvements in the camera lucida, the camera obscura, the microscope, and the telescope. Mr. Varley had nearly completed his ninety-second year when he died.

GENERAL NOTES.

Preservation of Food.—Professor Boussingault states that a quantity of beef-tea, having been submitted some eight years ago to a temperature of 20 degrees Cent. for several hours, has remained in perfectly good condition up to the present time. Sugar-cane juice was, at the same time, subjected to this treatment, and was found to be in excellent condition. Both substances had, of course, been kept in closed vessels.

Channel Passage.—A steam-vessel on Capt. Dicey's plan, or more properly the Sedley-Dicey plan, as brought before the Society last session, is now in the course of construction, and it is expected she will be ready for the service about March next. She will be 300 feet long, and draw six feet of water. Her cabins are large and roomy, with convenient fittings, and due attention to ventilation. Particulars will be given in a future *Journal*.

Iron in Victoria.—The high price of iron in England has revived discussion as to the probability of its profitable production in Victoria, Australia. A fresh discovery of iron minerals has recently been reported at Wallerawang, a little beyond the Zigzag, on the western side. Magnetic iron, brown hematite, and clay-band ore are stated to have been found in close proximity to limestone, coal, and fire-clay, and all within three miles of a railway station. It is proposed to start a blast furnace.

Railway Sleeping Carriages.—A sleeping carriage has just been started to run on the London and North-Western Railway. The interior of the saloon, which consists of three passenger compartments and two lavatories, one at each end, will seat four persons in each compartment by day, and sleep the same number at night. The arrangements for the latter are as follows:—The four seats, which are made in the frames, in each of the three compartments, and can easily be drawn forward so as to meet in the centre, will accommodate two persons at night, and there are upper berths for two other persons: these during the day are suspended against the roof, and being carried by quadrants or lazy-tongs, and balance-weights (unseen), are easily drawn down to a height of about four feet from the floor at night. To enable the passengers to reach these berths with ease, a pair of moveable folding-steps is carried in each of the compartments, so constructed by means of a moveable top, as to form a reading or other table during the day. The interior of the saloon is handsomely fitted up.

Resources of Sicily.—A Milan paper gives the following particulars of the "Inchiesta Industriale," or commission for the inquiry into the industrial condition of Sicily, which was held at Palermo and other principal towns of the island some months ago. The sulphur mines formed, of course, an important subject in the investigation of the commission, and especially those of Lezcara. By means of improvements that have been lately introduced in the form of machinery, drainage of the mines, &c., the produce has been tripled in four years, and from 15,000 tons it has risen to 50,000. It was the opinion that it would be desirable for the railway company to facilitate the means of transport, and that the export tax should be abolished. Several leading shipowners were examined, and from their evidence it appears that ship-building was on the increase, and one ship-builder stated that whereas formerly he built no vessels exceeding 300 tons, he now frequently received orders for ships of 500 tons, but that he considered wages too high for the quality of work required. The President of the "Trinacria Steam Navigation Company" reported that, including four steam-vessels building in England, they had ten steamers. The director of the "Oretea Foundry" employs 700 hands, and works 2,000 tons of metal a year. The iron used is supplied from England and Belgium; that of Lombardy is excellent, but the supply is insufficient. As to coal, it comes from England. He makes steam-engines and agricultural machinery, which are chiefly sent to Greece and Turkey. There are 18 manufacturers of brass bedsteads at Palermo; and since 1871 a considerable number have been exported to the Continent. Although the commission has elicited undoubted proofs of progress, when it is added that the wages of the workmen have increased by 20 per cent. during the last five years, and now stand at from 2.50 to 3 fr. per day, we have further evidence of the same facts.

German Sanitary Association.—A Sanitary Association for all Germany has just been formed, at Frankfort-on-the-Maine, after two days' conference. Burgomaster Hobrecht, of Berlin, is chairman. Burgomaster Erhardt, of Munich; Dr. Lent, of Cologne; Privy Councillor Varrentrapp, of Frankfort; Privy Councillor Wiebe, of Berlin; and Burgomaster Winter, of Dantzic, are members of the managing council. The association has for its object the promotion of a sounder sanitary administration throughout the empire.

Dutch Language.—Dr. Alexander Van Wyngaerden Bikkers has opened an evening class in the City of London College, 52, Leadenhall-street, for the study of the language of Holland. He has been induced to do this on the suggestions of Mr. Hyde Clarke, in the Society's programme, because the Netherlands and Dutch language is of great value commercially, being the language of Java and the Dutch East Indies, as also of Surinam and the Dutch West Indies. It is also the language in which large transactions are carried on in our Cape Colonies and the Republics of the interior of South Africa. Dr. Bikkers has also begun a course of eight lectures on the science of language.

Report on Asphalte Pavements.—A report, in the form of a detailed table on the various kinds and quantities of asphalte laid within the city of London, has been prepared by Mr. Haywood, engineer and surveyor to the City Sewers Commissioners, and printed by their authority. There are now altogether 25 streets, or portions of streets, in the City, of which the carriage-ways have been paved with ashphalte. One of the pavements has been down three years and nine months, two for two years and two months, eighteen under two years, four under one year, and five under six months, at the time of inspection. The most numerous portions have been laid by the Val de Travers Company, but seven other kinds have been tried, and the tabular report, with its numerous notes and remarks, is a valuable and important one, and should be looked to by all who are interested in the subject of roads.

Coffee Enterprise in Ceylon.—The hill region of Ceylon covers an area of about 4,000 square miles, is of a somewhat circular form, and its most elevated peaks rise to 8,280 feet above the level of the sea. Systematic coffee planting is, from physiological reasons, exclusively carried on in these hills, although irregular native garden-plantations are found everywhere in the south-western portion of the island, even close to the sea beach. The favourite elevation is between 2,000 and 3,500 feet, but in a few exceptional cases estates descend almost to the foot of the hills, whilst others are situated as high as 5,500 feet, and even higher. The number of systematically-worked coffee estates scattered all about these hills amounts to over 1,000, divided amongst 35 districts (very widely differing in some instances in physical aspect), covering an area of perhaps 440,000 acres, of which about 200,000 acres are cultivated, producing about 1,000,000 cwts. of clean coffee, worth on the spot about £3,000,000 sterling, and giving employment to upwards of 200,000 persons, chiefly Tamil labourers from the coast of India. This is exclusive of about 50,000 acres of native coffee.

Fuel Supply.—Among the anomalies of the fuel question the most striking consists in the fact that the supply of petroleum from the Pennsylvania wells is now at a rate which has reduced its value to one penny per gallon, and that yet no methods have been brought into general use to utilise this product, either for manufacturing or domestic purposes, so as to influence the price of coal. The present yield of the region is estimated at 30,000 barrels a day. Many single wells give as much as 1,300 barrels daily, and new discoveries are constantly made, the chief flow being from a locality embracing a space of not more than about a third of a mile, and most of the discoveries being on ground which had hitherto been considered unproductive, but which is now brought into play "by the use of nitro-glycerine torpedoes, that upon being thrown into the openings produce sufficient concussion to open the interstices in which the petroleum is secreted." An impression is become general that the existence of this fuel is as extensive as that of coal itself, and, meanwhile, although it seems not to be turned to sufficient account in Europe, to mitigate the inconveniencies from the scarcity of coal, its qualities are finding recognition in China and Japan, whither considerable shipments are now in progress.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

TECHNOLOGICAL EXAMINATIONS.

The subjects in which examinations were held this year, namely, Cotton Manufacture, Paper Manufacture, Silk Manufacture, Steel Manufacture, and Carriage-building, will be retained in the Examinations of next year, with the addition of Cloth Manufacture, Glass-making, Pottery and Porcelain, and the Manufacture of Gas.

The Programme is in preparation, and will be published as soon as possible.

In addition to subscriptions already announced, the Council have to acknowledge the following contributions to the Prize Fund:—

The Worshipful Company of Clothworkers	£105 0 0
G. N. Hooper, Esq.	10 10 0

Also as a special contribution to a Prize Fund for the Examination in Carriage-building.

G. N. Hooper, Esq.	£10 10 0

SIR JOSEPH WHITWORTH'S PRIZES FOR THRIFT ESSAYS.

Sir Joseph Whitworth has offered prizes of the value of one hundred pounds, to be awarded by the Society of Arts, for the best Essays on the "Advantages that would be likely to arise if railway companies and limited companies generally were each to establish a savings-bank for the working classes in their employ." With this offer he has transmitted the following observations:—

1. Is not a good rate of interest, with perfect security, more likely to promote the habit of saving than any other plan that can be devised?

2. Sir Joseph Whitworth suggests that the interest to be paid on the deposits should be the same as the dividend, with a guarantee that it shall not be less than 4 per cent.

3. By paying the same rate of interest as the dividend earned, there is a bond of union established between labour and capital.

4. An Act of Parliament might make the deposits of the industrial classes the first charge on the estate.

5. The proprietor of a private establishment, whose profits are not made known, might undertake to pay, say 7 or 8 per cent. when the profits reached that amount or more, the proprietor giving an undertaking to pay not less than 4 per cent.

6. In the case of Agriculture, each county might have its savings-bank for the savings of both men and women in the said county, and the interest to be paid might be 6 or 7 per cent.

7. To do this there might be a rate collected along with the poor-rate, to be called the interest or industrial rate.

8. As this rate increased, no doubt the poor-rate would diminish, and if the habit of saving became general among the labouring classes, there would probably be great gain to the property-owning classes, considering the great variety of ways in which they have now to contribute for the support of the unfortunate who now make no provision for themselves.

9. In order to realise what might be the probable saving to those who encourage the savings-banks thus suggested, Sir Joseph Whitworth points to the list of charities, also institutions, such as infirmaries, hospitals, union-houses, prisons, police, &c., &c.

10. In any establishment, if only one-third of those employed deposited savings, they would have immense influence over the other two-thirds of their fellow-workmen.

11. Men who spend all their earnings are generally reckless, and become the dupes of agitators; but the man who has put by some of his earnings will be likely to exercise forethought, and will not be led away by others.

12. In South Wales is it likely there would have been the late turn-out, if the different establishments had each had such a savings-bank as that proposed?

13. In the case of a man or woman falling into distress from causes beyond their control, what better proof could be given that they were deserving of sympathy and assistance from their friends, than the fact that they had put by savings at a time when they were able to do so? The rule of action should be to do as little as possible for those who do as little as possible for themselves.

14. Some of the points to be considered by the essayists will be the amount to which the savings shall be limited, and when the depositor wishes to withdraw the whole or any part of the sum deposited, what notice shall be given.

15. The co-operative system is no doubt effecting much good, but if the system here sketched out were adopted, the greatest good, in the shortest time possible, might be effected.

To the above observations Sir Joseph Whitworth has added the following:—

I think it will be admitted as desirable that one-third of the period of man's existence should, if possible, be spent free from the necessity of labour and toil.

The middle period of life is, therefore, the time when man's energies should be put forth, and the greatest amount of work should be done that strict obedience to the laws of health will permit. The experience of industrious men goes to prove that the most pleasurable existence is insured by following this course.

It is therefore wrong, in every sense, for the Amalgamated Engineers and other Trades Unions to combine and endeavour to compel young and middle-aged men, in the prime of life, to limit and reduce their hours of labour to the extent now being attempted, and thus prevent them from saving so much, and laying it by for that period of life when man's energies begin to fail, when work becomes irksome, and when rest is necessary in order to pass a comfortable existence. May not the case between the industrious working man who saves part of his earnings, and the man who is reckless and will not save part of his earnings, be fairly stated thus:—

That the man who does not save when he is in health and strength, robs the man who does save, because the law compels him to support those who have not saved, and to bury them when dead?

The principal subjects which the essayists should consider are the preceding.

After commending these observations of the enlightened and liberal donor to the consideration of the competing essayists, the Council, however, would further call their attention to the liability to frauds of various kinds to which such a system may be subject, such as, for instance, that of colourable investments being made by parties investing, in their own names, moneys not bonâ fide their own; and would impress upon the competitors the importance of suggesting the best means of preventing such abuses.

There will be two prizes, £70 for the best, and £30 for the second best essays. The judges reserve the right of withholding the prizes altogether, or awarding lesser sums.

The following are the conditions to be observed:

1. The essays must be sent to the House of the Society of Arts, Adelphi, London, addressed to the Secretary, on or before 1st December, 1873.

2. They must be delivered either in print or in manuscript. If in manuscript, they should be written distinctly on foolscap paper, on one side of the paper only. Every paragraph must be numbered.

3. They must be sent in sealed, with only a motto or cypher; and a separate letter, also sealed, with the motto or cypher marked outside, must accompany the essay, giving the name and address of the writer.

4. Brevity will be considered as a merit.

5. They may have been published anonymously before being sent in.

6. The Society is to have the right of publishing the two prize essays in its *Journal*.

7. The award of the judges will be final.

HALL-MARKING OF JEWELLERY.—PRIZE FOR ESSAYS.

1. It having been brought to the knowledge of the Council of the Society of Arts that what is termed "Hall-marking" of jewellery and articles of gold and silver, is inadequate to secure to the public that protection in the quality of the materials for which it is intended, they have accepted the offer of one of the members, Mr. Edwin W. Streeter, to place £25 at their disposal, to be awarded as a prize for an Essay treating on this subject, with suggestions for an improved system.

2. The Essays must be sent in not later than the 1st of November, 1873, marked with a motto, or cypher only, accompanied by a sealed letter, with the corresponding motto or cypher marked outside, giving within the name and address of the writer of the Essay.

3. Brevity will be considered a merit.

4. The Council shall have the right of publishing the prize Essay in the *Journal*, and they reserve the right of withholding the prize altogether, or of awarding a lesser sum, if the judges shall so recommend.

P. Le Neve Foster, *Secretary*.

ECONOMICAL USE OF COAL FOR DOMESTIC PURPOSES.

With regard to these prizes it has been decided that testing rooms will be provided, in which the various competing articles may be tested in succession, each competitor having allotted to him in turn a room and chimney, for a limited period, where he may fix his apparatus for the purpose of its being tested by the judges appointed by the Society of Arts, the same to be removed when directed by the judges; such fixing and removal to be at the cost of the competitor.

The competing articles must be delivered at the London International Exhibition Building, South Kensington, on the 1st December, 1873, with a view to their being tested, and subsequently shown in the Exhibition of 1874.

The ceremony of turning the first sod in the construction of the first railways in Persia took place lately at Rescht, on the Hurst, in presence of the foreign consuls and residents. Upwards of a mile of earthwork is completed.

Professor Heeren has analysed Mushet steel, and finds that, excluding carbon, and perhaps traces of other substances, it contains 8·3 per cent. of tungsten and 1·73 per cent. of manganese. Untempered, this steel resists the file, but after tempering it becomes much softer and readily yields.

It is stated that considerable excitement prevails in the oil regions over the discovery in the lower district of a fourth sand rock, which promises to be more prolific in the production of petroleum than either of the formerly producing stratas of the second and third.

The American Government contemplates running a line of telegraph along the coast of New Jersey from Sandy Hook, at the entrance to New York Harbour, to Cape May, at the mouth of the Delaware. This line is to connect the various life-saving stations on the New Jersey coast, and it is to be used to order the display of cautionary signals. A similar survey has been made along the coast of Massachusetts for the same purpose.

HINTS TO COLONISTS ON THE CULTIVATION OF SILK.

By B. Francis Cobb.

(Continued from page 876.)

The foregoing report from California should not be received as an authority, but rather as an aid, showing the experiences of the early rearers of a country the climate of which assimilates so closely to that of many of our colonies.

Of primary importance in the commencement of silk-rearing is to have good seed, or eggs; not only should the seed be of good quality and of a healthy breed, and distant from any locality where disease has been, but it should be selected from a country where the climate assimilates as much as possible to that where it is proposed to develop the seed. It is better to transport seed from a colder to a warmer climate than the reverse.

The neglect of these precautions has already led to much disappointment, and in many instances where "graine" or seed has been sent from a northern to a southern hemisphere, the unusual stimulant of heat applied in crossing the tropics, at a time when, in the ordinary course of events, the eggs should have been experiencing the coldest period of their hybernation, has so disturbed the natural course, that premature incubation has set in, and the worms show such a tendency to degenerate that, unless carefully tended by experienced hands, they continue to retrograde until the cocoons become worthless.

Seed sent from Europe to the colonies cannot be sent too soon after it is laid, and then should be treated with great care, and kept, as much as circumstances will permit of, dry, cool, aërated, and free from contact with the steam of engine-rooms or bilge water; this latter will poison seed, and thus seed suspended between the timbers of a ship, under the impression that the situation was the coolest in the vessel, has been found at the end of the voyage discoloured and bad. Neither should the seed be placed in the ice-houses of steamers, for the great and sudden changes from heat to damp cold has the effect of so injuring the worm, that although it may attain maturity, it will scarcely ever produce a good cocoon. The misfortune is that in cases of injury to the seed, it is very often not perceptible until the worm has attained the last stage, when, having given all the trouble and caused all the expense it can, it either dies or spins a miserable abortion of a cocoon, as unlike those of its progenitors as can well be.

In procuring seed, it is well to know the history of it, and also to be furnished with specimens of the cocoons from whence the moths have emerged that produced the seed. It would be probably better now to obtain guaranteed reproduction of Japanese annuals from Europe than trust to the chance of obtaining good seed from Japan.

The following, from Mr. Troup's report of his journey in Japan, conveys a good idea of the little dependence that can be placed upon the fact of Japanese seed actually coming from a good district:—

"June 23. Left Yonezawa early, and passing through Mia-uchi and other towns and villages, arrived at Koïdé in the afternoon. The town of Yonezawa itself is large, but the houses appear not to be so well built, nor the inhabitants as a rule so well to do as those of the country villages. The latter, in which the silk culture is apparently the staple occupation of the people, have about them an air of great comfort and tidiness. Koïdé, a rather large trading town, is one of the chief centres of the silk culture. The worms in Yonezawa this year were generally pronounced superior; but the quantity was said not to be very large. The intention here also appeared to be to make seed rather than silk. We discovered at this place that a practice was carried on which cannot be characterised by any milder term than that of a fraud. It appears that the Yonezawa seed having obtained some reputation for superiority, cocoons already formed have been brought this year from Joshiu to Koïdé to be hatched and lay their eggs there. These eggs will thus come into the market as Yonezawa seed. The empty cards ready to receive these eggs, already bearing the Yonezawa stamp, were shown to us, and the persons engaged in this transaction appear to have little care for the reputation of their seed, provided they can make some money by the operation."

The high prices ruling of late years for good seed of 20s. to 25s., and even 30s. per oz. must not be mistaken for the normal values; such prices have been given by European rearers, entirely in hopes of replacing the diseased races that were causing such heavy losses year after year. About half the above quotations would be a more correct price for the colonist to base his calculations upon.

Nearly all seed now offered for sale on the Italian markets is now subjected to what is called a "microscopical analysis," and unless the report given by the experts be a favourable one, it would be extremely difficult to realise anything like a remunerative price.

Good "graine" should be of a bright gray colour, evenly spread upon the cards, not in raised masses in one part and scantily covered in others; in the lumped masses the lower eggs have scarcely a chance of resulting well, and as they generally are the first to hatch, the worm is frequently smothered before it can extricate itself. The "graine" should be flat rather than round, and a slight convexity of the upper surface is considered by many to be a good feature. It would be a good rule never to purchase eggs that one knows nothing about, and can get no history of.

A correspondent, writing to the *Californian Farmer*, states as follows:—

"The beneficial results to the community to be derived from sericiculture, are not based so much upon its high per-centage of profits in investment, as upon its being one of the most potent means for diversifying our industries, because it can be profitably prosecuted in all portions of our State, thus most effectually favouring and inviting immigration.

"Having once established our mulberry plantations, and while continuing their most careful cultivation, the proper work of the sericiculturist begins. The greatest care will be required in selecting healthy eggs of the most approved varieties. The best Japanese varieties appear to be raised most in accordance with natural methods, are perfectly hardy, and produce silk of the finest quality. These should be our main reliance, and by keeping the different varieties distinct, preventing by the utmost care their hybridisation, destroying at once all the worms whenever they show signs of disease, and selecting well formed cocoons for hatching, we may secure the best eggs, and with them supply the ever increasing demand of the European trade. In a warm climate it proves difficult to keep silkworm eggs from being hatched prematurely before there is sufficient feed for them, or to facilitate efforts to prolong the season. We should early endeavour to find accessible localities, either in the northern part of the State or the higher mountain regions, where the temperature is more even, and remains until June lower than in the valleys; here depositories for silkwarm eggs could be located at small expense, to be drawn upon as wanted by the owners, such localities can only be found by careful trial and observation."

In addition to the Japanese varieties mentioned, there is a fine breed that has lately been obtained from the Taiho or Namsing district of China, of which very encouraging reports were received from Italy last year, the first time they had been introduced into Europe. The cocoon is a brilliant pure white, and much esteemed. From this breed the best Tsatlee is made.

Having obtained good seed, the best method of preserving it in that condition until the proper time for incubation arrives becomes a matter of vital importance;

however good the seed may be, if it hatches before the mulberry leaf is ready for it, a commercial failure must result; for, although worms may be kept alive and apparently thriving upon lettuce, black currant, and many other leaves, the experimentaliser must never expect to produce cocoons from such feeding as will take a good classification on the market. Many ingenious contrivances have been tried to meet this difficulty, but hitherto unsuccessfully. One of the most successful has been by means of prepared leaves gathered the preceding year, dried rapidly, so as to retain as much of the different component vegetable parts as possible, and then powdered and put away in jars or air-tight packages. When wanted, the powdered leaf is mixed with a little gum mucilage, or sweetened water, and spread about for the worms to feed upon. It has been stated that worms thus fed up to the second age have thrived better than those fed upon the leaf itself; but our readers must take this for what it is worth, and not place too much confidence in any substitute for the young, fresh leaf. Where seed can be kept at an even temperature of about 45° Fahr., until carried to another country, and the transportation takes place at a time when the temperature is about the same or a little colder, and again be kept in a dry, darkened chamber, at about the same temperature of 45°, incubation may by these means be retarded for a considerable period, so as to allow time for the mulberry trees to put forth leaves.

This was demonstrated by the illustrations of sericiculture at the South Kensington Museum last year, where eggs from Italy, kept cool there until the winter, and then sent to England, where they were kept in a dry, dark, but airy chamber at a steady, low temperature, were successfully retarded in their incubation for more than a month beyond what might be considered their normal period, and when set to hatch incubation set in at once with scarcely a failure; the whole hatched in the heated tropical departments of the Horticultural-gardens in within four days of each other, and as hatched were removed to the cooler temperature of the adjoining museum.

Captain Mason, at Yateley, has also succeeded in making his hatching agree with the foliation of his trees, and nothing could be more satisfactory than the quality of the cocoons he has produced.

A great trouble crops up when seed has to be transmitted from the northern to the southern hemisphere, or *vice versâ*, or even from the far east, when the seed is transmittted by the steamers *viâ* the Red Sea.

As already shown, the stimulus of the unusual heat during the voyage, occurring at a time when in its normal condition it should remain perfectly quiescent, shortens the period of hybernation, and seed so acted upon is not to be retarded by any means but at the expense of the health of the worm and the value of the cocoon.

This is still more vexatious in the case of seed sent across the line to our southern colonies, where not only is the seed stimulated to early action by the heat of the tropics during the passage, but, arriving during the southern summer, it appears impossible to prevent some of the worms hatching, and, as they do this in small batches, the best mode of treatment seems to be to force them all out; but this is not at all an easy thing to do without future injury to the cocoon, for the egg, like most other things in nature, has its allotted time to rest quiescent; and to shorten this, by forcing incubation, can only be done at the risk of deteriorating the breed. In sending seed from the southern colonies to Europe for sale, it will be advisable to ship off as soon as possible after the seed has been laid, and, supposing the worms to have been reared in the spring of a southern hemisphere, this would probably enable them to reach their destination in Europe in January or February. The stimulus of the voyage inducing an early incubation might then be an advantage, as their natural time would be the end of September or the beginning of October; and, hybernation having been shortened by the voyage two to three months, such seed might be made to form in Europe a valuable second crop. This is, however, a matter which only actual experiments can prove.

Most seed, especially Japanese, sent from a northern to a southern hemisphere, has a tendency to undergo a change from univoltini to bivoltini—that is to say, to produce twice in the year instead of once. It is not difficult to understand how this arises. The time of foliation of the mulberry in the north is about April or May, early or late as the seasons may be, and the seed laid in June in the course of nature hatches during the following April or May. When transported to the southern clime, all this is altered, and one is met by the paradox that midsummer is at Christmas, the spring in October and November, at which time foliation is young and at its best, and the mysterious influences of spring pervade nature.

The imported seed soon feels the effects of these influences, incubation sets in, vitality is manifested, and the seed hatches months before its normal time. When the importation has been from a colder to a warmer climate, it frequently happens that the eggs laid by the moth of this early incubation manifest a tendency to hatch again at the original nominal period of the northern spring, and thus an annual breed of a northern clime, may become bivoltini in a southern one.

It has been a subject of considerable discussion which of the two races, the annual or the bivoltini, is the more remunerative to the rearer. In Europe the experience of the last few years with the bivoltini races of Japan have completely discouraged their further introduction, and doubtless, as the old native races become restored, they will entirely supersede the bivoltini; but although this may be so in Italy, it does not follow that the bivoltini are unsuited to the colonies. They have the advantage of going through their different stages quicker than the annuals, and where the mulberry flourishes, it does not appear that the gathering the leaves for the second crop does much, if any, harm to the tree. The test after all will be in the result. Certainly the weight of silk of one crop of many of the annuals exceeds that of the two crops of bivoltini, and of of course the labour is much less. Last season in Italy the cocoons from one crop of good annuals, realised in many cases more money than two crops of the ordinary bivoltini, and this must be the final test for the rearer. One disagreeable habit of the bivoltini is that of making duppions or spinning double or treble cocoons, which is so much loss if a heavy carriage has to be incurred, as the value is comparatively so small that duppions would hardly pay to send from a great distance. Whatever a colonist may be induced to do hereafter, he should make it a rule to commence upon the very best annual seed possible to obtain.

Before proceeding further, it will be well for those who propose adding silk-rearing to their other labours to consider with what they have to deal, and a few of the peculiarities of the worm.

The breathing of silkworms is not from the head but from the eighteen small distinctly- marked apertures on each side of the body, and anything which closes any of these apertures, such as overcrowding, &c., must be detrimental to the health of the worm.

The body of the caterpillar has no canal by means of which the fluids of the mulberry leaf can be separated, and as but a very small portion passes with the excretor, the remainder has to be got rid of by transpiration through the skin; hence the ill effects of a sudden chill or cold draught, against which latter the worms may be observed to shelter themselves behind leaves or elsewhere, while the feeding, of such vital importance to the rearer, is discontinued. The peculiarities above mentioned point to the requirements of the worm, viz., a free circulation of air, but without draughts; and in the regulation of the magnanerie the windows should never, except in hot climates, be opened on the windward side.

Light they rejoice in, but sunshine is to be avoided, especially in tropical or semi-tropical countries, where it would soon be fatal. Scents of all kinds are injurious, and this is to be borne in mind, when scheming to protect them against their many enemies. Tobacco smoke should be prohibited, for it is very hurtful if in contact with them, and even the scent of it in the air of the apartment will frequently cause them to cease feeding and become restless. Loud noises are also detrimental.

The temperature and amount of moisture in the atmosphere of the magnanerie should be matters of the greatest attention, the readings of the hygrometer being as important as those of the thermometer, and sometimes more so; for it will be found that when artificial heat has been applied to raise the temperature, and the ventilation not sufficient to carry off the moist, vitiated air, that the worms will cease feeding from no discernible cause, and when such is the case, the external air must be admitted at once, notwithstanding it reduces the temperature, when it will be found that, with a colder but purer atmosphere, the worms will resume feeding.

Thunder storms affect the worms adversely, but the period at which they suffer most appears to be during the close heat immediately preceding the storm. This is to be mitigated by a person passing through the magnanerie with a flaming bundle of straw or other material prepared for the purpose, which burns without offensive smell. A person walking backwards, and waving the flame, will cause a circulation to set in and make a marked improvement in the aspect of the worms.

Any state of excessive electricity in the atmosphere disturbs the repose of the worms, and when continued and severe sometimes induces a serious disease—a species of dysentery or cholera—which is infectious, and is communicated by healthy worms touching the excreta or discharges of the diseased ones. This disease should be carefully watched for, and at the very first appearance every worm, not only diseased but those that have touched any of the discharge, either on the leaves, nets, or trays, should be at once destroyed. The only chance for the cultivator is to stamp the disease out at once before it spreads.

A somewhat similar disease, but not so deadly or contagious, sometimes occurs when the worms have been fed upon the leaves of suckers from the roots of the trees, or those from young trees in damp ground. It can be recognised by the worms emitting from their mouths and the pores of the skin, particularly the little point at the tail, a viscid, greenish, semi-fluid mucus, which, when rubbed over the breathing pores, effectually closes them, injuring the health of the worm so treated, and spoiling the cocoon. Starvation for a while is said to be the cure, but it is a question if a worm which has been so affected and cured will ever be able to spin a good cocoon.

As a rule, silkworms are much more likely to suffer from quality than quantity of leaves, and any peculiarity in the leaf should be sufficient to condemn it in the eyes of the colonist, who generally has the leaf in abundance around him.

The first thing to be considered is the magnanerie. The writer has seen most beautiful cocoons produced from a magnanerie which was probably the perfection of such things. A brick building, slated and ceiled, with ventilators under the roof, ventilators at each end of the room, and in the windows; steam pipes, and an Arnott stove were supposed to be able to regulate the atmospheric conditions to the greatest nicety; thermometers, barometers, and hygrometers were at either end of the buildings, and the feeding frames and silk nets all that could be desired. The leaves were cut with mathematical exactness by a pretty machine, weighed out into rations, and Dandolo's rules followed exactly. Without being able to find one fault, or suggest one improvement, the writer left that building, convinced that it was a failure.

At another time he found a man and a woman tending silkworms in their *magnaneries*, and producing very fair cocoons. This was on the opposite side of the world, and was certainly rather opposite to the description above. Four stakes had been driven into the ground, on the top of which, and around, three side mats had been suspended; some short stakes, driven into the ground of what by courtesy one may term the inside of the magnanerie, and another application of poles and mats, formed the shelves on which the worms were being reared. Leaves and small branches of mulberry were pitched in among the worms when it suited the convenience of the proprietors; rude bunches of straw were given the worms to spin in; and, notwithstanding the violation of almost every rule laid down by Dandolo, they managed to produce as a result very fair cocoons, and it was impossible to deny a certain success, although on a larger scale the probability is that failure would have been certain. It seems, therefore, inadvisable to attempt to give any positive instructions as to what like a magnanerie should be. The colonist may be guided by the climate, and the meteorological tables of a series of years, and if he finds the weather to be depended on for the couple of months necessary for his operations, he can then erect a magnanerie, at as little cost as possible, to suit the locality and climate. Of course, the less capital invested in buildings and plant, the better chance of a commercial success; and the simpler the means by which a certain result can be brought about, the better for the agriculturist.

(*To be continued.*)

ASPHALTE PAVEMENTS IN LONDON.

A report by Mr. Haywood, the engineer to the commissioners, on the condition of asphalte pavements in the City, has recently been published by order of the Commissioners of Sewers. This report embodies the results of Mr. Haywood's inspections up to April last. In order to obtain sufficient data for the examination, portions of many of the pavements were cut out, in order to ascertain whether they had lost materially in thickness. In nearly all cases some such diminution was proved to have taken place, but the conclusion arrived at was that it would not be possible to ascertain the exact loss in any case without making a considerable number of openings. When first laid the same thickness was never exactly pursued throughout, and in the case of those laid in the shape of heated powder considerable compression takes place. On the whole, there was no doubt that the asphalte had somewhat diminished in thickness under the wear of the traffic.

On the subject of the repairs executed, it was not easy to obtain accurate returns, the companies being bound to maintain the pavements in repair for a certain number of years. The results of the investigations are given in a tabular form. From this it appears that there are now altogether twenty-five streets, or portions of streets, in the City of which the carriage-ways have been paved with asphalte; one of the pavements had been down for 3 years and 9 months, two for 2 years and 2 months, eighteen under 2 years, four under 1 year, and five under 6 months, at the time of the inspection.

In nineteen places the Val de Travers asphalte (compressed) is laid, and amongst them are the two oldest specimens, that in Threadneedle-street, which was laid as a specimen by the Asphalte Company free of charge, and that in the Poultry and Cheapside; the former has now been down 4 years (3 years and 9 months in April), and the latter 2½ years. The older portion is in good condition, but the newer is beginning to require extensive repairs. On the other pavements the report generally is favourable as to surface condition. Val de Travers (mastic) has been down two years in George-yard, and is in good condition.

Mourotier (compressed) and Société Française des Asphaltes (compressed) have each been laid in Princes-street under a year. Both are in good condition, but the latter does not seem to have been well laid.

Limmer (mastic) has been laid in three places, Lombard-street, Moorgate-street, and Cornhill. This shows considerable wear, especially in Cornhill and Lombard-street; in Moorgate-street the surface is generally good. This has been down from one to two years.

Barnett's asphalte (mastic) is down in four places, Moorgate-street, Carter-lane, Lothbury, and Bishopsgate-street. That in Moorgate-street has been in use a year and a-half, and has been much repaired; the others for short periods only. Some of this is good, the rest is reported on unfavourably.

Maestu (compressed blocks), Trinidad (compressed), and Patent British (mastic) were laid down, but afterwards removed and replaced by Val de Travers compressed.

JAPAN.

The reconstruction of Japan, the erection of the mint, and the re-coinage of money—the basis of all transactions—the careful inquiries of the Japanese embassy into the customs of the West, and the character for aptitude evinced by the Japanese themselves, are hopeful signs for the future of that country, where the people seem anxious in all things, even in language, to assimilate themselves to the model of our own institutions. The capitalists and merchants of Great Britain will watch for signs of awakening in this, as in any other part of the world, however remote, where they can discern even the germs of those principles which, by experience, they have found to be successful in their practical results. The report of the British Consul at Yeddo contains mention of certain occurrences beyond the ken of casual observers, which introduce us more fully than any mere dry statements, into what is actually taking place in that country. Mr. Dohmen, as we can well imagine, experiences considerable difficulty in obtaining information respecting the trade which, if it had been possible to collect, would doubtless have served as a guide to exporters, but in the absence of which we are glad to trust to the personal experience and observation of a well-informed resident. Writing from Yeddo, the capital, he observes that the consumption of foreign goods appears to be very considerable. Almost in every street a certain number of shops may be seen where nothing but foreign articles are offered for sale. It would be idle to speculate on the future of direct foreign commerce, changes of every kind occurring so suddenly and unexpectedly; it is, however, natural to conclude that, where the actual consumption is there will eventually be direct commercial transactions between the importer and the consumer, whatever may be the obstacles that have to be overcome. The railway between Yokohama and Yeddo, which is being constructed by English engineers and with English capital, but for the Japanese government, is now almost completed, and its opening to the public is expected to take place at no distant date. The first line of telegraph, which at the outset met with so much opposition on the part of certain narrow-minded Japanese, has now become so popular that telegraphic wires are springing up in all directions within the capital. Already the Mikado's Palace, the Foreign-office, the Board of Works, and the Tokei-fu are in telegraphic communication with the Kanagarva-ken, and eight stations are to be opened to the public in various parts of the town. The government have engaged for that purpose the services of Mr. George, an English engineer, who, with a staff of English superintendents, is deeply engaged in constructing the line to Hiogo and Nagasaki, whence Yeddo will soon be in direct communication with the whole world. Besides these advantages, the establishment of a bank, on the foreign principle, and under the superintendence of an English banker, which the Tokei-fu is at this moment organising, will afford the Yeddo merchants facilities for engaging in commercial operations with foreigners hitherto unknown to them.

Important changes, it appears, are taking place in the capital. The ex-Damios, since they became dispossessed of their estates, have hastened to part with what they no longer considered necessary to their dignity. Their costly palaces are allowed to tumble down into a state of ruin and neglect, from which even the Imperial castle itself, and the magnificent mausoleums of the Shôguns do not appear to be exempted. Thus, that portion of the palace called the citadel, which was formerly the residence of the Tycoons, threatens soon to become a mass of ruins. Already the imposing and numerous gateways and bridges leading to it are left to take care of themselves, and a foreigner, who, a few years back, hardly dared to look at this wonderful stronghold, may now freely ascend its towers, overlooking the residence of the Mikado, without meeting even a gatekeeper. It is difficult to understand what object the government can have in view in allowing monuments, once the pride of Japanese of all classes, and in which all the money and labour the country could produce seem to have been lavished, to go to wreck and ruin, unless, perhaps, it be intended as an imitation of the Communists of Paris, who imagined they would obliterate the history of their country by the destruction of the Colonne Vendôme and other monuments. The costly articles of furniture and ancient arms which once adorned the princely dwellings of the Damios may now be seen in the shops of dealers in antiquities, and may be bought for a mere trifle. Many of these nobles have availed themselves of the leave given to them by the Mikado to travel abroad, and ere long the majority of them will be seen visiting Europe and America with their families. But the most remarkable change is the rapid adoption of foreign dress by all classes of the people. The fashions, however, that have hitherto been copied or invented by native tailors are so varied, and, in many instances, so ridiculous, as to defy the keenest imagination. This certainly is to be regretted, but the substitution of foreign for native dress has been productive of a most important result, namely, the general disarmament of the two-sworded class by peaceful means. Security to life and property, where two years ago a foreigner scarcely dared to visit his neighbour, unless attended by a strong guard of native soldiers, is now as efficient as in any other large city in Europe and America. This improved state of security has enabled the government to remove all the guard-houses which had been erected in the native towns and around the foreign settlement, and a police force of 3,000 men has been substituted for these guard-houses.

In the style of building the Japanese have as yet made little progress, but a few houses of brick have been erected. Fires have been as frequent during the winter as ever, and the thousands of wooden buildings thus destroyed are being rebuilt of the same inflammable material, and in the same shabby style. The government, however, see the advantage of adopting the foreign style of building. For this purpose they have engaged the services of English engineers and architects, who are erecting two barracks after the European style, besides the construction of a suspension bridge over a ravine in the Mikado's private grounds. Two gentlemen—Messrs. McVean and Joyner—have been engaged by the government to make a regular survey of the country, somewhat on the plan of the ordnance survey of Great Britain, as well as of the capital, and while waiting the arrival of the necessary staff and instruments required for that purpose are making designs for a technical school on a very extensive scale. The school is to accommodate about 360 scholars, and foreign teachers are to be appointed to give instruction. It is also contemplated, when the plan of Yeddo is finished, to effect great improvements of the streets and bridges, which are now in a very neglected state. Among the Japanese of all classes there is a universal desire for acquiring foreign languages, especially English, and other branches of learning. The principal establishment where foreign instruction is given is the Kaisiejo (school), under the superintendence of the Rev. Mr. Verbeck, an American missionary. The number of pupils is about 400, of which 200 are instructed in English, and the other 200, in about equal proportions, in the French and German languages. Besides languages, all other branches of elementary education are taught; and if the scholars go through the various classes regularly, they will doubtless acquire at the Kaisiejo a sufficient knowledge of what is necessary to carry on intercourse with foreigners and with foreign countries. Besides the establishment above named, there are a number of independent schools, both under native and foreign management, in which foreign languages and mathematics are taught. Great progress is also made in the art of studying medicine—186 pupils receive instruction at the Eastern school. Another school, where medicine and surgery are taught, is the Naval Hospital, at present established at Takanawa, in the building which was formerly the British legation. The total number of Japanese boys frequenting schools in Yeddo amounts to 39,181. This, out of a population of not quite 800,000 inhabitants, shows that nearly every Japanese is being taught to read and write. A naval school has also been established for the education of young Japanese in the art of navigation. There are at present 226 boys receiving instruction from twenty native teachers. At present there is only one foreign instructor attached to the establishment, namely, Lieut. Brinkley, R.A., who has charge of the artillery branch. It is believed to be the intention of the government to engage some eighteen English naval officers and non-commissioned officers for the purpose of putting the establishment on the footing of a naval college. The government have engaged an American agricultural mission—or scientific commission, as it is called—of which General Capron, late Commissioner of Agriculture at Washington, is the head. The object of this mission is to improve the breeding of animals and to bring the soil of Japan under scientific cultivation. Their field of operation is to be the island of Yezo.

The population of the capital city has been set down by various writers in Japan at from 1,500,000 to 3,000,000, but from information supplied to Mr. Consul Dohmen by the municipal government, it seems that even the lowest of these estimates in considerably exaggerated. According to the last census, taken since the restoration, the population consisted of 416,812 males and 363,509 females, or 780,321 souls in all. The former number includes 5,151 priests. The disparity between the number of men and women is owing to the presence of a large number of homeless creatures called "coolies," who perform all the rude manual labours of the citizens. Yeddo is, no doubt, large enough to contain 3,000,000 inhabitants, but, except in the commercial parts of the town, it is very thinly populated. The population of Japan is given as follows:—16,733,698 males and 16,061,199 females, or 32,794,897 in all. The area covered by the capital is given as 19,602,733 tsubos. This statement does not include the streets, canals, rivers, and moats; taking these, at a rough estimate, to cover one-eighth part of the town—which they certainly do—the whole extent of Yeddo will be 21,828,076 tsubos, being equal to 18,040 acres, or 28 square miles; and this city is therefore, in point of area, next to London, the largest in the world. What is called the military quarter includes the Mikado's palace, which, by itself, must cover nearly a square mile of ground; the various government departments, barracks, parade-ground, and such of the residences of the ex-Daimios and Hatamotos (the nobility and gentry of Japan) as have not been taken possession of by the government in the abolition of the feudal system. The temple grounds consist chiefly of the burial-places of the ex-Shoguns or Tycoons, namely, Shiba and Nyéno, each of which is a small town in itself. The unoccupied ground is that where formerly stood the princely dwellings of the nobles, which have either been demolished by the government, or have been abandoned by their owners, who are now no longer in a position to keep up such expensive residences. Some of these properties cover from twenty to thirty acres of land, and the most wealthy of the nobles possessed half-a-dozen of such places in Yeddo. Such of them as are not yet wanted for government purposes are being used as vegetable gardens and as mulberry plantations. The appearance of the city has certainly not improved by the late changes, and it must take a long time before the old splendour of the capital can return, in some modified and, it is to be hoped, improved shape.

PRESERVING GRASSES, FERNS, AND FLOWERS.

The following details in the art of preserving flowers, &c., are given by a lady correspondent of the *Villa Gardener*:—"Grasses should be gathered early in July, if we desire them to retain their bright hues without the aid of art. Gathered then, tied up in large bunches, and hung away in a dark closet, they come forth at our bidding, fresh and green as when plucked. Now, by brook side or in shady places, we can find graceful grasses, which will prove additions to our winter bouquets, but they will lose their colouring, and require a dip into Judson's Green Dye. Dry them again, and thay will last for years. Wild oats, feather-grass, and all their various species are very ornamental in winter, and mingled with the everlasting flowers—*Acroclinium*, *Xeranthemum*, and the white, yellow, and crimson *Helichrysums*—they vie with their more perishable sisters, whose glories are on the wane. We have just arranged two small vases for the coming winter. The brilliant pink and white *Acrocliniums* add much to their beauty. The white *Helichrysums* can be dyed a brilliant purple or scarlet with "Judson's Dyes," and exquisite bouquets can easily be manufactured. These "everlasting" flowers should be gathered as soon as the outer leaves open. Tie them up in bundles, as you pick them, and hang up, flowers downwards, to dry. Treated in this way, the stems are straight, and more easily used. They can be hung to dry in one's chamber, not requiring a darkened place. Most of these flowers are allowed to remain too long upon the bushes, and their beauty is spoiled. As they become dusky under the frequent sweepings of carpets, we dip them in cold water; their petals close entirely. We dip the grasses also, to cleanse them, else they will acquire a dingy hue. Many persons like crystallised grasses. These are easily made by dissolving 1 lb. of alum in a quart of boiling water, suspending the grasses just over the steam—not to touch the water—and as it cools, the crystals gather. Grasses need not be dyed before they are crystallised. A few of them mingled with the green grasses and brilliant-hued flowers light up well. Ferns are much sought after for floral decorations. Their feathery plumes, pinnated leaves, and graceful forms are very beautiful. They differ from the grasses, for those gathered late in autumn retain their colours better than the fresh ferns of June. The sap has hardened in their leaves. We have gathered them late in November, when they were surrounded by snow, and they have kept green all winter. The running fern is a lovely decoration for walls and pictures. Its flowers add much to its grace and beauty, but it fades quickly, and by Christmas but a faint green remains. Dip them in "Judson's Dye" (following the directions given on the bottle for dying ribbons), and you will keep their lovely colour. After they have been thoroughly pressed in heavy books, then dye them, spread on paper to dry in the shade, and then press again. Thus treated, they will last for years. Maiden-hair, the most graceful of our ferns, soon loses its colour; but dyed, it is an addition to every collection of grasses or ferns. Parsley fern is very beautiful; its soft feathery leaves are always sought after. These, if gathered late in the autumn, will retain their colour much better. The male fern, with its stiff stems, if well pressed, looks beautiful. We mingle it with the many-coloured leaves of autumn, or we pin it to the wall-paper, around pictures, or over lace or muslin curtains, and its effects are charming. Bunches of dyed mosses are to be purchased of all seedsmen in the cities: we dwellers in villages cannot avail ourselves of them if we would; but we can make them even prettier than those exposed for sale. Gather the mosses, pick out all the *debris*, cleanse from dirt, and dry in the sun; then dip into "Judson's Dye," spread on papers to dry by fire or sunlight. We gathered last year a very finely-fibred moss, dyed in a lovely green, and saved some of the original colour to mingle its brown hues with it. Then we took the "hoops" from an old skirt, tied them together, and on the circlet tied wreaths, which city friends said "surpassed those displayed at the shops."

COMMERCIAL INSTRUCTION.

Dr. Hodgson, as President of the Education Section of the Social Science Association meeting at Norwich, last week, in his opening address, said:—"In this eminently commercial country, it is at first sight not a little surprising that commercial instruction should rank so low. Doubtless it is not without some reason that the title 'Commercial Academy' should suggest so much that is narrowing and depressing, and so little that is elevating or thought-inspiring in education. Penmanship, arithmetic, especially the mercantile rules and book-keeping, with a modicum of geography, have formed the staple of most of such academies—unworthy namesakes of the ancient Academe. To Dr. Yeats, of London, belongs, in large measure, the honour of having in his own school at Peckham, as well as by his writings, done much to redeem commercial instruction from this quite unnecessary, if hitherto just, reproach. In four volumes which he has lately published, he treats succinctly, but clearly, fully, and most attractively—first, the natural history of commerce, its raw materials; second, the technical history of commerce, or its processes of manufacture; third, the growth and vicissitudes of commerce; fourth and last, recent and existing commerce. To these volumes I must refer you for the development of his plan. But at a glance it is obvious that the subject thus treated ranges over a very wide, and rich, and varied field, including, as it does, much of geology, botany and zoology, physical and political geography, mechanics and chemistry and their applications, history, economics, and statistics. In the raw products of the earth, their characteristics, the artificial changes that they undergo, their geographical distribution, and their economic uses—in the history of inventions and discoveries made in the arts, the story of the rise and growth of commerce, and the principles by which trade is and should be regulated—an intelligent and a well-trained teacher must find ample materials for an education at once high, and wide, and deep, thoroughly practical and utilitarian in the best sense, yet fraught with moral lessons and intellectual stimulus. It is to be hoped that the five noble schools of the Edinburgh Merchants' Company, with their 5,000 pupils, will ere long lead the way in this direction, new to this country, though well-known on the Continent."

In 1848 the United States had 6,000 miles of completed railroad. In January, 1873, the total had grown to 71,000 miles in actual operation, with 8,000 miles more in course of construction. The average railroad growth of the United States for the last five years has been nearly 6,000 miles per annum.

TECHNICAL EDUCATION.—THE BRADFORD BUILDING TRADE TECHNICAL SCHOOL.

(From the *Architect.*)

The want of well-instructed men as masters, foremen, and leading men, being strongly felt in the trade, induced the master builders of Bradford, in 1869, to establish a trade technical evening school, for the young men engaged in the business. The object of the school is to instruct the men in a scientific knowledge of their trade, but it has been found necessary to have classes for reading, writing, and arithmetic, as numbers of the apprentices have been neglected in their elementary education, and it is hard to teach technical science to those who read with difficulty, and whose knowledge of arithmetic is obscure. There are four teachers in the school, three of whom hold Government certificates, and we have during the past year put them under Government inspection. But we are in an unfortunate position with our technical education. The class of instruction given and required seems not to have been understood by the Science and Art Department, and up to now they have ignored the most important knowledge—that knowledge which will instruct a workman correctly and scientifically in the best manner of obtaining the true lines from which he can with confidence produce the most complicated piece of work, such as wreaths, twists, scrolls, curves and other forms required in staircases, handrails, and masonry; the intersections and forms of mouldings having different angles; the manner of obtaining the length of angle rafters, and the lines for cutting the same; the cut and length of purlins against angle rafters, especially where the rafters and purlins are moulded; a true system of developing circles in all their varieties; the true lines for the formation of each stone in a circular upon circular arch; every stone in this form of arch has an irregular side, all requiring very careful formation, and which can only be obtained by a true development of geometric lines. This is also the case with skew arches when properly executed, and when built in large ashlar. There is much information of this description needed by a first-class workman in the building trade, and it is, so far as I know, a knowledge peculiarly their own. It has not been taught in schools. Architects as a class know very little of it; it is workmen's lore; it has been left to them, and some ten per cent. of the workmen have a fair knowledge of such subjects; yet few, if any, are what ninety per cent. might be if such schools as the Bradford Builders' Technical Schools existed throughout the country. The Government examiners for certificates in building construction, so far as I can perceive, are acquainted with the existence of the peculiar scientific workmen's geometry, and it would be well if they were to take council with men who are practically engaged in our technical schools—men who not only theorise but go into actual practice in the school. We have followed theories in our school with actual construction. If our pupils are studying the skew bridge, circular upon circular arch, wreaths of wood or stone, roof construction or such like, the bridge or arch is constructed as a practical illustration of the geometric principle or theory. Technical schools can never have efficient help from Government until this technical knowledge is better understood by the Science and Art Department. Architectural drawing is well understood, and we find that provision is made for successful students in it; but in this difficult, and, to workmen, more important branch of scientific technical drawing, there is no help whatever. I do not think it is from want of will in the department, but from obscure ideas as to the subject itself. We can earn a little money at present to assist the Bradford Technical Schools by the results of elementary instruction; but, as the examiners do not examine in the very subjects that are the most important to our students, the result is that the industry and patient labour of students and teachers is not discovered by them. I trust the time is not far distant when a real technical examiner will be sent to every trade, and when every trade will have its technical school. We have had from the opening of the school an average of fifty young men attending the classes four nights a week, from seven to nine o'clock. The charge is from 3s. to 5s. per quarter. The majority of the masters pay for their apprentices. The school can accommodate a much larger number than attend, yet the results are good.

APPLICATION OF METERS TO STREET-LAMPS.

The Paddington Vestry have decided that the supply of gas to street-lamps in that parish shall be regulated by meter, and to attain that object an application was lately made to the gas referees, under section 48 of the Imperial Gas Act 1869, to prescribe and certify the mode of ascertaining the quantity of gas consumed by the public lamps. The referees, Messrs. William Pole and A. Vernon Harcourt, in their reply, state that they have every confidence that the system prescribed in their communication will accomplish the desired end in a convenient way, and with justice to both parties. The communication in question prescribes that the meters, which are to be enclosed in water-tight iron boxes, shall be of the most improved construction, and made by makers of acknowledged reputation, and shall be set into the ground at the foot of the lamp-column. A meter is to be attached to every twelfth public lamp, and the average consumption of the lamps to which meters are attached shall be taken to represent the average consumption of each public lamp. The lamps are to be fitted with burners and governors of a precisely similar character, and those, as well as the meters, are to be tested and put in repair if necessary, or oftener if the company wish to do so, at their own expense. The arrangements for lighting and extinguishing are left to the parties to settle amongst themselves; but the referees recommend that, although under section 84 of the Act the maintenance and repair of the meters legally fall on the parish, the actual care of all the appurtenances should be vested by arrangement in the gas company, subject to inspection on behalf of the parish. The register is to be read and recorded by two officers going round together on behalf of the parish and the gas company respectively, and if the record of a meter should vary more than twenty per cent. from the quantity it ought to consume, the record of the meter shall be omitted on taking the average, and the meter itself shall be tested and re-adjusted. Several minor regulations are laid down, and it is provided that all disputes shall be referred to an arbitrator, to be agreed on by both parties, or, failing such agreement, to be nominated by the gas referees. According to competent gas engineers, the supply of gas by measurement to the metropolis would effect a saving of a half-penny in the pound in the lighting rate, or about £40,000 per annum. Up to the present Paddington is the only parish which has adopted this system.

A company has recently been organised in Philadelphia for the purpose of working a process for preparing an enamelled brick for building purposes.

The Canadian Government has erected lighthouses on the south side of Hamilton Island and on Stone Point on the River St. Lawrence. These lighthouses are wooden structures, each about 27 feet high; the illuminating apparatus is catoptric.

The most recent application of the sand blast is for cleaning the fronts of buildings by removing the soot, dust, and other substances therefrom. The impact of the sand on the surface removes the soot or dust from all the crevices and indentations without perceptibly interfering with the sharpness of the architectural ornamentation.

THE WINES OF BORDEAUX.

It is satisfactory to see that the restoration of peace between France and Germany has enabled trade to return to its ordinary channels, and to recover its vitality and activity, and to resume the dissemination of its benefits. At the end of 1869, the English Treaty had been in operation ten years, a period quite sufficient to show its effects, and the consequences are apparent in all branches, exportation, importation, and navigation, where the increase in the trade of France was enormous, greater even in proportion than in the United Kingdom. In the general export account a particular statement is made of the quantity and value of the Gironde wines, of which the principal part is shipped at Bordeaux. There has been an increase since 1859 of 124 per cent. in the quantity, and 73 per cent. in the value; this difference of increase arising from the great proportion of the cheap wines shipped during the last two years. The increase has been nearly three times as great in casked wine as in bottled, and the trade with England has taken the same character. About one-sixth of the total exportation goes to the British dominions, to which the increase since 1859 has been nearly 200 per cent. In ordinary years the department is estimated to produce 1,250,000 50-gallon casks of red and white wine, exporting about one-half of that quantity. Like other crops, vintages vary considerably from year to year both in quantity and quality. Thus, Chateau Lafitte, and others of the first or highest of the five established classes, which have been sold to the merchant in a good year at £70 a cask, have in a bad year been bought at £6, and the most common wines, those of low wet soils, similarly range in price between £2 and £7 a cask. From an account of the vintages of the last eleven years, the red wines of 1864, 1865, 1868, and 1870, were all excellent in colour, aroma, and body, whilst the white wines were best in 1861-64-65, and 1869. In the latter year, the first-class white wines were bought up early, and made a most profitable purchase, as they proved to be worth one-half more than they cost.

Mr. Consul Hunt observes that the white wines are not known in England as they deserve to be. There is perhaps no wine in the world that, for richness of flavour and fullness of aroma, can be compared with the Chateau Yquen of 1861. The range of prices current during the same period also shows what risks may be incurred by inexperienced purchasers, and what an opening there is for passing on them wines of high name, but really of low quality. Indeed, if the extent to which wines with the labels of classed growths are found in all European countries be compared with their actual production, it will appear that this opening is not neglected. Of the red wines annually made in the department, estimated at 1,000,000 casks, one-fiftieth part is from classed vineyards; the remainder consists of about 12 per cent. of good table wine, 20 per cent. of medium, and 66 per cent. of low quality, unclassed. No dependence, however, can be placed on the accuracy of the total estimate. There are no tithes or fiscal charges on wine in the growers' hands, and no other public or trustworthy means of knowing the quantity made by them. Thanks to the sulphur treatment, the wine growers have quite averted the losses threatened by the oidium vine disease in the years 1854, 1855, and 1856, when they had great reason to apprehend the speedy and complete extinction of their vineyards. In those years the classed wines, which had usually yielded between 10,000 and 15,000 casks, fell to less than a third of the lowest number, and there were estates of hundreds of casks that yielded next to nothing. Those who desire to secure the claret now bottled of the vintage of 1868, a year that has not been equalled since 1848, and may not be seen again for another twenty years, should be careful to give their orders to trustworthy shippers, houses of established credit, who, whatever may be the price, will deliver the quality they are paid for.

THE SERAING WORKS.

With the exception of Krupp's famous steel works at Ems, the works of the Cockerill Company, at Seraing, near Liége, are the largest in the world. These works were established by an Englishman, named John Cockerill, who at the beginning of the present century settled at Liége, and introduced there the construction of machines for wool spinning. On his death, his works were continued by his two sons, James and John, who in 1817 bought from the Netherlands government the palace of Seraing, where they established works for the construction of steam engines and machinery for spinning flax. The Seraing works continued to increase rapidly, and John Cockerill introduced the smelting of cast-iron with coke into his establishment, and purchased the grant of coal mines upon which the works stand. The working of the factory was chiefly supported by orders of the government, and soon afterwards supplied all the engines for the Belgian network of railways. After the decease of John Cockerill, a joint-stock company was established, to continue the operations of the deceased, which comprised coal and iron mining, the reduction of the ores, the manufacture of cast and wrought iron and steel, the construction of machines, and mechanical and manufacturing engines, iron bridges, and ship-building.

The gradual improvements of the works, which have been continually enlarged, have brought the productive power of the various departments to their present state. They now comprise four collieries, with eight shafts and 24 steam-engines, together of 900 horse-power, giving employment to 2,400 workmen, and producing annually 350,000 tons of coal. The coke ovens give employment to 140 persons, and produce 140,000 tons of coke annually. The number of iron mines belonging to this company are 30, with 17 steam-engines, of 306 horse-power collectively, 800 workmen, and an annual production of 150,000 tons. Five blast furnaces yield annually 55,000 tons. Ten Bessemer converters produce 17,000 tons of steel. The production of the rolling mills is 40,000 tons, in rails, girders, bar and sheet iron. The forges produce 1,500 tons.

The engine-shops contain 368 lathes, planing machines, drilling, screwing machines, &c., giving employment to 1,400 workmen, and producing yearly 7,000 tons of machinery. The bridge and boiler shops employ 500 workmen, and turn out 6,000 tons of boilers, &c., yearly. The total steam-power used at the Seraing works (including collieries and mines) is furnished by 212 steam-engines, of the collective power of 7,595 horses, and the number of workmen employed in the different departments is 7,830.

In the Antwerp ship-building yard there is the usual stock of tools appropriate for a ship-builder's yard, two steam-engines, of 15 horse-power each, and 680 workmen. The immense area of the works is intersected by 22 kilos. of railway of the usual gauge, and 12 kilos. of narrower tramways. 15 locomotives are employed for working these lines, and a number of horses. The works communicate with the Meuse by means of a canal and two wharves.

The wages paid annually amount to 8,500,000 francs (£340,000), and the production of the various departments from 25,000,000 to 30,000,000 francs (£1,000,000 to £1,200,000). The annual consumption of fuel is 350,000 tons. The establishment owns a large infirmary, counting 85 beds, and an orphan asylum containing at present 41 children; it also possesses a dispensary, and delivers medicines gratuitously to the workpeople and their families. Attached to each department is a refectory and kitchen for the meals of the workpeople; and some baths have been built at the collieries for the miners. Lastly, a society for relief and pensions is instituted, without being compulsory, for the people of the works.

The Seraing works, up to the 1st January, 1873, have constructed 2,100 steam-engines, varying from 4 to 600 horse-power each, for manufacturing purpoes, 900 locomotives, 31,540 sets of mechanical apparatus, and various pieces of manufacture of every kind. The shipyards have supplied 282 vessels of every kind. The Cockerill Company are in position to turn out annually 100 locomotives, 70 marine engines, and a large quantity of every description of work, iron, steel, rails, &c.

ON THE CULTIVATION OF FLAX BY THE PRE-HISTORIC RACES OF SOUTHERN EUROPE.

A Florence scientific periodical publishes the following particulars of the cultivation of flax by the pre-historic races of Southern Europe, taken from a memoir written by Dr. Oswald Heer, a well-known botanist:—

The cultivation of flax has been carried on for 5,000 years in Egypt, and has always been one of the most diffused plants in that country. In ancient Babylonia, Palestine, and on the Black Sea, flax occupied a similar position. It seems to have been cultivated in Greece during the pre-historic period, and at an early date was carried into Italy, while its cultivation in Spain was probably originated by the Phœnicians and Carthaginians. It is also met with in the oldest Swiss lacustrine villages, whilst at the same time no hemp or fabrics manufactured from wool are to be found there. This is considered to be a remarkable fact, since the sheep was one of the oldest domestic animals, and was known during the stone period. The impossibility of shearing the fleece by means of stone or bone implements is supposed to have been the reason why woollen fabrics were not used. It is thought probable that the skin, with the wool attached to it, was used for clothing. The lake dwellers probably received flax from Southern Europe, from whence fresh seed must have been derived from time to time. The variety cultivated was the small, native, narrow-leaved kind, from the coast of the Mediterranean, and not that which is now grown in Europe. It must, therefore, at this period have been cultivated in Southern Europe, although Dr. Heer could not ascertain among what people and at what age this took place. If this could be discovered it would be an important point in the determination of the antiquity of the lake dwellers. At the time of the Empire both summer and winter flax were cultivated in Italy, as at the present time; but the variety that was grown in Egypt has not been determined. It is thought probable that the narrow-leaved sort was first introduced, and after that the Roman, and then the common varieties followed. The common plant has doubtless arisen from the cultivation of the narrow-leaved, whilst the Roman winter flax and the *Linum ambiguum* constitute the intermediate stages. The original home of the cultivated flax was therefore on the shores of the Mediterranean. The Egyptians had probably cultivated it, and from them its use was doubtless disseminated. It is possible that the wild variety and the winter flax were grown elsewhere at the same time, when the cultivated variety had long since driven them out of use in Egypt.

A rich mine of argentiferous lead is stated to have been discovered in the department of Exe-Yitoniés. The scene of the discovery is only a short distance from the sea.

It appears that in the first seven months of this year coal was imported into France to the extent of 4,044,146 tons. In this total Belgian coal figured for about 2,400,000 tons, and English for about 1,200,000 tons.

Within 17 years, the extent of coffee land cultivated in Ceylon has increased, as nearly as possible, 175 per cent., the number of plantations rising from 404 to 1,087, the crop from 374,000 to 760,000 cwts. The out-turn of produce has therefore increased 100 per cent., but the average yield per acre has decreased from 5·5 cwts. to 4·88 cwts.

THE COLLEGE OF PRECEPTORS.

The following correspondence, relative to the College of Preceptors, and its claims to public recognition and assistance in the work in which it has so long been engaged, for the improvement of Secondary Education, has been forwarded to the *Journal* for publication :—

To the Right Hon. W. E. Gladstone.

Sir,—The Council of the College of Preceptors have observed that various changes have recently taken place, or are about to take place, in the arrangements under which some of the leading literary and scientific societies receive accommodation for their offices in buildings belonging to the Crown; and they therefore venture, most respectfully, to take the opportunity of placing before you the following statement respecting the objects, operations, and present position of the College, and to urge, for the consideration of Her Majesty's Government, the claims of the institution to participate in those advantages which have long been accorded to other societies of a kindred nature.

The College of Preceptors was founded in 1846, and incorporated by Royal Charter in 1849, for the purpose of advancing the interests of education generally, but more especially among the middle classes of the community. At the time of its incorporation, though the attention of successive Governments and of the public had for many years been directed to the organization and improvement of primary education, nothing had been done, or even attempted, with the view of elevating that of the middle classes, by far the larger proportion of whom then, as now, were educated in private schools. The first efforts of the College were aimed at raising the standard of instruction in these schools, which from the first embraced schools for girls as well as schools for boys, by establishing examinations of Teachers, in which teaching power as well as acquirements could be tested, and subsequently, by examinations of the pupils, which have now developed into an extensive system carried out in various parts of the country, as well as in London. The first class certificates awarded by the college at the pupils' examinations are recognised by Her Majesty's Judges, and by the various medical Corporations of the United Kingdom, as exempting candidates from the entrance examinations otherwise imposed by the Incorporated Law Society and by the General Medical Council on all persons intended for the legal and medical professions; and of the examinations generally it may not unfairly be said that they have led the way to the institution of other examinations which have exercised, and continue to exercise, an important influence on the improvement of secondary education in England, amongst which may be mentioned the University Local Examinations, those of the Society of Arts, and the various legal, medical, and other professional entrance examinations, some of which, as those of the Royal College of Surgeons, and of the Royal Veterinary College are conducted, on behalf of those bodies, by the Board of Examiners of the College of Preceptors. The total number of persons examined annually by the College has averaged, for some years past, about 3,000—a number which greatly exceeds that of the candidates who present themselves annually before any other examining body especially concerned with the education of the middle classes. Besides the establishment of these examinations, the College has stimulated the interest of teachers in their professional work by periodical meetings for the reading and discussion of educational questions of a practical character, by courses of lectures on methods of teaching, and by the foundation of a professorship of education, and a training course of lectures and lessons for middle and upper class teachers, which latter has been attended with a success which amply proves that it has met a public want hitherto unprovided for. As a result of these efforts the college has gradually gathered round itself, as will be seen by the accompanying list of members, honorary members, and examiners, many of the most distinguished educators of the country, and has been instrumental in carrying out many of the improvements in the higher education of the community which have taken place during the last quarter of a century. It may be added, that since the date of its incorporation, the college has expended upon these objects a sum of upwards of £40,000, derived mainly from the subscriptions of its members, and the fees paid by candidates at its various examinations.

It will be seen that the college has in this way, for many years past, endeavoured to perform for the secondary education of this country functions which, in other countries, are performed by the State, but nevertheless, up to the present time, it has never received recognition, encouragement, or assistance in any form from the Government. The council venture, however, to hope that the increasing interest which is now manifested by the public in all matters connected with secondary education, will go far to support the claims of the College, as the only corporate body, consisting almost entirely of middle and upper class schoolmasters and schoolmistresses, and devoted specially to the advancement of that portion of the general education of the country with which they are concerned, to be placed on an equal footing, in reference to state aid, with those societies which are devoted to the advancement of special departments of literature, science, or art.

The request, therefore, which I have the honour, by direction of the Council, most respectfully to prefer, is, that Her Majesty's Government will be pleased to consider whether the importance of the work in which the college is engaged, and the efforts which the members have made to carry it out with success, do not justly entitle the Corporation to some assistance from the state, and I am to submit whether such assistance might not be given in the form of accommodation for the offices and lecture-rooms of the College, either in those portions of public buildings which have recently been vacated by the removal of various learned societies to Burlington, House, or in any other public buildings that might be more suitable; and I am directed further to ask whether, in the event of the claims of the College being deemed worthy of any consideration, you would be pleased to receive a deputation from the council, when they would be prepared to place the matter more fully before you, and to give such information on points of detail as you might require.

I am, &c.,
John R. O'Neil, Secretary.

College of Preceptors, 14th July.

To the Secretary of the College of Preceptors.

Treasury Chambers, 4th August, 1873.

Sir,—The Lords Commissioners of Her Majesty's Treasury have had under their careful consideration the application addressed to the Right Hon. W. E. Gladstone on behalf of the College of Preceptors by you, dated 14th ult., in which are urged the claims of that institution to participate in the advantages which have been accorded to other societies, by being assigned accommodation for the offices and lecture-rooms of the college in some public building.

I am directed to acquaint you that my lords do not think it advisable to extend further the principle of granting aid by the State to learned societies, and they regret therefore that they are unable to comply with your application.

I am, Sir, your obedient Servant,
R. R. W. Lingen.

NOTES ON BOOKS.

La Matiere Medicale chez les Chinois. Paris. (*G. Masson*) 320 pp.—We have received from Dr. J. L. Soubeiran a copy of this work, which he has prepared in conjunction with M. Dabry, the French Consul in China, and the importance of which may be judged of from the fact that the French Government have deemed it desirable to publish it at the expense of the State. It furnishes some curious information as to the medical knowledge and practice of the Chinese. Although this nation is so highly advanced in all that relates to arts and manufactures, and while possessing a general knowledge of the uses of the principal drugs, and animal and vegetable substances used in medicine in Europe, they still retain a good deal of barbaric superstition as to the presumed virtues of many inert and ridiculous products. In collecting, arranging, and classifying scientifically the animal, vegetable, and mineral substances forming the materia medica of the Chinese, Dr. Soubeiran has done good service, and it is not improbable that many of the medical substances used by the Chinese, and alleged to have useful properties, will be carefully examined and tested. Some curious information is furnished as to tea, opium, and other articles of commerce; and there is a valuable Chinese and French vocabulary, which will be found useful for reference in occasionally identifying products. There is much interesting information as to the oils in use. For instance, a bland species of castor oil is used for culinary purposes; in the north an excellent oil is obtained from the kernels of the apricot; the so-called tea oil, a yellowish oil used for burning, is made in large quantities in Hou-nan and Kiang-si from the seeds of *Camellia oleifera*.

The Turkish Minister of Posts and Telegraphs has intimated that a new line of telegraphic communication with Greece has been opened by way of Tchesme and the island of Scio. The price of a single twenty-word despatch from Constantinople to Syra has been fixed at the very stiff rate of 5s. 9d., an almost prohibitive tariff, one would think.

The Ilfracombe (Tasmania) iron companies have been doing little or nothing pending the completion of their smelting and other appliances. The promoters of a company formed for working iron deposits at Penguin Creek are progressing with their arrangements.

A Bill authorising a loan of £100,000, for the construction of a railway and telegraph from Geraldton to Northampton, and a line of telegraph from Newcastle to Champion Bay, has been passed by the Legislative Council of Western Australia.

GENERAL NOTES.

Royal Albert Hall.—The *Musical Times* for October 1st says:—"A record of the excellent organ performances at the Royal Albert Hall is due to those artists who have so zealously laboured to bring into more prominent notice an instrument which, up to a very recent date, has been so strangely neglected in this country. In addition to the interesting recitals given on Sundays, Mr. W. T. Best has played most of Bach's organ works, the Concertos of Handel, the six organ Concertos of Mendelssohn, besides several adaptations, including Bach's Concerto in the Italian style, Schumann's Allegro Brillante in D flat major (Finale to his *Etudes Symphoniques*), and Liszt's new march "Von Fels zum Meer." On the 4th and 5th ult., Dr. Charles Maclean, organist of Eton College, gave recitals on behalf of Dr. Stainer. His programmes contained extracts from authors not often heard upon the organ, among which should be specially noticed an Allegro from Rubinstein's Pianoforte Sonata in F, and an "Andante expressivo" by Brahms. With these exceptions Dr. Stainer has occupied his post at the organ on Thursdays, Fridays, and Saturdays. Besides many well-known classical works, he has included movements by Merkel, Sir W. S. Bennett, Henry Smart, J. B. Calkin, Sir F. Ouseley, Agnes Zimmermann, &c., and an older school of music has been represented by Corelli, Couperin, Murshbhauser, D. Scarlatti, and others." It then proceeds to give a list of the works which have been performed in the hall, at the series of daily Exhibition Concerts, given by Messrs. Novello, Ewer and Co., in connection with Her Majesty's Commissioners, under the conductorship of Mr. Barnby.

Amateur Orchestral Society, Royal Albert Hall.—The weekly practices of this society, which H.R.H. the Duke of Edinburgh initiated last season, will be resumed on Friday evenings in the Lecture Theatre, South Kensington Museum, the use of which has been kindly conceded to the Society by the Committee of Council on Education. The first practice will be held on Friday, 7th November, at 7.30 p.m. It is understood that H.R.H. the president will probably be present at the second practice. It is very desirable that candidates for admission to the orchestra should make application before the end of this month to the Hon. Secretary, Amateur Orchestral Society, Royal Albert Hall.

Production of Coal in Sweden.—The production of coal in Sweden has not increased very rapidly. In 1870 the quantity raised exceeded only by 5 per cent. the yield of the previous year. There is a prospect, however, at present that the production will be greatly increased by the discovery of large fields in the province of Skara, lying in the south of the kingdom, and through which the railway from Goteberg to Stockholm runs. Trial borings have been made, and in one case, at a depth of 560 feet, twelve different seams have been found, varying from 3 feet to 8 feet in thickness. Several companies have been organised to work the new mines. This discovery is of the greatest importance to Sweden, as the export of timber from that country has reached its maximum, and the demand for charcoal for melting purposes has made wood very scarce and dear. At present Sweden imports coal from Great Britain, but it is anticipated that she will soon export this fuel to other countries. These coal-fields, according to the opinion of eminent geologists, are widely extended.

Constantinople Water Supply.—The construction of a new reservoir at Ihsondéré, for the improved water supply of Constantinople, has been suspended. The labourers who had been set to work have been dismissed, and a number of horses employed have also been sold by public auction. It is stated, however, that the enterprise is not definitely abandoned, but that the work will be resumed in the spring. Old Byzantium was renowned for an abundant supply of water, and had 200 large cisterns and subterranean reservoirs.

Glauber's Salts.—There is in the district of Alcanadre (province of Logrono, Spain) a natural deposit of Glauber's salts, which amounts to 73,440,000 cubic feet. The deposit is crossed by the railway from Tudela (province of Navarre) to Bilbao, at a 196 kilometres distance from that seaport.

Culture of Arrowroot in Natal.—Arrowroot has now become literally a staple production of Natal. The plant does not require a first-class soil. It grows very readily, and yields heavy crops on coast lands, which are entirely valueless for the growth of sugar. Upon these grounds it is deservedly a great favourite with the colonists. There are now 628 acres of land employed in its growth, which yield yearly from half a ton to 12 cwt. of fecula (starch) for each acre. The market value of the arrowroot now manufactured in Natal every year is about £9,000. The cultivation of arrowroot requires but a very moderate capital at starting, and is attended by quick and large returns. Cuttings from the roots, something after the fashion of the cuttings of potatoes, are put into the ground in rows, in the months of September and October. The roots are ripe at the end of the wet season, and the manufacture of the starch is carried on during the dry months of winter.—*Journal of Applied Sciences.*

Railways in the Argentine Republic.—A Buenos Ayres paper gives a full account of the ceremony connected with the commencement of the Rosario Railway. This line, with its various branches, represents a total of 500 miles, and will start from Almafiro, passing through the little town of San Martino, close to Pilau, and from thence to Capillar del Senor, and thence in a straight line to Rosario, a distance of 186 miles. By the terms of the concession the main line will have branches to the various towns and ports along the route. The extent of these branches will be as follows:—Zarate, 21 miles; Salto and Rozas, 10; San Nicolas and Pergamino, 70; Arrecifes, 25; San Pedro, 20; Baradero, 21. The country through which the trunk line and its branches passes is admitted to be the richest and most thickly populated in the province of Buenos Ayres.

Shipbuilding in Italy.—The number of ships built during 1872 in Italy was as follows:—

	No.	Tons.
Genoa	66	38,895
Castelamare	14	6,986
Porto Maurizio	5	3,845
Venice	5	2,461
Spezia	3	2,007
Naples	3	1,230
Palermo	1	480
	97	55,911

Of these, five were steamers of upwards of 150 tons. The above, of course, does not include small coasting vessels, of which upwards of 200 was built.

NOTICES.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

THE LIBRARY.

The following works have been presented to the Library:—

La Matière Médicale chez les Chinois, par le Docteur J. Léon Soubeiran et D. de Thiersant. Presented by Dr. J. L. Soubeiran.

Report of the Commissioner of Education for 1872. Presented by the Bureau of Education, Washington.

Experimental inquiry into the Mechanical Properties of Fagersta Steel. By David Kirkaldy. Presented by the Author.

Report of the Fresh Water Fish and Fisheries of India and Burma. By Surgeon-Major Francis Day, F.L.S., F.Z.S

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FRIDAY, OCTOBER 24, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

GENERAL EXAMINATIONS, 1874.

The Programme of Examinations for 1874 is now ready, and may be had gratis, on application to the Secretary.

These Examinations, in 1874, will be held on the evenings of the 21st, 22nd, 23rd, and 24th April. The Time-table has been arranged as follows:—

Tuesday, April 21, From 7 to 10 p.m	Wednesday, April 22, From 7 to 10 p.m.	Thursday, April 23, From 7 to 10 p.m.	Friday, April 24, From 7 to 10 p.m.
Arithmetic. Logic. Floriculture.	Theory of Music. English History. German. Spanish.	Political Economy. French. Fruit and Vegetable Culture.	Book-keeping. English Language. Italian.

Friday, April 24, 6 to 7 p.m.—Dictation.

The rule which formerly prevented a candidate who had once obtained a first-class certificate in a subject from being again examined in that subject with a view to gaining a prize, has, in accordance with the wish expressed at the Conference, held on the 27th June, 1873, been rescinded. In future, therefore, a candidate who has obtained a first-class certificate in a subject may be again examined in that subject, but not more than one first-class certificate in any subject will be counted for the Prince Consort's Prize, or for the Council Prize to Females. A candidate having taken the first prize in any subject cannot again take a prize in that subject, nor can a candidate take a prize of the same grade twice in any subject.

The Elementary Examinations, held by the District Unions and Local Boards, for which papers are furnished by the Society, are fixed for the 10th, 11th, and 12th March.

Full details in reference to the Examinations are given in the Programme, copies of which should be applied for to the Secretary of the Society of Arts, by all intending to come forward as candidates, or otherwise interested in the Examinations.

TECHNOLOGICAL EXAMINATIONS.

The subjects in which examinations were held this year, namely, Cotton Manufacture, Paper Manufacture, Silk Manufacture, Steel Manufacture, and Carriage-building, will be retained in the Examinations of next year, with the addition of Cloth Manufacture, Glass-making, Pottery and Porcelain, and the Manufacture of Gas.

The Programme is in preparation, and will be published as soon as possible.

In addition to subscriptions already announced, the Council have to acknowledge the following contributions to the Prize Fund:—

The Worshipful Company of Clothworkers	£105	0	0
G. N. Hooper, Esq.	10	10	0

Also as a special contribution to a Prize Fund for the Examination in Carriage-building.

G. N. Hooper, Esq.	£10	10	0

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The fifth lecture of the third course of Cantor Lectures for the Session, "On Wines; their Production, Treatment, and Use," was delivered by J. L. W. Thudichum, Esq., M.D., on Monday evening, May 19th, 1873, as follows:—

Lecture V.

The wines of France compared to those of Spain and Portugal. The Gironde, its vineyards, vines, and varieties of wines. The Bourgogne and its productions. Belgian appreciation and sweetness of Burgundy wine. The wine requires the procédé. The Champagne; peculiarities of viticulture. Chemical treatment of effervescent wine to ensure its soundness. Absurd notion of some writers on champagne; of the same on second wines and sugar-water wines.

The wines of France may conveniently be considered in five great groups, namely, those of the provinces on the Mediterranean, the ancient Languedoc, termed Vins du Midi; those of the valley of the Garonne and Gironde, commonly termed wines of Bordeaux; those of the Rhone-valley; wines of the Bourgogne; and wines of the Champagne. They are never treated with brandy to the same extent as the Spanish and Portuguese wines, and the highest qualities are never treated with any brandy at all. Plastering is only practised in the southern provinces, and applied more particularly to red wines. The white wines of Sauterne, Burgundy, and Champagne are never plastered or brandied. Sweet, or so-called liquorous wines are produced in the southern departments, in the Sauterne district, and in the Champagne; but they differ in kind among each other, and the only wine that has any resemblance to the heavy peninsular wines is the red wine of Roussillon.

From this it follows that vinification requires less extraneous aid in France, that the art of producing wines of natural composition and strength is there more developed than in the Peninsula. More than this, the French wine merchants can do for the wines of the Peninsula that which the Peninsulars themselves cannot do for their own wines. I quote a passage from an important letter which I have lately received:—"You are aware of the differential duty in this country

(England) in favour of the wines of France of lower alcoholic strength than 26 degrees. In virtue of a treaty between Portugal and France, the manufactures of France are admitted at about half the duty imposed on those of England, and the wines of Portugal are reciprocally admitted on easy terms into France. Hence large quantities of the lowest class of Portuguese red wines are now imported into Bordeaux, and there judiciously mixed with the weakest possible French wine, so as to come into this country at the low duty, and under the attractive title of the 'Gladstone' clarets. Another class of the same mixture is exported in much larger quantities to the Brazils and the river Plate. C—— tells me that he now sells his *vin ordinaire* to the French buyers at a price one-third higher than he was accustomed to do in years gone by." In a similar manner large quantities of Spanish wines are imported into France, and re-exported as French wines to other countries.

I must tell you that the informant C——, mentioned in the letter just quoted, is a Portuguese gentleman, landowner, and grower of wines in the district of Torres Vedras. Please notice that what he sells to the French buyers is his vin ordinaire. Now, compare to this the following fact:—When some time ago a quantity of the best red Torres Vedras wine was imported to this country it could not be sold at any price, though it was better and cheaper than any of the "Gladstone" clarets. This is the result partly of the astonishing ignorance of the public as regards wines, partly of the extremely limited information possessed by wine merchants, as a body, of their own business. They pay well for Gladstone claret which is compounded thus:—The producer, who did sell and would have sold his wine direct to London, say, for £10 the pipe, now obtains £15 from the French buyers. These carry it to Bordeaux, mix it a little, put it in hogsheads duly branded, and sell it at £20 for two hogsheads at Bordeaux. So that the consumer of the Gladstone claret pays at least double the amount of money which he need have paid could he have been supplied from Torres Vedras direct; and the British wine merchant loses at least the £5 which the Bordeaux merchant, more active, cunning, and instructed than his British *confrère*, puts into his own pocket. In a similar manner the Bordeaux market is largely supplemented from the Alto Douro, as I have been reliably informed; and when we take into consideration the large amount of Spanish wines transformed at Cette into what by any other name would taste the same, we must admit that the wines of Spain and Portugal come to us in many shapes, and that they must, at least in part, be so similar to French wines as easily to pass under their names without detection.

France produces no white wines which can be compared to those of Jerez, plastered and brandied as they are. She produces no red wines which in body and flavour are equal to the Alto Douro wines; but she produces wines of eminent finesse, such as the Médocs and Burgundies; she produces that peculiar French wine, effervescent champagne. In all her genuine productions she stands unrivalled, and when we consider their quantity we may, perhaps, derive some consolation from the fond belief that "Gladstone" claret is only a small addition to them.

The Gironde is a beautiful and rich province. Its most valuable part is the Médoc. There an undulating gravelly soil, easily penetrated by the frequent warm rain which comes from the Gulf of Gascony, bears that beautiful twin pair of vines, the *Carbenet sauvignon* and the *Carmenère*. The vines are kept low on the ground, trained to espaliers not above a foot high. Each vine when pruned has two bearing, or fruit branches, and two spurs for wood. The new wood does not grow much above a yard in height, and altogether the Médoc vine is the smallest of any which I have observed.

The tillage of the soil in the vineyards is throughout effected with the plough drawn by oxen. The operations have for their result to keep the earth away from the plants during the period of arrested vegetation, and to heap it up around them, and keep it in a loose state during the period of active growth. The vintage is in September, and vinification is quick and simple. The grapes are trodden by men on platforms and the pulp and juice are transferred to large vats, where fermentation is completed. During this process the husks and stalks rise to the top, and form a dense cake (chapeau). This protects the wine below from the excessive influence of the air, but its upper part not rarely becomes somewhat acetified or putrid. This, therefore, is removed by careful vignerons, and only that part of the husks is left in the vat which is vinous and perfectly sweet. This is now beaten, broken, and submerged by means of suitable instruments, in order to bring the husks in contact with the new wine, so that it may extract all the colouring matter. The operation is repeated until complete, and the wine is then drawn off; the husks are pressed, and the whole of the new wine is immediately placed in new casks of 228 litres each, called "barriques." In these it completes its slow fermentation, and becomes clear. It is then racked and laid up in "chais" above ground, or in cellars below ground, until ready for sale. During this period samples for tasting are not taken from the bunghole, which remains turned to one side, and with the bung submerged in wine, but from a hole bored into the bottom of the cask.

The wines of the Médoc are all red, and of very uniform character, though greatly differing in quality. They are divided into classified and non-classified wines. To the first rank of the classified belong those five great properties, termed chateaus, from the habitation attached to them, under whose names so many sins are committed. It is impossible, in the space allotted to me, to give you the details of the other classes, but you will find them in the works which treat of the Médoc, by W. Frank, by Cocks, or by Armailhac, and in the chapter of our English "Treatise on Wines," already quoted. The wines which do not belong to any of the five classes are termed "citizens" and "peasants" (*bourgeois* and *paysans*.") The first of these have again degrees of quality, namely, superior, good, and ordinary citizens, but the paysans are mostly held to be of one quality only.

Immediately surrounding Bordeaux is the district of the Graves, so termed, it is said, from its gravelly soil. It produces both red and white wines, of which the former resemble those of the Médoc, to the extent, for example, that Chateau Haut Brion, an estate in the Graves, ranks with the four first-class estates of the Médoc, and is always mentioned together with them, as if it were situated in the Médoc. The white wines resemble those of Sauterne, but are much less esteemed on account of a peculiar objectionable taste, which is termed flinty or earthy, and the cause of which has not yet been explained. To the south-east of the Graves, and bordering upon the river Garonne, is the district of Sauterne. This is the most beautiful part of the Gironde, and in its general features has much similarity to the Rhinegau, near Mayence. All the hills and slopes are covered with the twin-pair of vines, the semillon and the sauvignon. They are cultivated in a manner which differs from the viticulture of the Médoc. The vines are trained to permanent stakes, and their bearing branches rise with age from the ground up to two and three feet above the ground. The grapes are white and of medium size; they have the peculiar faculty of becoming very sweet without passulation, so that while yet plump they yield a must which does not during fermentation lose the whole of its sugar, but remains sweet, and sometimes greatly so, without the addition of any spirit. The collection of the grapes is effected in several stages, so that several qualities of wine are produced from the same vineyard. The vintagers go provided with scissors and baskets, and cut out the finest and ripest berries one by one. These, after pressing and fermentation, yield the wine called "head-wine" (*tête*), a sweet, liquorous wine, which has taken the place of Lunel muscat, and is almost entirely consumed in Russia. It is very expensive, and the produce of 1865 came, in cask, at the Castle of Yquème, to 15s. per bottle. The second class, or the less saccharine berries, yield a wine which after fermentation contains no sugar, but becomes dry, and is termed the "middle wine" (*milieu*). This is Sauterne, commonly so called, and is an admirable wine for the dinner-table. All the grapes which have not been used for the former two qualities are ultimately thrown together, pressed, and the wine made from them is termed "tail" ("queue"). When all the grapes, or the three varieties of wine, are thrown together, the result is termed "ensemble." In order to produce as much sweet wine as possible, the vintagers have to go as many as ten or eleven times through the vineyards at intervals of several days. This production of sweet wine for Russia has depressed all qualities of dry Sauternes which are suitable for the English taste, and in consequence it is probable that its consumption will become still more limited than it has been hitherto.

On the right bank of the Garonne there are extensive vineyards producing red wines, which are exported from Bordeaux under the name of the town. They have no prominent qualities, and are therefore frequently mixed with some Médoc wine and exported as such. On the low marshy ground in the fork formed by the confluence of the Garonne and Dordogne, which is termed "Entre deux Mers," large quantities of wine are grown. They are termed marsh-wines (vins de palus), and in warm years attain considerable quality. But the viticulture of this district is entirely calculated to produce quantity, and therefore it selects vines with medium sized grapes, such as the "verdot" and the "merlot," and trains them on espaliers in such a manner that each stock has from two to three tiers of bearing branches. I have here a sample of pure verdot wine, made in 1865, which then cost £5 per barrique; in 1867 it had doubled in price. It is probable that the vines of the marshes prosper so well in this part because it is their native land.

To the north-east of the Garonne are yet some districts which produce much wine, those of Libourne, St. Emilion, and the hills upon the banks of the Garonne called the "Côtes." The St. Emilion wines are fine, but thinner than the Médocs; they are also paler in colour; for some reason or other they are not esteemed in England, where the eye and taste of the wine-drinker are perhaps too much influenced by deep-coloured young ports. The wines of the Côtes are all white; they are eagerly bought by the Bordeaux trade, mixed with deep coloured wine of Narbonne, and sold as red wines to Transatlantic markets. In 1867 I saw a consignment of such wine at Bordeaux, which was sold at 9s. the dozen bottles, in one-dozen cases, packed—cases, bottles, and corks included.

If any of my audience should be without experience in the purchase of Bordeaux wines, and yet desire to acquire some, I would advise him to dispense entirely with names, and simply to select red or white wine according to his taste and according to the price to which he desires to limit himself. There are in the wine-trade, unfortunately, few or no guarantees against substitution, as we see, again, from the story of the "Gladstone" claret above related; and it would therefore be preferable if the public, instead of asking for names, contented themselves with a general thing, such as sherry or port, and compelled the merchants to abandon false labels. The only final control of the consumer as to genuineness is in his own palate.

The wines of the Bourgogne used to be more esteemed in England than they are now. This arises from the fact that they require management, and that neither merchant nor consumer will take that trouble. If the wine ferments a little in bottle, the consumer becomes excited and the merchant is annoyed. Now the Belgians know better. They go to Burgundy, buy the fine wine in the first year, and bottle them immediately. No doubt they risk that some of them may ferment a little, and become what is called "frisky;" but they preserve the flavour by this early bottling, and remove the little carbonic acid by decantation from the deposit and shaking. Thus it is that the best Burgundies are drunk in Belgium, and the rest of Europe gets but little of them. The vine from which Burgundy is made is the black pineau, or golden plant, the same as that from which the white champagne is made. Its grapes in favourable years become very saccharine, so that a small per-centage of sugar escapes the first fermentation. This makes the wine unsafe for a year or two, and the Burgundy people avoid a second fermentation by adding a little brandy, from 1 to 2 per cent. of absolute alcohol of the entire wine. The wine thereby becomes a little stronger and more heady, but the increase in alcoholicity is not one-third of that which is inflicted upon the weakest port wine. Burgundy still remains in strength below 26 degrees of proof spirit. There seems no great objection to this slight alcoholisation, as it preserves flavour, prevents fermentation, and, according to prominent French authors, also has the effect of preventing the so-called diseases, or of postponing their most destructive effects.

The reputation of the Burgundy wines is sorely tried by the substitutions which are made of the wines of the district of Mâcon and Beaujolais. The substitution is less objectionable if the wines are made from the genuine Burgundy grape—the pineau above mentioned—but they become abominable when for pineau wine is substituted that of the gamay. This vine is a vigorous plant and rich bearer, but its wine is coarse and mostly acid. By its acidity and deep colour it is very suitable for being mixed with water, and drunk after the French habit, with meals.

To be continued.

EXHIBITIONS.

AMERICAN INDUSTRIAL EXHIBITIONS.

A New York journal thus speaks of the value of the various industrial exhibitions which are held throughout the States:—

"To the superficial observer it may seem that our industrial fairs and expositions are being multiplied to such an extent as to greatly overdo the matter; in short, to use a slang phrase, but a most expressive one, that they are run into the ground. In this immediate vicinity we have some half a dozen fairs, more or less. There is the fair of the American Institute, of the Brooklyn Industrial Institute, the Newark Industrial Exposition, the New Jersey State Fair at Waverly, and several minor ones. Then, at the West, every large city has its annual gathering. Chicago, St. Louis, Louisville, Cincinnati, &c., have all organised permanent expositions; and, we are happy to say, have met with wonderful success in the task. The fair at Cincinnati, we understand, is this year a success beyond all expectation, and the same may be said of the others. In New England we have numerous gatherings of a similar character—the New England State Fair, which is held at Mystic Park, near Boston, being particularly noticeable for its extent, the excellence of its management, and the variety and beauty of the articles exhibited. Then we have our own State Fair, and special fairs at Rochester, Buffalo, &c., together with local fairs in almost every county. So that it would almost seem that the matter is, to a certain extent, overdone. But, on the other hand, when we come to consider the relations and influences of these organisations, we cannot help feeling that they are accomplishing a most desirable work, and advancing not only our material but our intellectual and moral progress. For it is an undoubted fact that humanity everywhere demands recreation, sociability, and amusement; and if we can cause purely industrial fairs to take the place of the circus and the horse-race we have accomplished a great good, even if no other result were to follow. But these fairs perform a higher office than merely to act as a substitute for the questionable amusements we have mentioned. If well-arranged and properly carried out, they perform a three-fold function, serving at once to afford to the young the most perfect and pleasant means of becoming acquainted with the nature of our great industrial operations and products; to our manufacturers and producers generally, acting as a stimulant to perfection, and affording a means of comparison and consequent improvement; and, lastly, performing an office which, though perhaps the least dignified, is not the least useful, in bringing these products to the attention of those who may possibly become purchasers. The educational influences of our great industrial fairs we regard as perhaps the most important and useful of all the offices performed by them. Those who are in the habit of attending these gatherings must have observed the large number of young people always present; and those who have accompanied a small party of young people through the fair must have observed the delight and eagerness with which they drank in the new streams of information thus opened up to them. For some years past no fair of the American Institute has occurred to which we have not availed ourselves of our privilege as members, and taken a few young people to see the wonders there exhibited. Their delight at seeing the actual operations of the great industrial arts carried on before them, the interest with which they listened to such explanations as we could give, and the deep impression which the whole thing left on their minds, has convinced us of the value of the fair as a means of imparting such knowledge. It is not often that we can gain access to the *ateliers* of the actual workman; and even if we could, the dirt, noise, and confusion are enough to deter many who would enjoy an examination of the same things as presented in fairs.

"It is, therefore, with great pleasure that we observe that the managers of most of our fairs realise this truth, and are yearly increasing the extent and efficiency of this department of their exhibitions. Nor, in doing so, do they act with injustice to those exhibitors who come more purely for competitive and advertising purposes. As soon as the feeling that our fairs are great educational institutions, as well as places of amusement, has taken hold of the public mind, the better class of our citizens will patronise them still more liberally; the general fund will be enlarged, thus giving new facilities for extension; and the crowd of visitors will be increased, thus giving greater advertising advantages to the exhibitors; and we trust that, on the other hand, the general public will appreciate the earnest efforts which the managers of our fairs are evidently making to attain this end. New York, Brooklyn, and Newark have no more commendable institutions within their limits than the industrial expositions which now appeal to them for support."

Vienna Exhibition.—The report is contradicted that the exhibition will remain open until the 23rd November, as originally intended; it will be closed on Sunday, November 2nd.—On Tuesday evening, at Willis's Rooms, a testimonial was presented to Mr. Philip Cunliffe Owen, the secretary to her Majesty's Royal Commission at the Vienna Exhibition, in recognition of the valuable services which he rendered to the British exhibitors. The testimonial consisted of a cheque for 1,300 guineas and a piece of plate, on which was inscribed:—"To Philip Cunliffe Owen, Esq., this silver dessert service, and a purse of 1,300 guineas, are presented by 275 British subscribers, at the Vienna Universal Exhibition, as a small token of their esteem and regard, and in remembrance of his unwearied exertions on their behalf whilst secretary to her Majesty's Royal Commission. October 21st, 1873." Mrs. Owen was also presented with a case of jewellery, on which a similar inscription was engraved.

Canadian Exhibition.—The last advices from Canada report that the Quebec Provincial Exhibition promised to be most successful. There were over 6,000 entries. A series of lectures on agricultural subjects was to be given during the evenings while the exhibition remained open.

HINTS TO COLONISTS ON THE CULTIVATION OF SILK.

By B. Francis Cobb.

(Continued from page 887.)

Of late the seed produced by the open-air process of Mons. A. Roland, of Orbe, Switzerland, has obtained a reputation which is becoming each season more established, and some of the largest rearers in Italy have now certified to the value of the breed. The orders for this grain the last two seasons have been much in excess of what M. Roland could supply. The value of this to colonists becomes manifest when it is known that through the energy and indomitable perseverance of Mrs. Bladen Neil this valuable breed of silkworms is already in the Australian colonies, and being successfully reproduced there. This lady, by means of a skilfully-contrived refrigerator, produced while crossing the tropics an artificial winter for the seed to hybernate in, and thus avoiding the deteriorating influence of unseasonable hot weather while crossing the tropics, has raised in the colony worms of all the strength, value, and freedom from disease of the original race among the Jura mountains. In a pamphlet published in Melbourne, after giving an extremely interesting description of her peregrinations in Italy in search of a silkworm of pure breed and without disease, and, after almost despairing, stumbling by chance on M. Roland, Mrs. Neil thus describes her subsequent successes:—

"London was at last reached, and the three or four weeks I passed there were entirely taken up in securing the various fittings for a magnanerie. Then an ice-box had to be invented, in which I could secure both air and light, as well as cold, during the passage out to Australia, so as to imitate, as near as possible, the Swiss winter, and prevent the hatching of the eggs until the usual period in Europe.

"It was at this period that, through the kindness of Sir D. Cooper and Sir A. Brady, I obtained the all-powerful help of the Peninsular and Oriental Company, and made the acquaintance of Mr. Francis Cobb, the late hon. secretary of the Silk-Supply Association, from whom I obtained very valuable hints. Many were the consultations we had to discuss the matter. Mr. Ash, of Oxford-street, undertook to supply a box, in which the thermometer should range from 44° to 50°, provided it was charged daily with ice. Then followed some pleasant meetings, with Mr. Bayly, of the Peninsular and Oriental Company, and Mr. Peter Le Neve Foster, of the Society of Arts. Mr. Bayly promised that every assistance should be given me, and an extra supply of ice was ordered to be placed on board at Suez, and also at Galle. Time passed quickly when so much had to be done, and I spent more time than was pleasant in going to and fro in the underground railway, leaving me but few opportunities for visiting my own friends. At one of these meetings at Sir Antonio Brady's, Mr. Cobb proposed that I should return to Milan. This would be the fourth time, and I had hoped to have taken up the grain at Lyons, and gone on through Marseilles; but on learning from him what an advantage it would be to see this patent reeling machine, as being the one most suitable for us, with a sigh I agreed to retrace my steps to Milan; and, as if to reward me for so much extra travel, I made the acquaintance in Venice of Mr. Rawdon

Brown, who has since sent me a handsome present of the best kinds of mulberry trees, and who also introduced me to the agents of the Peninsular and Oriental Company, from whom I received every attention and assistance in their power.

"When I arrived at Milan, furnished with credentials from the Society of Arts by the Secretary, I at once realised the value of the advice, for I found M. Keller's machine all we could possibly wish, being a slow reeling one, consequently any intelligent colonial girl could learn to reel in a few days. In all the other machines, the rapidity with which the silk is reeled renders it impossible for a girl to become a proficient, unless she begins as a child; and even after years of training, unless she has a very quick eye, she can never become a first-class reeler. From M. Keller I obtained the particulars of prices contained in the chapter devoted to 'raw silk and organzine.' His filature is a vast establishment at Como, which I went over, and there saw many hundreds of women in his employment. Previous to this I had revisited Orbe, where I went to see my old friends, and discuss for the last time our plans for 1873 and 1874; the grain with which M. Roland entrusted me for reproduction in Australia was placed in my charge, and I proceeded onwards by Milan towards Verona. The weather there was unusually mild; the thermometer reaching 70° caused me some dread for the eggs, but on entering the station and explaining my difficulty, the polite officials changed my ticket for the night train, and the chef at the buffet placed my precious box in a cool cellar, and at night I continued my journey to Venice, where I had two days' rest, and, thanks to Antonio, Mr. Brown's admirable servant, I embarked with every comfort and no trouble. At Ancona my excellent friend Mr. Hodgson brought me an hygrometer, for testing the moisture inside the ice box. All went on well till leaving Alexandria, when I had rather a difficulty about a carriage. The weather in Egypt was warm, and a direct current of air was required throughout the night. After some time the P. and O. Company's agent came to my assistance, and I was locked in safely with my boxes for the night. At Suez a supply of charcoal was required, and, for fear of accident, I obtained a supply of lettuce seeds, and good soil in boxes, being determined to save the race, if all else failed. The ice process commenced here, and about every ten days I examined the boxes, and changed the charcoal; at 5 a.m. each morning the ice-box was fully charged, and at 11·30 p.m. every night some eight or ten pounds of ice, kept in a Norwegian box (an admirable contrivance), was broken up and placed in the ice chamber of the box. At Galle, the change from ship to ship was carefully effected, and all went well till nearing Melbourne, when it was discovered that the ice was melting too rapidly. The indefatigable purser of the *Bangalore* provided numberless blankets in which to roll the remaining blocks of ice. It being Sunday night none could be obtained in Melbourne, though a telegram had been sent on entering the Heads. The weather was very sultry, and in fear and trembling did we close in the last block of ice. The instant we reached Sydney a supply was procured, and I left the old ship with the kind wishes of the captain and officers for the success of the experiment. It was not until the following morning, when Mr. Brady examined the grain with a strong glass, that I felt sure that success had been obtained. He pronounced the grain to be in perfect condition."

The headings of the Hoosac Tunnel from the central shaft to the west end have been so far advanced that the workmen in each now hear the daily blasts in the other. Only a few months are required to blast out the intervening rock.

The *Times of India* says that a scientific geographical survey of native Sikkim is in contemplation by the authorities.

THE FROZEN AUSTRALIAN MEAT EXPERIMENT.

The letter of Mr. Samuel Wilson, chairman of the Melbourne committee for exporting frozen meat, published in the *Journal* of the 10th inst., drew fresh attention to the experiment of sending carcases of beef and mutton from the Antipodes to this country. Since the successful trial at the last Melbourne Exhibition of Mr. Harrison's method of preserving uncooked meat by the application of ice, great interest has been felt in the matter; and particularly so since it became known that the *Norfolk* had sailed from Port Philip, on the 23rd of July last, with some twenty tons of beef and mutton, in half and quarter carcases on board, frozen in accordance with Mr. Harrison's method, and in charge of Mr. Harrison himself. When the arrival of the *Norfolk* in the Thames was announced, several gentlemen went down to Gravesend on Sunday last, to welcome Mr. Harrison and his cargo, and many more were present on Monday morning when the vessel came into the south West India Docks. A sad disappointment was experienced, when it was found that Mr. Harrison had not been successful in the application of his principle on board the *Norfolk*, and that the greater part of the meat had been thrown overboard before half the journey home had been accomplished, and the rest some time afterwards. The simple account of the failure may be put in half-a-dozen words. The supply of ice prematurely failed through the faulty construction of the apparatus, and consequently the meat became subject to the usual process of decomposition.

What may be called the official account of the failure is that supplied by Mr. Levey, the Secretary to the Victorian Commissioners to the International Exhibition. It is as follows:—"The experiment of shipping frozen meat from Australia to England, which has been tried on board the *Norfolk*, has resulted for the present in disappointment. Mr. James Harrison, who had charge of the experiment, attributes the failure entirely to the hurried way in which the preparations were made. The contract for the fittings was not completed until a week after the stipulated time, and as the ship sailed punctually to date there was no opportunity of testing the apparatus. After getting to sea it was found that the leakage of cold brine—upon the maintenance and circulation of which the success of the process depended—was so great, and the waste of ice so excessive, that failure seemed inevitable. On the 34th day out the greater part of the meat was thrown overboard. About a ton was kept, in the hope that with the remaining ice it might be brought to London, but when off the Azores the last of the ice melted, and nothing further could be done."

It is hardly necessary to say more on the subject at present, but it must be distinctly understood that the failure on board the *Norfolk* does not involve any substantial doubts as to the soundness and practicability of Mr. Harrison's freezing principle. He conclusively demonstrated the truth of his theory at the last Melbourne Exhibition, when he constructed an ice-chamber under the supervision of the authorities, in which for some weeks he kept a large quantity of beef and mutton in a frozen state. When the meat was taken out and thawed it was found as sweet as when it was placed in the ice-chambers and, when cooked, its taste was not distinguishable from ordinary butchers' meat. Moreover, the meat, when exposed to the external atmosphere, which ranged from a temperature of 63° to 68° Fah., kept perfectly good for between 70 and 80 hours, during which period, from time to time, portions were cooked. This long continuance of the meat in a sound state, after being exposed to the air, may be noted as contrary to the generally-received idea that meat which has been subjected to refrigeration decomposes more quickly than that which has not been so treated. It must, however, be remembered that, by Mr. Harrison's system, the meat is throughly frozen, every particle of moisture being converted into ice; and experiments have proved that meat frozen by this system will, when thawed, actually keep longer than ordinary butchers' meat. In addition to the experiments at the Melbourne Exhibition, Mr. Harrison has successfully carried out others with even still better result. At a farewell luncheon given to him before sailing, meat which had been frozen, as Mr. Wilson tells us, for 85 days, was eaten by all present, and pronounced to be undistinguishable from fresh butchers' meat.

We must, therefore, only look on the experiment as a failure *pro hâc vice.* The importance of the matter, as well as the scientific interest felt, will, without doubt, cause the experiment to be renewed at the earliest opportunity. Sincere sympathy is due to Mr. Harrison, to the public, and indeed to the Food Committee of the Society, who were anticipating with no little interest a trial of the meat. Experienced persons have every confidence in Mr. Harrison's system; but whether it can be conducted on board ship, or indeed under any circumstances, at a cost which would make this means of transport a commercial success, is another matter, the possibility of which can only be ascertained by experiment. That fresh meat, preserved by cold in some way or other. will ultimately be brought in large quantities to our shores from all parts of the world is very probable. The great question is the question of the cost of manufacturing ice or cold air, and of preserving ice when once made. Professor Gamgee is directing his attention to the transport of fresh killed meat, which he maintains can be preserved even in hot weather, for seven or eight days, by cooling down the carcases to 40° or 45° Fahr. immediately after slaughter, and maintaining that temperature by the use of compound tubular refrigerating machines. He considers that the cost of this process would be but trifling, and that a large trade might be done in this refrigerated meat, if steamers were specially constructed for the purpose. In the meanwhile, it would be as well to suggest that Mr. Harrison should make some experiments in this country before he again leaves for Australia.

TEXTILE EXPORTS OF SWITZERLAND.

In a statistical report relating to the trade intercourse between the United States and Switzerland, furnished by a correspondent of the *New York Herald* at Geneva, some information is given respecting the export of embroidered cotton goods, the produce of St. Gall. A few years ago the exports barely exceeded 100,000 dollars, while during the past year it exceeded 2,000,000 dollars, and the manufacturers have orders in hand from the United States which will employ all available labour for the next 12 or 15 months. There are two distinct articles under this head—namely, hand embroidery and machine embroidery. The first-named gives employment to upwards of 12,000 persons, mostly women and children, whose wages vary from 25 cents. to 50 cents. per day. Hand embroidery consists of cotton tulle and muslin, used for curtains, handkerchiefs, and numerous articles of ladies' dress. The tulle used as groundwork is imported from England or from neighbouring factories in Alsace. Machine embroidery gives employment to nearly 20,000 persons. Each machine is worked by an able-bodied person and an assistant to thread the needles, with an additional assistant for every two machines to mend defective places. Wages are paid per hundred stitches; the price of labour varying according to the operator, averages about 4s. per day, the assistants earning about 1s. 3d. The machines formerly employed in most kinds of embroidery consisted simply of a kind of frame, while those now in use are of an exceedingly ingenious character, increasing many times the rapidity of working, as well as giving greater variety and richness in design. The needles have a point at each end, with eyes in the middle, attached to a kind of carriage. They travel over the web, passing the threads in and out, while pincers take hold of the needle at one end of the web and send it back to the other. Machines have lately been introduced capable of working more than 100 needles at once, thus producing an infinite variety and beauty of patterns. So far the working of the new system has been kept secret, but there is now a machine at work in the Vienna Exhibition. The web employed for common embroidery consists of cotton cambric, which, as well as the thread, is produced in Switzerland and Alsace.

SWAN RIVER MAHOGANY AND JARRAH WOOD.

This is a local name given to a species of Eucalyptus (*E. marginata* of Smith) restricted to Western Australia. Jarrah, or Djaryl, is the aboriginal name, and it is commonly called mahogany by the colonists, from its similarity to the wood from Honduras and the West Indies. It is applicable for furniture and every purpose for which ornamental wood can be required, some of it being of the very finest grain, and showing much figure, mottled curls, feathers and excrescences, a feature peculiar to colonial wood, and highly effective in point of ornament.

The tree grows to an immense size, attains a great height, and is very plentiful. Of this wood it was stated some years ago by Admiral Sir James Stirling, before a committee of the House of Commons, that there is sufficient to build 20 British navies.

None of the neighbouring colonies possess timber of similar character, or endowed with equally valuable properties. The advantages of this timber are its great strength, hardness, and closeness of grain, combined with durability under exposure to either salt or fresh water. It is never attacked by white ants or by the *teredo navalis*, which abounds in tropical and semi-tropical seas, and this confers upon it an additional value. It somewhat resembles the red gum in appearance, but the grain is darker, finer, and closer than that of the latter wood, and it is susceptible of a very high polish, which brings out a rich, dark hue. It is invaluable to the Western Australians, who use it for shipbuilding, pier, and railway construction, as well as for the interior of buildings and for furniture. If cut at the proper season, when the sap is down (a precaution too little attended to), it will be found to be the most enduring of all woods. On this condition it defies decay; time, weather, water, the white ant and the sea-worm have no effect upon it. The Jarrah is much sought after for railway sleepers and telegraph posts in India and the colonies. It is admirably adapted for dock-gates, piles, and other purposes, and for keel-pieces, kelsons, and for other heavy timber in shipbuilding. The timber is being used by Government in the construction of military barracks in Ceylon, where it is supplied at little more than half the price charged for Indian teak. Possessing such advantages as the jarrah timber does, there can be little doubt of its commanding an extensive market, and proving useful in a variety of ways, as well as remunerative to the enterprising individuals who have embarked their capital in it.

The chief objection raised against it is that it is liable to "shakes," the trees being very commonly unsound at the heart. In the colony vessels of considerable burthen are built entirely of this wood, the peculiar properties of which render copper sheathing unnecessary, although the sea-worm is most abundant in those waters.

Although this valuable wood has hitherto been but little known beyond the colonies, it will doubtless shortly come into more general use, as two companies have been formed for supplying the market on a large scale, one Indian and the other colonial. The latter was organised about two years since under the title of the Western Australia Timber Company, and the Government ceded to it 320 square miles of jarrah, tooart, and karie timber country, with 2,000 additional acres of land for every mile of railway made by the company. The area selected by the company is about twelve miles from Geographic Bay, which lies to the north of Cape Leuwin. The works consist of a loading jetty, which was completed towards the close of last year in that bay; a line of railway twelve miles in length from the bay to the timber district, and mills for sawing the timber. The company expect to be able to supply jarrah timber at the same price as charged for red gum—a greatly inferior timber. The company have works at Ballarat, where they have accumulated a large store of jarrah and tooart wood. This tooart wood is a species of white gum, and has a very close grain, is extremely hard, cannot be split, and is capable of enduring great heat without rending. The tooart wood has been suggested for use in gun carriages, on account of its non-liability to split.

The timber of this tree exhibits the wonderful quality of being absolutely impervious to the inroads of the cimuoria, the teredo, and chelura, those minute creatures so destructive to wharves, jetties, and any sort of naval architecture exposed to the water of the sea; it equally resists the attacks of termites. In these properties the red gum tree of Victoria largely shares. The mahogany eucalypt has in Victoria been brought, for the first time, largely under cultivation, and as clearly the natural supply of this important timber will, sooner or later, prove inadequate to the demanded requirements, it must be regarded as a wise measure of the governments of France and Italy now to establish this tree on the Mediterranean shores, a measure for which still greater facilities are locally afforded at Melbourne. The durability of timber, when used in the construction of piers, wharves, and jetties, involves an interesting and important inquiry, or account of the costliness of these structures, and the rapidity with which they are apt to succumb to the attacks of those marine animals, the teredo and the diminutive chelura. In a report made at Melbourne some few years ago by Captain Ferguson, the chief harbour master, it was stated that these erections, in Hobson's Bay alone, have cost the sum of £180,000; and, at the present rate of their decay, it will be necessary to renew them in the course of fifteen or twenty years. When the pillars become bored by the teredo, or eroded by the action of the chelura, until their diameter is reduced to one-half, the whole superstructure is endangered, and immediate repair or renewal is urgent. Constant examination and repairs are therefore needful; and it must be obvious that in deep water these operations are attended with the utmost difficulty. It is not a little curious that hitherto no kind of wood has been able to resist these agencies but the Swan River mahogany. Examination of its structural peculiarities reveals the presence of cells of extraordinary size and number, far surpassing those which have been previously noticed in other woods.

Next to these in size and number are those of the red gum (*Eucalyptus restrata*, Schlecht). This timber resists for a long time the destructive agency of the teredo, and is inferior only to the Swan River mahogany. In Ogle's work on Western Australia, it is stated that a jetty at Swan River, which had been built in the early days of the colony, of oak procured from a wreck, was completely destroyed by the teredo, whereas the mahogany similarly exposed had not been touched by it. A pile which had formed part of the Swan River wharf since 1832 was sent to the Melbourne Exhibition 30 years afterwards untouched. The structure of *Eu. rostrata*, or red gum, presents cells of a beautiful red colour, commonly as a double series, and accompanied by even more abundant infiltration than either of the ironback eucalypts, since it appears diffused in the woody fibre. There is scarcely a more splendid object for the microscope than a well-illuminated section of these cells in the red gum. This is a very valuable species of timber for the extraordinary endurance of the wood underground, and for this reason it is highly valued for fence posts, piles, and railway sleepers; for the latter it will last a dozen years, and if well selected much longer.

In order further to prove the durability of this wood, three logs were recently sent to Victoria which had for the last thirty years formed a portion of the Causeway Bridge, at Perth, over the Swan River. They were drawn by the Government and forwarded to Melbourne, with a view of exhibiting the capabilities of this wood. The logs are about twenty feet in length, with a diameter of about twelve inches, and having been sawn down the full length and polished, exhibit the splendid grain of the wood to great advantage. The piles when drawn appeared to be as sound as the day on which they were driven in, although they were half under water the whole of the time. A piece was sawn off the whole length of each of the three piles, one surface being polished and the other left rough, so that the soundness of the timber is apparent. The facts connected with these piles are vouched for by Mr. Manning, C.E., clerk of the works at Freemantle, Western Australia. In contrast to this may be mentioned the circumstance attending the use of three heavy sheer-legs of Baltic timber during the construction of the same bridge. The portions of these legs which were under water were completely riddled in the course of ten months by the *teredo navalis*, whilst the three jarrah piles do not show the slightest signs of insect ravages after thirty years' immersion in the same water. The immunity of this wood from the attacks of insects, whether land or marine, has been proved by analysis to be due to the presence of tannic acid in the wood.

For piles it should be used whole (not cut into quarters), either round or hewn; the former is preferable, there being very little sap, and the outside portion of the heartwood is stronger than the inner portions, near the centre; hence the desirability of keeping the annular rings complete. Captain Hybut, of the *Lord Raglan*, also brought recently to London a log of this Jarrah timber, being a pile taken from a old jetty at Freemantle. It was driven 30 years ago, and had been under water during the whole of that time. It is as sound as on the day on which it was driven; and, in order that there might be no mistake about it, the government seal is affixed to it, and it is accompanied by a certificate signed by the governor of Western Australia. This timber can be had in any quantity. The Jarrah wood is being used for the Madras railways, and is much approved.

M. Xenos has applied for a concession for tramway lines to connect Athens with the environs, the Piræus, &c.

The value of the railway carriages exported in the first nine months of 1872 was £26,166; in the same period of the present year it amounted to £105,444, being an increase of nearly 400 per cent.

A number of the leading tradesmen in Oxford-street have signed a circular expressing the opinion that a noiseless pavement is desirable for the roadway in Oxford-street, and stating that they are willing to bear a portion of the cost of laying it down.

Mr. Todd, Postmaster-General of South Australia, has been lecturing at Adelaide upon the great Australian overland telegraph. Mr. Todd stated that during the first six months of this year the overland line had yielded a revenue of £54,000.

Since the opening of the Chesapeake and Ohio Railway, the development of the coal and iron resources of Virginia is making rapid progress; seventeen coal mines and seven iron mines are now in operation along the line, and twelve blast furnaces will shortly be in operation.

The United States Signal Service has recently constructed a telegraph line to the summit of Pike's Peak, in Colorado, which is said to be the highest point reached by any line in the United States, or perhaps in the world. The height is said to exceed 11,000 feet. Regular reports as to the weather are to be sent to Washington three times daily.

THE VALUE OF LEEDS SEWAGE.

The following report by the Sub-Committee on Utilisation of Sewage upon Manures at the Knostrop Sewage Works, has been laid before the Streets and Sewage Committee:—

"In order to test the relative value of the native guano produced by the A B C process, at the Knostrop Sewage Works, the committee have had six plots of grass land, each half an acre, treated with various dressings. On each plot they put 30s. worth of each sort of manure, but the carriage, labour of spreading, and subsequent dressings, caused a difference in the cost of the several plots; and, in that treated with street sweepings, the quantity laid on was so much in excess of what was proper that the result is of little use for comparison, and it is probable that next year, with no further dressing, this crop may be very good, and the benefit then apparent.

"From the first the Peruvian guano appeared to take the lead, the grass being higher than the rest, including that on the plot dressed with native guano, but when cut the weight of hay was not heavier, having much more of the long strong stalks, whilst the native guano had more herbage and fine grass near the roots.

"The grass was all cut at the same time and made into hay, the finest quality of all, as decided by a competent judge, being that grown on the plot manured by the native guano. He says:—'During my examination (of the hay) I pointed out one part of the stack which I considered the finest quality of hay, and Mr. Craven at once said, "That is the hay grown on the plot of land manured by the native guano."'

"No additional value is put on the hay on this account. The opinion of the same judge upon the after-grass is annexed to the report on each plot. The appended statement, Table I., shows the cost of the various dressings in detail.

"The weight of hay produced, the value of the crop, and the quality of the after-grass on each plot were as shown below in Table II.

"The native guano was calculated at the rate of £3 10s. per ton, and it will thus be seen that the result is slightly superior to that obtained by the same value (30s. worth) of Peruvian guano at £15 per ton, and, whilst it is admitted that the Peruvian is exhausted the first year, it is claimed for the native guano that the effect will be seen for one year or more afterwards.

"The committee propose to test this by allowing the several plots to remain exactly as they now are, without any fresh dressing, and see the result next year. The committee were surprised to find that the native manure, which is composed of a mixture of native guano and night soil, valued at £4 per ton, produced 2 cwt. 2 qr. 10lb. less hay than the native guano, which has no mixture of night soil.

TABLE I.

30s. of each sort of manure.	Quantity used.	Price of manure per ton.	Cost of manure.	Cost of cartage and labour.	Cost of brush, harrow, and extra treatment.	Area of land.	Total cost of each dressing.
	T. C. Q. L.	£ s. d.	£ s. d.	£ s. d.	s. d.		£ s. d.
1. Street sweepings	17 11 0 0	0 1 8½	1 10 0	2 12 0	1 6	Half-acre.	4 3 6
*2. Stable manure	7 10 0 0	0 4 0	1 10 0	0 16 6	1 6	Do.	2 8 0
3. Peruvian guano	0 2 0 0	15 0 0	1 10 0	0 2 10	...	Do.	1 12 10
†4. Native manure	0 7 2 0	4 0 0	1 10 0	0 1 10	...	Do.	1 11 10
5. Native guano	0 8 2 7	3 10 0	1 10 0	0 1 10	...	Do.	1 11 10
6. Sewage mud	1 0 0 0	1 10 0	1 10 0	0 7 4	1 6	Do.	1 18 10

* This manure was purchased at Knostrop, and the cartage was not expensive.
† There was more carting and trespassing on this plot than any other.

TABLE II.

Manured with 30s. worth.	Cost with labour &c.	Weight of hay produced.	Hay per cwt.	Value of the crop.	Value above manure.	Less than value of manure.	After-grass.
	£ s. d.	cwt. qr. lb.	s. d.	£ s. d.	£ s. d.	£ s. d.	
1. Street sweepings	4 3 6	13 1 23	4 0	2 13 10	...	1 9 8	Best crop of after-grass.
2. Stable manure	2 8 0	15 1 4	4 0	3 1 2	0 13 2	...	Second best crop of after-grass.
3. Peruvian guano	1 12 10	14 0 8	4 0	2 16 7	1 3 9	...	Nearly equal to second.
4. Native manure	1 11 10	11 2 9	4 0	2 6 4	0 14 6	...	Light crop, but fine quality.
5. Native guano	1 11 10	14 0 19	4 0	2 16 7½	1 4 9½	...	Still lighter crop, but finer quality.
6. Sewage mud	1 18 10	12 0 0	4 0	2 8 0	0 9 2	...	Lightest crop, and poorest quality.
Total	13 6 10	80 2 17	...	16 2 6½	4 5 4½	...	... ...
Deduct loss on No. 1	...	...	...	...	1 9 8	...	
					£2 15 8½		

Two methods by which telegraphic despatches may be received and sent in a railway train in motion are reported from America.

The Italian minister of Public Works has issued a circular, urging the prefects to give an impetus to the creation of necessary commercial roads.

The value of the timber exported from Sweden in 1871 was £3,204,560, of which £1,696,493, or about 53 per cent., went to England. The kinds most in demand are spars, pit props, lathwood, sleepers, and split wood. After Great Britain, Denmark, Prussia, and France receive the largest amount.

According to the *Times of India* some specimens of Zanzibar coal, sent by the political agent to the Government of Bombay, have been favourably reported upon.

The South of Scotland Compressed Peat Fuel Company have commenced the regular manufacture of peat on Kirkconnell moss. In a short time it is expected that abundance of the new fuel will be in the market.

Asphalte pavement is to be tried in Brighton. A large number of Seyssel blocks are stored near the Aquarium, and the Works Committee have endorsed a recommendation from the Surveyor that an asphalte pavement should be laid on the south side of Junction-road.

THE FOOD OF THE FRENCH WORKING CLASSES.

Dr. Bertillon recently read a paper on this subject before the Paris Academy of Medicine, which has attracted considerable attention. The doctor has collected a large amount of facts, and arranged them in an effective manner.

One of the most striking instances of the value of animal food was derived from the department of the Tarn, where there was an industrial establishment employing 630 men, who lived principally on vegetable food. M. Talabot, who was the director of the establishment, about the year 1835 found that the sick fund, established to give the men during illness half the amount of their ordinary wages, was constantly in debt; he took measures for the introduction of butchers' meat into the food of the men, and the effect was so great that the average loss of time per man on account of illness or fatigue was reduced from fifteen to three days per annum. The animal food had saved twelve days' work a year per man.

The absence of meat in alimentation, said Dr. Bertillon, as Haller had before noticed, has moreover an injurious effect on the superior faculties of man, as well as his physical powers.

Dr. Bertillon stated that the theoretical ration of 1,000 grammes of bread and 286 grammes of meat, was almost identical with the ration of the French soldier, which had been arrived at by mere observation, namely, 750 grammes of household bread, 316 grammes of white bread for the soup, 285 grammes of meat, and 200 grammes of carrots and other vegetables.

The case is, however, far different with the general population of France. M. Le Play has shown that the vine-dressers of Armagnac eat four meals a day, and meat with two of them; but that the case is very different elsewhere. The vine-dressers of Morvan, for example, eat meat only about once a year, the peasants of Maine twice, the miners of the mountains of Auvergne six times, and the weavers of the Sarthe on *fête* days only. The people of Brittany are the worst off of all. M. Le Play affirms that the greater part of them never taste meat at all, and only a few of them five or six times a year, at the great religious *fêtes* of the Pardons. Finally, says M. Le Play, the great mass of French workmen—the agricultural labourers—scarcely consume any meat.

The following table is given by Dr. Bertillon to show the relative consumption of animal food as compared with vegetable, the latter being taken at 100:—

	Per cent.
English workman	37·7
French sailor	31·7
Agricultural labourer in the Vaud	15·6
,, ,, North of France	7·7
,, ,, Corrèze	4.5
,, ,, Vaucluse	3·3
Lombardy workman	2·0
Irish ,,	1·0

Nor does the French peasant obtain the basis of his food from the most nutritive and precious of the cereals—wheat; entire departments depend principally on buckwheat (*sarrasin*), maize, millet, chestnuts, &c.

It is in the last named disinherited districts, says M. Bertillon, that the mortality is the greatest, though, instead of their being insalubrious, it is in Brittany, the Alps, and the Limousin, where we go to breathe the purest air, though these countries have no other condition in common but poverty and insufficient nourishment.

The privileged regions, on the contrary, are those in which the population is well fed, the Aube, Burgundy, the Gironde, the Eure, &c. In the great towns the mortality is increased by excess, late hours, and unwholesome drinks; but it is very sad to say that M. Bertillon shows that all these causes are surpassed in effect by the misery which weighs on the peasants in healthy districts with soft climates. The following table shows the mortality per thousand of the population in the departments of Finistère, the Seine, and the Aube, where neither the misery of Britanny nor the anti-hygienic conditions of Paris exist:—

Ages.	Finistere.	Seine.	Aube.
From 5 to 10 years	11·70	11·20	5·7
,, 11 to 15 ,, ...	8·76	9·97	5·01
,, 16 to 20 ,, ...	8·55	9·24	5·15
,, 21 to 30 ,, ...	13·55	12·06	6·62
,, 31 to 40 ,, ...	13·40	12·23	6·76
,, 41 to 50 ,, ...	17·25	16·35	8·44
,, 51 to 60 ,, ...	28·75	26·62	14·40
,, 60 and above	79·	76·10	60·70

"In our climate," says M. Bertillon, "man requires good food to enable him to resist the effects of labour; and, although famine is unknown in France, the chestnuts of Limousin, the *cruchade* of the Laudes, the *bourriol* and the *tourtou* of Auvergne, produce the same results, when they form the only food in the human constitution, as the potatoes of the half-famished Irish."

A cry of alarm has been heard that France is becoming depopulated; more infants die than formerly, and the number of deaths of adults in the full force and vigour of their life is greater in France than elsewhere.

Two elements concur in rendering a nation great and respected—intelligence and numbers. It is useless to answer interested and calumnious criticism on the first head; but when the facts under the second are revealed, when the causes are clearly pointed out, it is the duty of administrators, under a beneficent government, to fight against them and to warn the population against the evils which are slowly decimating it.

M. Bertillon's memoir contains forty charts, and on account of the cost of publication a subscription list is open for the purpose, but it is hoped that the Academy of Medicine, with the aid of the Government, will enable the author to place the important results of his labours before the world.

PARIS NATIONAL SCHOOL OF DRAWING AND MATHEMATICS.

The new establishment, which is intended for the instruction of all those whose occupations include the application of the fine arts to industry, is situated in the school quarter—No. 5, Rue de l'École de Medicine—and has just issued its programme for the current session.

It is divided into day and evening schools, and the whole are gratuitous; the morning classes meet twice, and the evening classes once, a day, and the duration of each is generally from two to three hours.

In the morning classes the work includes drawing from the living model, or from the antique, and from the round, the study of the figure, of animals, flowers and ornament, every day; professional studies of furniture, vases, bronzes, tapestry, paper hangings, decorative panels, &c., copies and compositions, arithmetic, algebra, fractions, logarithms, equations of the first and second degree, rectilinear geometry and trigonometry twice a week; geometric drawing twice a week; perspective and its applications twice a week; sculpture, including the figure, living animals and plants, composition of ornaments, and lastly, engraving on wood during eight hours each day.

In the evening schools the course of study is nearly the same, but the professional studies mentioned above are replaced by the history and composition of ornament, illustrated practically by a professor; and there is a special class for architecture and construction, including descriptive geometry, shadows, perspective, stone cutting, statics, strength and stress of material, and, lastly, architectural composition and perspective as applied to sculpture.

The professors appointed to direct the school include MM. Faure, Cabasson, Etex, Hédin, Rébout, Rouillard, Aimé Millet, Pannemaker, Ruprich-Robert, Train, and other names well known in the art world of Paris.

Such is one of the means by which our neighbours, in the midst of all their difficulties, are doing all in their power to instil into the minds of the working classes, and of youth, the principles of art and science and the elements of taste; the lesson is an important one to all who have a due feeling of the value of art.

THE CHEQUE BANK.

As an entirely new financial and commercial experiment, the establishment of the Check Bank deserves some notice. Whether the plan is or is not successful, it is certainly quite new, and its progress will be watched with considerable curiosity.

Up to the present time no attempt has been made to extend to the less wealthy classes the advantages of the banking system that has grown up for the benefit of the comparatively rich. It has always been considered that it would never answer a banker's purpose to keep an account for any one who was not prepared to deposit and leave a considerable sum in his hands. By the use of this money the banker recompenses himself for the trouble he takes in keeping his customer's accounts. The natural consequence of this has been that the conveniences and advantages of making payments by cheque have been denied to the very large class of people who cannot afford to keep a considerable sum of money by them. How great a convenience is thus lost, it is hardly needful to say; the ease and the safety with which money can be transmitted by cheque are alone sufficient reasons to make everybody who can afford it keep a banking account. In some countries of Europe, Italy for example, a system of small banking accounts has arisen, and there are banks where an account can be opened with 100 francs. Business on such a small scale would probably never answer in London, and for this reason an attempt is now made to start a new system of a simpler character than that employed for large transactions.

The Cheque Bank proposes to open an account with any person for any amount, giving in return for the cash paid in, cheques up to that amount. These cheques have stamped on them the full amount for which they can be drawn, and they vary in value from £1 upwards. But though the cheque cannot be filled up for more than a certain sum, it can be drawn for any smaller amount, the balance being put to the credit of the drawer. The result of this is, that for every cheque issued the necessary amount to pay it lies in the bank, and it thus carries with it a guarantee of its own genuineness. Each cheque is therefore like a bank-note, except that it can be drawn for any sum below its maximum. A possible drawback may be that the cheque, like a note, possesses an intrinsic value, and that its owner, if he lost it, even when blank, would lose the money, or at all events have some considerable difficulty in obtaining it. Also, any rogue into whose hands such cheques might fall, would only have to fill them up in his own or any other name, and, so far as appears at present, there would be nothing to prevent his getting the money for them at any bank in connection with the Cheque Bank; eventually, of course, the fraud would be detected, but as the guarantee lies in the cheque, and not in the name of the drawer, it would be accepted without suspicion by strangers, in a way that cheques, as now employed, are not. Such drawbacks, however, may not in practice prove of any importance, and if the system becomes widely known and popular, it may prove useful by offering a new method of circulation, and by collecting and rendering available for trade purposes a large aggregate mass of small sums now kept out of general circulation as a reserve for small payments.

With regard to the management of the moneys entrusted to it, the necessity for being prepared to pay any amount of calls upon it precludes the bank from investing them. It, therefore, deposits them in other banks, so that they are at once available. Under no other system could the safety of the project be ensured, but by thus distributing and dividing its deposits it proposes absolute security to its customers.

CORRESPONDENCE.

PRESERVED FRUITS, &c.

Sir,—Some thirty years ago the Society of Arts received from Australia samples of wine, and also of dried figs, peaches, &c., the product of those colonies; but, though much has since been done to extend the culture of the vine and improve and extend the manufacture of wine, but little result has yet appeared in our markets; while the preservation of fruit and its shipment to this country has been almost entirely disregarded. At the present time, however, I am informed that samples of Australian quince, peach, and apricot jams are obtainable. This has recalled to my mind an old premium, which was long since published in the Society's list, and pointed to the fact that in the tropics, as well as in Australia and other British colonies and possessions, the fruits there produced in such abundance, and thrown away, might be utilised and placed in our markets at highly remunerative prices, if some enterprising capitalists could be found who would direct their attention to the proper preparation and preservation of them. I am quite aware that guava and such like jellies and preserves are at present made and sold, but the trade is limited, and more of a fancy than a general trade. Much of the preserve is poor in flavour and bad in colour, owing to the imperfect methods used in their preparation, the old method of boiling and mashing the fruit in sugar over a hot stove in open pans being commonly used, As a result, the sugar settles and burns at the bottom of the pan, the fruit is discoloured, is not unfrequently over-sweetened, and at the same time the high temperature of the boiling syrup drives off the light essential oils which should be retained, and are, in reality, the fruit essences which it is desired to preserve. In the hope of preventing waste, and improving and extending the production of preserved fruits, I venture to suggest that the water bath or a steam jacket should be used in the preparation of jellies and preserves where fruits of delicate flavour are dealt with; that the fruit should not be mashed up, as is at present the case, thereby affording the greatest possible facility for getting rid of the essential oils; that the juices of the fruit mixed with the sugar should be cooked separately, and to a greater extent than the fruit itself; and in other cases the use of the vacuum pan might be resorted to with advantage.

We know that so delicate an article as milk is deprived of its water, and preserved in combination with sugar to an enormous extent, and no trace of injury to its flavour results. Why, then, should so large a proportion of the flavour of fruit be lost in the process of preserving it? I am glad to see that, within the last two or three years, considerable quantities of fruits have been placed on our markets, preserved in tin cans by the cooking process now so largely employed in the preservation of meat, but many of them are weak in flavour and watery in character, though some recently introduced are a great advance on the first samples received. Cannot those who preserve fruit gather an idea or two of practical value from those who deal with the preservation of vegetables? Is it impossible to dry some of the fruits by means of currents of hot air, or, better still, cannot the process of drying by means of dry cold air, introduced and described to the Society by Mr. Buchanan, a year or two since, be applied in the preparation and preservation of fruits for the English market; and is it impossible to create an entirely new trade, such as a fancy biscuit trade, by combining the preserved fruits with other products, viz., sugar, flour, eggs, &c., and import them in tins to this country?—I am, &c.,

H. G. H.

RAILWAY SIGNALS.

SIR,—The terrible frequency of railway accidents has induced me to offer through the medium of your journal the following suggestions:—

That the signalling should be electrical and automatic. That instead of the driver having to notice signals at a long distance from him, through rain, fog, and other atmospherical conditions, entirely adverse to careful observation, an index hand and plate should be attached convenient for observatien on the engine itself, labelled with the notices most required, such as stop, danger, &c., &c. That within a certain distance of all stations, any two engines on that portion of the line should complete an electrical circuit, causing a bell to ring on each engine, thus signalling their proximity to each other. The electrical communication to be made from the stations by means of wires laid parallel with the metals, and connected with sets of studs that a projecting rod from the engine would touch in passing, and that could be raised or lowered at the option of the signaller by means of levers or otherwise. This is, of course, a rough outline of a plan, but one I believe that could be easily worked out, and would be the means of saving much valuable life and property.

I am, &c.,

EDWARD DUNMORE.

Bodowain, Llandudno, North Wales, Oct. 6, 1873.

SMOKY CHIMNEYS.

SIR,—In the month of December, some years ago, several rooms in my residence, Llwynoffa, near Mold, were rendered useless by a violent pouring out of smoke. I was just leaving to visit friends in the neighbourhood of Denbigh, for the purpose of attending a ball in that town; during the night the ball-room itself was visited by puffs of smoke. This circumstance naturally reminded me of the state of my own house, and the very slender prospect of a merry Christmas on our return.

The following morning, in company with some of my young friends, in the garden of my hostess, I caught sight of the parapet of a bridge over a road, which my imagination converted into a chimney, for the purposes of experiment. I mentally constructed a casing round it, open at the top. I considered that an opening in the lower part of one side would receive the wind from sixteen points of the compass, and that a similar opening on the opposite side would take it in from the remaining points, so that a current of air would rise on the windward side of the chimney, and so carry off the smoke.

On returning to Mold I procured an ordinary round chimney-top, and had it cased with zinc, according to my theory. It stands from 16 to 18 inches high, and the casing of zinc is about 1½ to 2 inches from the earthenware. There is a square hole in the zinc, about three inches in diameter, on each side, communicating with the outside hollow tubes or chambers.

It was placed on my chimney the following day, and has never been removed since. It entirely answers its purpose, as we have not had a particle of smoke from that day to this. These tops are now made entirely in fireclay both in Ruabon and Buckley, and can be delivered in London at six shillings each, the weight being ninety pounds.

The great success in Chester has been at a chimney at the Ragged Industrial School, Broughton, as the head of a college in Cheshire had attempted to cure it and entirely failed. My steward tells me that he has sold 120 of them, and I have placed from 40 to 50 on my own property.—I am, &c.,

C. BUTLER CLOUGH.

Chester, 11th October, 1873.

GENERAL NOTES.

Colonial Manufactures.—The New Zealand Government have offered the following bonuses to stimulate colonial manufactures:—£5,000 for the production of 1,000 tons of pig-iron of marketable quality. No bonus will be given for less than 100 tons. £2,000 for the production of 250 tons of sugar, manufactured in the colony from the beetroot.

A Natural Sand-blast.—A curious instance of the attrition of glass by sand is noticed by a correspondent of the *Builder*, writing from a village on the coast of Northumberland. In a house near the shore it was noticed that in some of the windows many of the panes of glass were completely obscured, or "ground," by the action of the wind and sand blown against them. The obscuration was so complete that the effect of "ground glass" was produced. The panes presented various degrees of obscuration, according to the period since which they had been inserted, some being new and clear, others partially "ground," and others totally so, by the action of the wind and sand.

Camphor Wood.—This wood promises to become, at no distant day, a very valuable and important article of commerce. It grows freely in tropical countries, without cultivation, and especially thrives near the sea-coast, where it may be easily obtained for shipment. It attains large proportions, being sometimes found fifteen feet and upwards in diameter, and of proportionate height. It is very valuable for carpenter's work, being light, durable, and not liable to injury from insects. Its aromatic, agreeable perfume is also well known. The wood is strong and very durable, and is especially applicable for ship-building, and may be applied to all purposes for which teak wood is used. Camphor wood piles have been known to remain in a good state of preservation over a hundred years.

Commerce of Algeria.—The French Minister of Commerce has just completed an account of the commerce of Algeria for the years 1867 to 1872, both inclusive. It appears that the imports amount to 196,000,000 francs, and the exports to 112,000,000 francs only; the number of vessels employed in the trade amounts to 4,000, with a total of 800,000 tons; of these vessels and tonnage, 1,611 ships and 579,000 tons are under the French flag. The principal imports into Algeria are sugar, wines and spirits, coffee, olive oil, woven fabrics, and small wares; the principal items of export are raw hides, wool, tobacco, canes, rushes, cereals, and vegetable hair. With millions of acres of forest land the export of timber from Algeria is so small as not to be enumerated.

Fibre of the Ixtle Plant.—A writer in an American paper draws attention to a valuable vegetable product, the Ixtle fibre (*Bromelia sylvestris*) which grows abundantly on the southern shores of the Gulf of Mexico, and is remarkable for its lustre, strength, and flexibility, without kinking. Within the thin envelope which forms the leaf, there is a perfect skein of thread of extraordinary tenacity, length, and fineness. The outer covering or cuticle can be easily removed by a chemical process, and the whole fibre made available without further expense. The idea of the writer is to use all the refuse leaves not employed for ropes or textile fabrics, for paper, cured and baled like hay. The Ixtle fibre, according to the writer, requires but little cultivation, and the leaves can be dried for a few days in the sun. It is open to question whether a fine quality of paper for banking cannot be made from the fibre. The plant, it is said, can be brought to New York for less than fifty dollars per ton.

Tin in New South Wales.—An alluvial tin lode near Jillamatong Lake, in the parishes of Abington and Blakefield, in the Cooma district, New South Wales, is about to be worked by a Sydney proprietary on behalf of the discoverers. The alluvial tin in this neighbourhood is said to be an extremely rich deposit, and it is no doubt geologically connected with rich openings made at Mowenbah.

Railways in Peru.—Peru now possesses a railway across the Andes, which is represented to be the greatest modern triumph of engineering skill. Passing from the sea coast directly over the mountains into the interior, it ascends by a long series of remarkably easy grades and beautiful curves to the highest point ever reached by a locomotive, and through some of the finest scenery of the South American mountain regions.

Telegraphic Clocks.—In Pittsburg, Pennsylvania, an electric clock has been established to move the hands of seventy different clocks, scattered all over the city. The motive clock is powerful, and has a pendulum composed of hollow coils of copper wire. These swing to and fro over the poles of horseshoe magnets, and every time they pass from one pole to the opposite a current of electricity is called up inductively in the coils, flows up the wire, and thence to the seventy dials, giving a current of an opposite nature at each swing. Behind each dial is an astatic, permanent magnet, suspended on a pivot, and surrounded by a coil of wire, and it rotates under the electric influence from the wires. A small weight may be used to each dial if the hands are heavy, and the pivoted magnet may merely regulate the time. Of course every clock will be exactly alike, and will run with very little attention. To prevent the pendulum of the motive clock from moving too fast by the increase in the length of vibration of the pendulum, a magnetic bridling apparatus is attached.

A New Use for Ice.—Coaxing iron tubes to accommodate themselves to circumstances is something new in engineering. The *St. Louis Republican* describes the mode of operation. The weight of the St. Louis-bridge is at present supported by cables, and while this is the case the expansion and contraction of the tubes by heat are of no consequence. It will be different when the last tubes have to be fitted. From the slackening of the cables the arch at the centre will "settle" about three inches. Provision has been made for this by increased length of the tubes, all the calculations being based on a temperature of 60°. At the temperature of 60° it is known to the sixtieth of an inch what would be the intervening space between the approaching tubes, and the dimensions of the last joints were adjusted accordingly. Only once, however, has the weather been favourable for the operation, and, after wasting some time, it was determined to try to reduce the temperature artificially. Early one morning 45 tons of ice were applied to the tubes, and bound on by gunny bagging. At 3 p.m. the expansion had been reduced about two inches. Finally, the application proved successful. On the following day the connecting tubes were put in, and the first arch completed.

Aeronautics in America.—The American aeronaut, Mr. Samuel A. King, intends during September to make an extended balloon voyage from Buffalo, New York. For this purpose he is building a large balloon to replace the "Mammoth," which was destroyed by the recent great fire in Boston. It is Mr. King's purpose to make the longest overland voyage, if circumstances favour, ever yet accomplished. It is no part of his plan to go out over the ocean, to explore the sea, but he expects to be able to settle something about the upper currents when he comes down. His voyage is undertaken wholly in the interest of science, and, in view of the extraordinary degree of attention now being drawn to the subject of meteorology, the results will be regarded as of much more than ordinary importance. From a communication made by Mr. King in 1871 to the Washington Philosophical Society, it appeared that out of 170 aerial voyages made by him during the past twenty-five years, about twenty-five per cent. showed that the currents of the atmosphere were moving to the north-eastward; a second twenty-five per cent. gave westerly currents; and a third gave north-westerly currents. The remaining forty voyages were about equally distributed among northerly, southerly, and easterly currents. Mr. King's experience, therefore, agrees with that of most European aeronauts, who have repeatedly testified that there is no constant westerly current of air prevailing at any altitude above the earth's surface which they have been able to reach in their balloons.—*Nature.*

Instruction of Artisans in Vienna.—The great exhibition of Vienna is to be commemorated by the establishment of an "athenæum," as it is called, modelled after the Conservatoire des Arts et Metiers of Paris, and the Museum of Industry at Brussels, for the special instruction of workmen and small manufacturers. It is to be installed in the midst of the industrial quarters of the capital. A large quantity of drawings, designs, models, instruments, machines, tools, raw and partially manufactured materials, have been promised by exhibitors, and Baron Schwarz-Senborn, director of the exhibition, has presented a collection of between three and four thousand volumes of books connected with industrial exhibitions. The establishment starts with a capital of more than £11,500.

The Turners' Company's Prizes.—The Lord Mayor presided last week in the Egyptian-hall of the Mansion-house, at the fourth annual distribution of these prizes. Their origin was explained by Professor Tennant, the master of the company, and the general results of the present competition for excellence of turning in ivory and stone by Mr. Thomas Forshaw and Dr. William Pole, two of the judges in either department. The Lord Mayor, before presenting the chief prizes, congratulated the company upon the success which had attended its efforts to promote technical education in the trade with which it was more immediately connected, and referred to similar inducements held out by other City Guilds, mentioning in particular the Coachmakers' and Paperstainers' Companies. He thought, however, more was to be accomplished in the matter of technical education by the united action of all the guilds than by individual efforts, and hoped at the forthcoming aggregate meeting on the subject, to be held in that hall, the Turners' Company would bring their experience to bear upon the proposed combination. The prizes were then distributed. The money prizes were given by the Baroness Burdett-Coutts. In some concluding remarks Professor Tennant noticed the excellence of the work from Whitby in jet, two prizes and the first honorary certificate having been carried off by competitors from that town.

New Refrigerating Apparatus.—On Tuesday last some experiments were made at the factory of Messrs. Siebe and West, Mason-street, Westminster-road, to test the working of an ether refrigerating apparatus, invented by Captain Frederic Warren, R.N. The apparatus consists of a small steam-engine, to which is attached a second cylinder for condensing ether vapour. The cold produced by the expansion of the condensed ether is utilised by being communicated to brine contained in pipes, around which the ether circulates. The brine thus cooled is used in its turn either to freeze water or to cool air, the water being contained in reservoirs immersed in a vessel of cold brine, and the air being conveyed in pipes, which winds backwards and forwards in such a vessel. The ether employed, being contained entirely in closed apparatus, is scarcely at all wasted, and little more than its first cost need be taken into account. In the experiments, the moisture on the outside of the pipes leading to the refrigerator was rapidly frozen; and the air of the room, after being withdrawn at a temperature of 62 deg., was almost immediately returned into it at 45 deg.; while, as this process continued, the temperature of the room was rapidly reduced and might easily have been brought to the freezing point and so maintained. Captain Warren claims that the temperature of any limited space can thus be kept down to almost any required degree; and he proposes to apply the method to the construction of cold chambers on board ships, to be used for storing fresh provisions, or, in the case of merchant ships, for the conveyance of perishable freight. Thus he would have a cold chamber for bringing dead meat, say from Aberdeen to London, and would accomplish this at a very small expense; but he does not think it possible to freeze a whole cargo of dead meat, so as to obviate internal putrefaction during the long voyage from Australia. He proposes, however, to cool railway carriages in hot climates, to provide cool vans for the conveyance of dead meat and other provisions in India, to cool the air admitted into hospital wards in hot climates, and to provide an unlimited supply of pure ice at almost nominal cost. Messrs. Siebe and West have prepared the necessary machines for all these purposes. Captain Warren asserts that one of his cool chambers would allow a man-of-war to carry a month's supply of fresh meat and vegetables for her whole company.

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FRIDAY, OCTOBER 31, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

BETHNAL-GREEN MUSEUM.

The following correspondence has taken place between the Right Hon. W. E. Gladstone, M.P., and the Secretary of the Society:—

The Secretary of the Society of Arts, to the Right Hon. W. E. Gladstone, M.P.

3rd July, 1873.

Sir,—A memorial relative to the beneficial action of the Bethnal-green Museum has been prepared by the Society of Arts for presentation to you.

It has been signed by one hundred and fifty members of the Council and of the Society, of whom twenty-two are peers, and sixty-three are members of the House of Commons. In additon to the above, thirty-seven peers, and sixty-three members of the House of Commons, not members of the Society, have expressed their concurrence in the object of the memorial.

I am directed to request that you will have the kindness to receive a deputation to present the memorial, and to name a day for doing so, giving, if possible, at least a week's notice.

I have the honour to be, Sir,
Your obedient servant,
(Signed) P. Le Neve Foster,
Secretary.

The Right Hon. W. E. Gladstone, M.P.

[*Enclosure.*—The memorial, with signatures attached, as has already appeared in the *Journal.*]

Mr. Gurdon to the Secretary.

10, Downing-street, Whitehall.
July 5th, 1873.

Sir,—Mr. Gladstone desires me to acknowledge the receipt of your letter of the 3rd inst., requesting him to receive a deputation to present a memorial from the Society of Arts, on the subject of the museum at Bethnal-green.

I am directed to express Mr. Gladstone's sincere regret that the pressure of his duties, as First Lord of the Treasury, renders it absolutely necessary that he should confine his attention to those matters which fall directly within his province; and he therefore trusts that those on whose behalf you have written will kindly excuse him if he asks them to address themselves to the Privy Council office.

I have the honour to remain,
Your most obedient servant,
(Signed) W. B. Gurdon.

P. Le Neve Foster, Esq.

The Secretary to Mr. Gurdon.

Society for the Encouragement of Arts, Manufactures, and Commerce, John-street, Adelphi,
18th July, 1873.

Sir,—I have brought before the Council your letter of the 5th July, in reply to mine of the 3rd July, asking Mr. Gladstone to receive a deputation to present a memorial from this Society on the subject of the Bethnal-green Museum. The Council observe that you express Mr. Gladstone's regret that the pressure of his duties as First Lord of the Treasury renders it absolutely necessary that he should confine his attention to those matters which fall directly under his province, and his trust that those on whose behalf the reception of a deputation was sought will kindly excuse him if he asks them to address themselves to the Privy Council-office.

I am directed, in reply, to point out that the memorial, having relation to a subject of vast importance to the education, general cultivation, and social welfare of the people, did appear to the Council to bring the subject strictly within the consideration of the Prime Minister, rather than of a department of the Government. Moreover, it did appear to the Council that the deep interest which the subject excites is manifested by the unusual character of the signatures, being those of sixty peers and 130 members of the House of Commons attached to the memorial, and justified the Council in asking for the special attention of Mr. Gladstone himself.

Under these circumstances, the Council submit their conviction that the subject involves considerations of principle and policy worthy the attention of the Prime Minister of this country, and too wide in its political and fiscal considerations to be dealt with effectually by any single department of the Government.

They, therefore, respectfully decline to adopt Mr. Gladstone's suggestion that they should address themselves to the Privy Council-office.

I have the honour to be, Sir,
Your obedient servant,
(Signed) P. Le Neve Foster,
Secretary.

W. B. Gurdon, Esq.

Mr. Gurdon to the Secretary.

10, Downing-street, Whitehall,
July 22, 1873.

Sir,—I am directed by Mr. Gladstone to acknowledge the receipt of your letter of the 18th instant, and to request that you will be kind enough to acquaint the Council of the Society of Arts that the intention of the reply to your communication of July 3rd was to point out that, in regard to a subject of the nature of that which you brought before him (viz., the beneficial action of the Bethnal-green Museum), which falls properly within the province of a department of the State appointed to deal with it, the First Lord of the Treasury could not take the initiative out of the hands of that Department.

This Mr. Gladstone would be doing were he to receive the proposed deputation; and he would be acting contrary to the rules of administration which are necessary for the conduct of public business.

If, however, the Society of Arts think fit to favour him with a written communication, Mr. Gladstone will himself correspond with the proper department concerning it.

I have the honour to be, Sir,
Your obedient servant,
(Signed) W. B. Gurdon.

P. Le Neve Foster, Esq.

The Secretary to the Right Hon. W. E. Gladstone, M.P.

Society for the Encouragement of Arts, Manufactures, and Commerce, John-street, Adelphi, W.C.,
6th October, 1873.

Sir,—The Council of the Society of Arts have directed me to reply to Mr. Gurdon's letter of the 22nd July, in which he states that, "if the Society of Arts think fit to place before you a written communication, you would yourself correspond with the proper department concerning it."

The deputation which desired to have the honour of waiting on you, and explaining in detail the objects of the memorial, would have stated that, in their view, the experiment of the Bethnal-green Museum is suggestive of the following points:—

1. That a general popular desire exists for such museums, and that it would be good national policy for the Government to encourage the establishment of them.

2. That, like primary elementary schools, it would be impossible that such museums could, without State aid and inspection, become part of a national system, aiding technical instruction and secondary education.

3. That this question, unfettered by any denominational difficulties, is quite ripe for solution; that the necessary expenditure for aiding museums of science and art would be advantageous from every point of view, even remunerative as respects commerce; and, further, would be auxiliary in promoting morality and social good order.

4. That such museums are absolutely necessary to the industrial progress of the country, which is behind other countries already in the possession of them.

5. That the time has come when it is necessary that all public museums and galleries of works of science and art receiving Parliamentary aid should be brought under an intelligible system of administration, controlled by a responsible minister of State, so as to render them auxiliary to the development of local museums and galleries.

The Council submit that these are subjects not only of general policy, but involve some new principles of administration, large financial considerations, the reform of old institutions, &c., which it is the province of the general Government, and not of any single department, to deal with. The Council especially desired that the answer they might receive should come direct from yourself as Prime Minister. They could not hide from themselves the knowledge they possessed of the several departmental difficulties which attended the opening of the Bethnal-green Museum, and that they had been made cognisant, through Parliamentary returns and the revised estimates for 1871-2, of the opposition which the Treasury, as lately administered, had persistently offered to carrying into effect the decisions made by her Majesty's Government in 1866, for conducting the Bethnal-green Museum.

The Council respectfully request you to have the kindness to bring this memorial before her Majesty's Government. They hope it will meet with favourable consideration and lead to decisive action; and they will feel obliged by receiving an answer upon it at as early a period as convenient.

I have the honour to be, sir,
Your most obedient servant,
(Signed) P. Le Neve Foster,
Secretary.

The Right Hon. W. E. Gladstone, M.P.

Mr. Gurdon to the Secretary.

10, Downing-street, Whitehall,
7th October, 1873.

Sir,—Mr. Gladstone desires me to acknowledge the receipt of your letter of October 6th, the contents of which he will not fail to make known to his colleagues.

I am, Sir, your obedient servant,
(Signed) W. B. Gurdon.

Pe Le Neve Foster, Esq.

SCHOOL DRILL.

The following correspondence has taken place on this subject between the War-office and the Secretary of the Society:—

The Secretary of the Society of Arts to the Right Hon. Edward Cardwell, M.P.

27th February, 1873.

Sir,—The Council of the Society for the Encouragement of Arts, Manufactures, and Commerce have instructed me to address you on the subject of the relations between the labour market and the military service of this country. It has appeared to them that these relations are intimately connected with the Arts, Manufactures, and Commerce of this country, and raise questions of high and growing national importance, whilst they apparently present increasing difficulties, both as respects enlistment and desertion.

The Council, therefore, believing that the cultivation of drill in schools was most desirable, have, during the last three years, instituted annual reviews of the district and other schools in and about the metropolis. The first review was held by H.S.H. the Duke of Teck, at the Crystal Palace, in 1870; the second by H.R.H. Prince Arthur, in the Royal Horticultural-gardens, in 1871; and the third by H.R.H. the Prince of Wales, in the Royal Horticultural-gardens, in 1872, the lads having been previously inspected by H.S.H. Prince Edward of Saxe-Weimar, in Hyde-park. At each review about 4,000 lads attended, and their discipline and manœuvres were highly commended by military authorities, and particularly by the late Field-Marshal Sir John Burgoyne, a copy of whose letter is annexed.

The Council believe that the difficult economic question involved in the due maintenance of the military force of this country would be beneficially influenced by the encouragement of drilling in schools. It appears to them that this healthy and useful exercise should not be limited to a few schools of a particular kind, but that it is most desirable that it should be introduced in all schools, for all grades of society, and should eventually be made compulsory, as in Switzerland. It is true that drilling is recognised in a negative way by the revised code of the Committee of Council on Education, but it does not appear to be sufficiently encouraged. And the Council of the Society of Arts venture to impress upon you that its due encouragement appears to them to be an especial function of the War Department with reference to recruits.

The Council venture to think that the time has arrived when reviews, such as they have held, might be extended to different parts of the kingdom, and placed under the direct administration of the War Department.

The Council desire me to express to you their thanks and feelings of satisfaction at the policy which you have announced of connecting the soldier with useful occupation during the period of his military service.

The Council further express a hope that you will agree with them that the evidence which may be obtained from other countries on this subject is worthy of investigation at the present time, and they direct me to inquire if you would be willing to name two military officers, to join with a Committee of the Society of Arts in investigating fully the connection of the military system of Switzerland with the industry of the people of that country, and report generally upon it.

I have the honour to be, Sir,
Your obedient servant,
(Signed) P. Le Neve Foster,
Secretary.

The Right Hon, Edward Cardwell, M.P., &c., &c.

Lord Lansdowne to the Secretary.

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Pall-Mall, 11th July, 1873.

Sir,—I am directed by the Secretary of State for War to acquaint you, for the information of the Council of the Society of Arts, that he has had under consideration the proposal that the reviews of schools in and about the metropolis, instituted by the Society, in order to encourage the cultivation of drill in those schools should be extended to different parts of the kingdom, and placed under the direct administration of this Department.

Mr. Cardwell understands that this proposal would involve, besides the cost of inspection, charges for conveyance, for refreshments, and for prizes, and he desires me to express his regret that there are no funds at his disposal from which such expenses could be defrayed; but he desires me to express his willingness to employ any means in his power to facilitate the object which the Society has in view, and to inform you that if any schools, or association of schools, of sufficient position and standing, who can show a sufficient number of drilled boys to make an inspection desirable, will apply to His Royal Highness the Field-Marshal Commanding-in-Chief for an inspecting officer, their request will be favourably considered.

I am, Sir, your obedient servant,
Lansdowne.

The Secretary, Society of Arts,
John-street, Adelphi.

The Secretary to Lord Lansdowne.

18th July, 1873.

My Lord,—I have the honour to acknowledge your lordship's letter of the 11th inst., No. $\frac{40104}{6}$, in reference to the review of school drill, as proposed in my letter of the 27th of February last.

The Council desire me to express their high gratification that their efforts to establish drilling in schools throughout the country should have received the approbation of the Secretary of State for War, and that he is willing to employ any means in his power to facilitate the object the Council have in view, though at present he is unable to comply with their wishes by reason of having no funds at his disposal for the purpose.

The Council, however, trust, and venture to urge, that Mr. Secretary Cardwell will be pleased to take steps, at the proper time next year, for placing the necessary amount upon the estimates, and seek Parliamentary sanction for the required expenditure, say £500 at least, for continuing the experiment in London.

I am to add that the Council propose to address the Lords of the Committee of Council on Education and the School Boards on the subject of introducing drill into schools. As the knowledge of this correspondence will be very acceptable to the members of the Society, I am to remark that, if there should be no objection, the Council propose to lay it before them.

I have the honour to be, my Lord,
Your Lordship's obedient servant,
(Signed) P. Le Neve Foster,
Secretary.

The Lord Lansdowne.

Lord Lansdowne to the Secretary.

Pall-mall, 16th August, 1873.

Sir,—I am directed by the Secretary of State for War to acknowledge the receipt of your letter of the 11th ult., on the subject of the introduction of drill into schools; and in drawing your attention to the communication from this office of the 11th ult., to inform you that while perfectly ready to fulfil the engagements therein undertaken, Mr. Cardwell cannot promise to make any special provision in next year's estimate for the object the Council have in view.

I am to add there is no objection on the part of the Secretary of State to the correspondence which has taken place on this subject being laid before the members of the Society. I am, Sir,
Your obedient servant,
J. C. W. Vivian.

The Secretary, Society for the Encouragement of Arts,
John-street, Adelphi.

The Council have appointed a deputation to wait on Mr. Cardwell on this subject.

INSTITUTIONS.

The following Institution has been received into Union since the last announcement:—

Quebec Institute, 15, Lower Seymour-street, Portman-square, London, W.

NATIONAL MUSEUMS AND GALLERIES, AND PUBLIC EDUCATION.

The Council have passed the following resolutions:—

1. That the undermentioned persons be invited to serve on a standing committee for the purpose of bringing under Parliamentary responsibility the national museums and galleries, so as to extend their benefits to local museums, and to make them bear on public education. The following are the several objects in view for effecting this purpose:—

2. All museums and galleries supported or subsidised by Parliament to be made conducive to the advancement of education and technical instruction to the fullest extent, and be made to extend their advantages to the promotion of original investigations and works in science and art.

3. To extend the benefits of national museums and galleries to local museums of science and art which may desire to be in connection, and to assist them with loans of objects.

4. To induce Parliament to grant sufficient funds to enable such objects to be systematically collected, especially in view of making such loans.

5. For carrying out these objects most efficiently, to cause all national museums and galleries to be placed under the authority of a minister of the Crown, being a member of the Cabinet, with direct responsibility to Parliament; thereby rendering unnecessary, for the purposes of executive administration, all unpaid and irresponsible trustees, except those who are trustees under bequests or deeds, who might continue to have the full powers of their trusts, but should not be charged with the expenditure of Parliamentary votes.

6. To enter into correspondence with all existing local museums and the numerous schools of science and art, including music, now formed throughout the United Kingdom, and to publish suggestions for the establishment of local museums.

7. Also to cause the Public Libraries and Museums' Act (18 and 19 Vic. c. lxx.) to be enlarged, in order to give local authorities increased powers of acting.

Proposed Committee.

Earl of Carnarvon.
Earl Russell.
Lord Elcho, M.P.
Lord Geo. Hamilton, M.P.
Lord Houghton.
Lord Lyttelton.
Sir Thomas Acland, Bart., M.P.
Sir Antonio Brady.
Sir John Lubbock, Bart., M.P
Right Hon. Sir Stafford Northcote, Bart., C.B., M.P.
Sir Wm. Thomson, F.R.S.
Sir S. Waterlow, Bart., Lord Mayor of London.
Sir Jos. Whitworth, Bart.
Right Hon. Sir John Pakington, Bart, M.P.
Right Hon. W. J. Henley, M.P.
Right Hon. Cowper Temple, M.P.
The Honourable Mr. Justice Grove.
Thomas Ashton, Esq. (Manchester).
E. A. Bowring, Esq., M.P.
Dr. Carpenter, F.R.S.

Henry Cole, C.B.
Montague Corry, Esq.
W. De la Rue, F.R.S.
E. B. Eastwick, Esq., M.P.
Gabriel Goldney, Esq., M.P.
Principal Greenwood (of Owens College, Manchester).
John Henderson, Esq., M.P.
Dr. Hooker, F.R.S.
C. Wren Hoskyns, Esq. M.P.
James Howard, Esq., M.P.
Prof. Huxley, F.R.S.
U. J. Kay-Shuttleworth, M.P.
George Melly, Esq., M.P.
S. Morley, Esq., M.P.
Dr. Mouat.
A. J. Mundella, Esq. M.P.
Prof. Roscoe, F.R.S. (of Owens College, Manchester).
Lyon Playfair, Esq., C.B., M.P.
Hodgson Pratt, Esq.
Prof. Ramsay, F.R.S.
C. Seely, jun., Esq., M.P.
Colonel Strange, F.R.S.
E. Thomas, Esq., F.R.S. (Athenæum Club).
George Trevelyan, Esq., M.P.
Thomas Twining, Esq.
Professor Tyndall, F.R.S.
G. W. Ward, Esq. (Nottingham).
Prof. Williamson, F.R.S.

Also the heads of the City Companies for the time being.

Also the Chairmen of Local Committees of Schools of Science and Art, and of Local Museums Committees.

Also the members of the Legislature who signed the Bethnal-green memorial.

In absence of Chairman of Council for the time being, Lyon Playfair, Esq., C.B., M.P., to be requested to act as Chairman of the Committee.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The continuation of the fifth lecture of the third course of Cantor Lectures for the Session, "On Wines; their Production, Treatment, and Use," was delivered by J. L. W. Thudichum, Esq., M.D., on Monday evening, May 19th, 1873, as follows:—

Lecture V.

(*Continued from page* 897.)

The effervescent wine, which, from the country of its origin, is termed Champagne, is one of the most essentially French discoveries or inventions. It is made mainly from the same grapes from which Burgundy wine is made, particularly from the black pineau. This sometimes surprises persons who learn the circumstances for the first time. It is, therefore, well to mention that the juice of the pineau is colourless, like that of white grapes generally, and remains colourless if separated quickly enough from the coloured husks. The colouring matter is thus shown to be insoluble in the juice; but when the juice has fermented, it easily dissolves the colouring matter, and red wine, like red Burgundy, is the result. For this reason, all coloured Burgundy is fermented with the husks, like all coloured still Champagne, whereas all colourless, *i.e.*, white Burgundy, all white still Champagne, and all effervescent Champagne, is fermented after complete separation from the husks. The culture of the pineau vines in the Champagne may be termed viticulture by constant rejuvenescence. The vines are every three years sunk into the ground, and one year's wood only is allowed to project from the ground and form the new vine. This gives to the Champagne vineyards the aspect of constant youth, and much of the character of the vine is, no doubt, determined by this peculiar mode of growth. The vintage in the Champagne is the most cleanly harvesting operation which one can wish. Every bunch of grapes is carefully cut, and sent through a cleaning operation by practised hands, so that it contains only sound and ripe berries, and a minimum of stalk. If other wine-making people would take a lesson from the cleanliness of the practices in the Champagne, it would be a great advantage to their products and to wine-drinkers. Carrried in panniers, on donkeys and mules, the grapes arrive at the cleanest of press-houses, and are immediately subjected to pressure in the cleanest of presses. They are not previously disintegrated by such processes, as treading or passing through crushing rollers. The presses are therefore very powerful instruments, surpassing all other wine-presses in efficiency. The must which flows from them is tasted from time to time, and only those portions which are suitable are retained for champagne; those portions which are rough from admixed juices of husks and stalks are kept apart. The selected must is now freed from gross impurities by a process of subsidence, and is then filled into barriques to undergo the first fermentation. In ordinary years the whole of the sugar is fermented, and yields about 8 or 9 per cent. of alcohol; but in very good years a small quantity of sugar escapes this first fermentation, and remains in the wine, to yield, by a second fermentation in the bottle, the effervescence which is desired. The wine which has lost all its sugar in the first fermentation, requires therefore an addition to it of sugar before it can acquire the mousse in bottle. It will therefore be seen that two fermentations are required in the production of mousseux wine; one in cask, to decompose the bulk of the sugar, and produce alcohol, or rather wine, and one of the young wine in bottle to produce effervescence.

The particulars of the steps which lead to perfect mousseux are interesting, and capable of accurate appreciation from a scientific point of view, as we have shown in the repeatedly-quoted treatise. Great care is bestowed upon the clarification of the young wine by means of isinglass, previous to its being drawn into bottles. Then the acidity and sugar of the wine are carefully adjusted, so that it shall contain exactly two per cent. of unfermented fermentable sugar. The qualities are mixed so as to produce large parcels of wine of uniform quality. This sweet wine, termed clairet, is now filled into the ordinary bottles and corked, in the manner in which we see the champagne corked when it is quite ready for use. The bottles are stacked in rooms of rather a high temperature, and begin now to ferment. This is observed by the fact of the wine becoming turbid, and by the breaking of a few bottles here and there, with some report of an explosion. When this stage is reached, the bottles are carried to a cooler cellar, when they complete their fermentation and deposit the yeast. When the wine has become quite clear again, and all the yeast is collected on the side of the bottle, the latter is so manipulated that all the yeast settles in a small lump upon the cork. This has now to be removed from the bottle by a skilful operation, termed "disgorging." The wires and strings which hold down the cork are cut, and the cork is allowed to be expelled by the internal pressure, together with all the yeast and impurity. The loss of wine caused by this is filled up with some clear wine, and the wine is now sweetened by the addition of a solution of sugar, commonly termed liqueur. For the wine, when disgorged in the effervescent state, is what is termed quite dry—that is to say, not in the least sweet, but tastes rather rough and unpleasant, from the mass of carbonic acid dissolved in it. The liqueur which is used is most commonly a saturated solution of sugar-candy in old mature good wine, and nothing else. For common wines more complicated liqueurs are made, with wine, sugar-candy, some brandy, and some flavouring materials. The quantity of liqueur introduced varies between 10 and 28 centilitres per bottle of about 80 centilitres. For special dry champagne, such as is preferred by some consumers in England, a lesser per-centage is taken. Chemical analysis of finished champagne shows us that it contains from 5 to 8½ per cent. of sugar. The wine thus cleared and sweetened is again corked, and wired, and stringed; the bottles are washed, labelled, and covered with tinfoil, to preserve the cork from mould and insects, packed in boxes or baskets, and sold to the consumers.

[This part of the lecture was illustrated by the performance before the audience of the whole of the operations described; bottles with the deposit were exhibited, then disgorged, adjusted, liqueur was added, and all the subsequent operations performed to prepare the wine for use. This demonstration was made for the lecturer by M. Mandart, cooper, of Crutchedfriars, London, in the usual manner, and with all the approved apparatus and machinery as used in the first establishments in the Champagne. The wines in the various stages of brut or dry, of sweet or finished, or liqueured, and the liqueur itself were tasted by many persons of the audience. Many varieties of finished champagne, from cheap qualities to high-priced cabinet wines were also exhibited by the lecturer, and tasted by the audience at the conclusion of the lecture. The same was the case with regard to Bordeaux and Burgundy wines, of which common as well as selected, or classified, high qualities were exhibited as illustrations, and tasted by many persons of the audience.]

It has thus been demonstrated to you, that the manufacture of champagne, though theoretically simple, is nevertheless a complicated mechanical operation, requiring above all cleanliness, skill, good taste, capital, and good cellars. Indeed the skill which is brought to bear upon the manufacture of this attractive beverage always excites my most unbounded admiration. So do the cellars which the people of the Champagne have dug in their chalk rocks, like so many huge natural caverns. In these labyrinths there reigns an ever-equal temperature, and the wine is therefore never disturbed by fluctuations of temperature, so that by this absolute repose it attains that brilliancy which is the main cause and condition of its stability after disgorgement. But champagne, too, has its accidents, for it is subject to those unfavourable changes caused by fungi, which are termed diseases. The most dangerous and common disease used to be viscosity or ropiness. Against this disorder the manufacturers have now an almost certain prevention, in the various forms of tannin, from nut-galls, from catechu, or from grape-husks and kernels. This remedy was given to them by M. François, a scientific chemist, of Rheims; and so universal has been its application and success, that viscous champagne is now scarcely ever heard of or met with. There are some persons and writers of a certain class who denounce this addition of tannin as an adulteration, and endeavour to make champagne ridiculous or disliked by describing it as a cooked, liquored, brandied, sugar-candied, tannified, &c., compound, indeed, as the most execrable and unwholesome drink that the world has ever seen. I warn you to be on your guard against these publishing sophists. They denounce sherry, port, hock, and champagne all in no measured terms, and in a manner which shows their almost comical want of information as regards these wines, and while so denouncing them, sell them, nevertheless, to anyone who will buy them from their shops. You recognise them easily by the panacea which they propose for all the evils inflicted by all the favoured wines, namely, the recommendation of Greek and Hungarian wines. These latter alone are pure and natural, say these sophists, all other wines are impure and unwholesome, or the products of fraud. It is not necessary for me to expose in detail the groundlessness of these accusations, and the hollowness of these recommendations. They have been practically judged by the disastrous commercial results of their operations, and the verdict of the public. All the newspapers in Christendom, even though led by the London *Times*, will not succeed in persuading people that Greek and Hungarian wines are better than champagne and sherry. The wines of Greece and Hungary have merits of their own, but they cannot be made evident by declamation and unmeasured abuse of established beverages. I must here also allude to the attempt which some of these people have made to throw blame upon Dr. Dupré and myself, for having in our treatise described the methods of making second wines, according to the processes of Petiot and Thénard, and of improving the wines of unfavourable years, according to the processes of Chaptal and of Gall. As regards second wines, they have been made, and are made, annually in large quantities in all wine-producing lands. Thus, in Spain, water is poured on the murk, and the fermented product, termed "agua de pie," is drunk in some parts, distilled in others. In the Alto Douro this agua de pie yields a wine rising in its alcoholicity to 6 and 7 per cent. (Viscount of Villa-Major, in his report to the Portuguese Government), and constituting the drink of the labourers on the estates (pipa do lavrador). In the whole of the Sauterne district the workpeople make such wine, and drink it with pleasure and benefit. In the Champagne and in Burgundy, such wine is made, and consumed by those who make it (piquette). The Italians have it, and term it "piccolo." In Austria and Hungary it passes by the name of "hansel," which in English would be "Johnny," or wine which is the drink of the typical servant class. Now Petiot's process consists in nothing else than in the addition to the water used in this process, of a certain quantity of pure cane-sugar, in order somewhat to increase the alcoholicity, and bring it near to that of first or natural wine. The objectors are very angry that such wine is better than the mere piccolo, or small wine, made with water only. But no one can relieve them of the fact; and the workpeople prefer the sugar-water wine to their former water-wine; and, as Professor Nessler, of Karlsruhe, has shown, they prefer it to any natural first wine which can be bought for the same money. Why, indeed, should the application of sugar to the increase of the quantity of wine be not just as justifiable as the application of sugar to the increase of the quantity of beer? Millions of pounds of sugar (both grape and cane sugar) are annually used in breweries in this country, and it is difficult to object to the practice, for the vast improvements in the production of beer in late years are mainly due to this judicious introduction of sugar as an element of brewing. Now, as regards the processes of Gall and Chaptal, I consider it perfectly ridiculous to raise any opposition to them, for they are absolutely needed in bad years, even in good viticultural situations, and are no more hurtful or objectionable than the processes by which alcohol and acid are adjusted and determined in beer. What, indeed, is the viticulturist to do with wine which is good in every respect except that of being too acid? Does anybody expect that he will be inclined, or even able, to cast it into the gutter? Has such wine not for centuries been made drinkable by chalk and potash, and many other agents? And is it reasonable to censure a process which puts these heterogeneous agents aside and applies homogeneous agents to the must for the correction of its faults?

Considering all this and many other points on which time forbids me to dilate, I must warn you against those sycophantic declamations of persons who try to profit by virtuous professions. I happen to know their practices, and am able to state that they are the same as the worst I have witnessed in the course of my inquiries. They plaster, colour, dye, and boil; they chalk, potash, and tannify; they flavour, mix, and, in short, treat in all the old-approved fashions their own wares, and ultimately misrepresent them perhaps more than those of other people. But all this need not frighten any sensible man. I do not believe that as much as a single cask of Petiotised or Gallicised wine has ever been imported into England. I have never seen or tasted any. These wines have their own spheres amongst the populations which produce them, and are not articles which have a future in the shipping trade—for no art can ever compete with nature for quality and price. The cheapest wines and the best will always be the most natural ones, provided that science helps the producers to preserve them from the beginning. No artificial product, made with the aid of crystallised sugar, can ever be so cheap as natural must at the vineyard. When the English public shall have become acquainted with this fact, and have taken the trouble to get prepared rationally, and brought to England the wines with which, for example, Spain is overflowing, then this fictitious fear of artificial wines will come to an immediate and necessary end.

THREATENED SUPPRESSION OF THE SOUTH-KENSINGTON MUSEUM.

To the Secretary of the Society of Arts.

Sir,—I request you to print, in the Society's *Journal*, the address which I delivered on 20th Oct. to the students of the Hanley School of Art; and I beg leave to ask my fellow-members to read it, and to help me to avert the suppression of the South Kensington Museum.

The Government, before the late change in the Chancellorship of the Exchequer, proposed to effect this suppression by destroying the individual Parliamentary responsibility of the management, which had successfully created the museum, and to substitute the irresponsibility of a Board of fifty trustees of the British Museum, a principle of management now exploded. The members of the Society have an especial interest in the maintenance and progress of this museum. It specially aids the great work of the Society in promoting Arts, Manufactures, and Commerce. It is the useful offspring of the Great Exhibition of 1851, which could never have come forth without the essential help given by the Society of Arts. They assemble in it in thousands once in the year as their festival.

I ask the Council to allow a meeting of the Society to be called, to request the Government at once to abandon this project.—I am, &c.,

Henry Cole.

Oct. 24, 1873.

Art Students of Hanley,—In competition with 122 schools of art in the United Kingdom, your school has the proud distinction of ranking fourth in merit, according to the figures given in the annual report of this year. This eminent position is due to your good works, based upon a comprehensive and national system of science and art applied to productive industry, the establishment of which the nation owes to the wise foresight of the late Prince Consort. That system provides for the instruction in science and art of all classes of the people and grades of society, offering to all different steps of instruction, in schools elementary and special, in the circulation of examples, and in public museums, forming an essential part of the whole. The system, although allied with State aid, is a purely voluntary one. It has now existed for twenty years, and has taken root in the country and in the colonies; it is imitated in Europe and the United States. The demand of the people for this instruction in science and art has increased annually, until it has now reached the cost of about a quarter of a million a year. And this annual increase, which affords an index of the public desires—as Mr. Lowe told the House of Commons, before he was Chancellor of the Exchequer—is "the great merit of it."

I propose to take this occasion to show you how great is the debt of gratitude due to the Prince Consort, and to put on record my personal knowledge of his labours for public instruction in science and art. I shall connect with them a short history of the working of the present system of science and art instruction since your Hanley school was first established. The school was founded in 1847. The average number of students was sixty-seven only for the first five years. There were at that time only twenty local art schools, most of them oppressed with debt and difficulties. There was no elementary drawing taught in schools for the poor, and no public attempts at scientific instruction. There were no training schools for teachers in either art or science. The total number of pupils in all the art schools did not exceed five thousand. There were no museums of an industrial character and aim. The Great Exhibition came in 1851. The Prince Consort, the founder of that work, was also its commander-in-chief. He won not only with brilliant success that great battle against popular prejudice and ignorance, but converted the enemies of science and art into friends. I recollect Sir Robert Inglis coming up to me in the glass-house in Hyde Park. He grasped both my hands, his fine, venerable, monastic face blushing like a peony, and said, "This is a work to thank Heaven for! I confess I opposed the idea. I opposed the building in Hyde-park, but now I make my apology." Please to remember Sir Robert was the staunchest of Tories. He was called in the House of Commons "the member for heaven." He stood up against Catholic emancipation; he voted against the Reform Bill, and for the boroughs of one vote; he voted for the Corn Laws; he beat the drum ecclesiastic loudest of the loud. He was never known to alter an opinion, but he did alter his opinion once, and about this Exhibition, and he became a staunch friend to it, and welcomed its results in promoting the diffusion of science and art.

The exhibition made Prince Albert (not then called Prince Consort) alive to the urgent wants of his adopted country for better technical instruction. At the close of the exhibition, he persuaded Lord John Russell, the Prime Minister, to authorise an attempt to reform the schools of design. Hanley was then called a school of design; and, in 1852, Lord Granville, then Vice-President of the Board of Trade, invited me to give up my duties in the Public Record Service, and to try for a year what I could do with the schools of design. The Department of Practical Art, accordingly, was founded. In a month or so after my appointment Lord Derby became Prime Minister for the first time; and Mr. Henley, my immediate chief, was his President of the Board of Trade. Prince Albert enlisted his sympathies with science and art instruction. One of my first recommendations, which it was my duty to submit to Mr. Henley, was that the artisans of the country should be offered help in learning geometrical drawing, and that small prizes should be given for success. Adam Smith had made the same suggestion a century before, but it had never been acted on. So little was the subject understood that Mr.

Porter, the statistician, then the secretary of the Board of Trade, opposed my advice. "He did not think it the duty of the State to help carpenters to learn geometrical drawing." Mr. Henley decided the contrary; he did think it the duty of the State, and there are now thousands of artisans besides the students of the Hanley school who have to thank Mr. Henley for his sagacious decision. During this year, at the instance of the Prince, the Queen graciously consented to allow the department the use of Marlborough-house as the head-quarters of the new system. Her Majesty and the Prince lent objects of priceless value as specimens of industrial art. The finest collection of Sèvres porcelain ever shown to the public was obtained from the Queen's stores in the several Royal palaces. The Prince interested himself to secure the Bernal collection, and succeeded in obtaining about a fourth part of it for the country. When the Government—not yet trained to know what majolica was—declined to purchase the Soulages Collection, the Prince headed a private guarantee fund with a thousand pounds, and the collection was at last secured to this country. The late Marquis of Salisbury cut through all red-tape difficulties in the purchase, and Mr. Lowe, in 1865, stoutly defended the purchase against the Treasury and Audit-office.

The time approached for resigning Marlborough-house for the Prince of Wales' use. Prince Albert persuaded Lord Palmerston to submit an estimate to Parliament for erecting the temporary iron building at Kensington, called the "Boilers," and the new collection of ornamental art and offices of the Science and Art Department were removed there. A year or two before this event Lord Aberdeen's Government, at the Prince's suggestion, enlarged the Department of Practical Art into one for Science and Art, and Mr. Cardwell appointed Dr. Lyon Playfair, who now represents so well in Parliament the University of Edinburgh, to organise the science branch. The country has greatly to thank the late Marquis of Salisbury and Sir C. Adderley—one of the members for your division—for the earnest aid they gave in founding the present science organisation. South Kensington thus became the centre of Science and Art instruction throughout the United Kingdom.

You must allow me to contrast the working of such instruction in 1852 with that now going on. I will take Art first, as the elder branch. In 1852 there were only 20 art schools, with 5,000 students, paying £2,600 in fees; now there are 122 schools, with 22,800 students, paying £24,800 a year. Hanley school had only an average of 70 students, paying £45 a year; now it has 214, doing more and infinitely better work, and paying £138 a year. There was no teaching in schools for the poor, now there are 194,500 children taught drawing. There were no night classes for artisans, now there are 538 classes, with 17,200 students. My able colleague, Mr. Richard Redgrave, has given essential assistance in securing these results. As respects Science, there were no Science schools or classes before 1854, now there are 948, with 36,783 students, and I must say this result is greatly due to the ability of Major Donnelly, who is the youngest man I know with the oldest head.

I must state briefly a few facts about the South Kensington Museum. The nation obtained the ground on which it stands for one-fourth its present value, through the influence of the Prince Consort. The Natural History Museum now at last erecting to the west of the Kensington Museum, is on ground obtained at a third its present value, through the Prince's labours. In the year 1872, the South Kensington Museum itself was visited by upwards of 1,156,000 persons. I call that something like a pilgrimage; its art library was used by 19,750 students; its educational library by 15,360 persons—clergymen, teachers, and others interested in elementary education, coming from all parts of the country to consult it. The museum circulated, without accident, to local exhibitions, upwards of 5,400 paintings, objects, diagrams, &c., which were visited by more than 604,000 persons. It lent to local schools of art for study upwards of 1,300 objects, and 2,100 books, prints, &c., relating to fine arts. I will not trouble you with accounts of the successful working of other museums, in Dublin and Edinburgh, all branches of the Science and Art Department, but I must say that the country's thanks are due to Lord Granville, to Mr. Disraeli, to the Duke of Buckingham, and the Marquis of Ripon, for the museum in Bethnal-green, which was opened in state by the Prince of Wales, to the great gratification of the hard-working people of that poor, unfashionable district, which had not seen royalty for two hundred years. This museum has been visited by more than a million of persons in the first year. No accident has occurred, and the East-end has been quite as well behaved as the West-end.

I recommend Hanley to go and study what Nottingham is doing in founding a permanent museum for its town. Let the corporation of Hanley go and do likewise for the Potteries, with the co-operation of the other boroughs. Each borough cannot have a good museum; but there could be a splendid central one. Last week the Nottingham Town Council determined to have its municipal museum.

People are still apt to look at Museums as mere collections of things "rare and curious," things for learned people only, for rich people only; for dillettante only. Prince Albert and his followers looked at them from a very different point of view—the point of view of Science and Art applied to productive industry. What does the architect do who wants to learn his profession? He looks at buildings. What did Flaxman do when he applied himself to pottery? He studied Greek pottery. What did Herbert Minton do to get a rank for his manufactures, which compete successfully with Sèvres? He collected and studied the master-pieces of Sèvres. Why is Mr. Phillipps, the jeweller, trusted to set jewels with good taste? Because he studies the ancient and mediæval models. What gave Pugin his reputation for Gothic metal work but his study of mediæval models? What has created a trade in majolica in this country but the Soulages collection? What has given the Craces, and Jackson and Graham, and Gillows, and Hollands, &c., their reputation for art furniture, but their knowledge of ancient examples? It is simple savage ignorance, and priggish pedantry, not to recognise the absolute necessity of examples of art, easily consultable by by the public, who are consumers; by the manufacturers, who are producers; and by artists and artisans, as students. Where are they to consult them, if not in Public Museums? Why is the Frenchman more apt in industrial art than the Englishman? Because, for a century he has had his Museums in Paris and every large town free to him; and public Museums are necessary for science as well as art. The collection of diagrams, of educational apparatus, and of specimens of natural history, are indispensable to the managers of schools and teachers. Where is there any collection, except in the South Kensington Museum? Why does the Admiralty have a museum of the models of ships? Do you think mechanical science would be in the state it is, if our engineers could not consult the examples of their predecessors? The fact is, that if museums are not educational, but are only peep-shows, and monopolised by the few extremely learned men, they are of a very limited value.

It now becomes my painful duty to tell Hanley and all the schools of Art and Science in the United Kingdom, that this organisation, so wisely instituted and bravely fought for by the Prince Consort, which has already borne fruits greatly prized by the nation, and imitated by foreign nations, and is so indispensable for the progress of this country, commercially, socially, and morally, is now in great jeopardy. The Government, as constituted in last August, a little mesmerised and much garotted, had it in contemplation to make changes which were directly opposed to the further development of the present Science and Art system, and to the beneficent spirit of all the aims and labours of the wise Prince who had started it.

The Science and Art Department has hitherto won its position and flourished under the inestimable advantages of a management which insured individual Parliamentary responsibility. In different ways the Department has had the sympathetic support of statesmen of all political parties—of Mr. Labouchere (afterwards Lord Taunton), of Mr. Henley, of Mr. Cardwell, of Lord Stanley of Alderley, of the Marquis of Salisbury, of Earl Granville, of the Duke of Buckingham, of the Duke of Marlborough; so it had of the Marquis of Ripon,—but I say with deep sorrow he succumbed to a malevolent influence before he resigned office. I even believe that the evil spirit drove him out of office. He is succeeded by Lord Aberdare, who took an intelligent interest in the South Kensington Museum when he was Vice-President of Education. I appeal to him to continue its friend.

Manufacturers of Hanley and the Potteries well know what business is, and that nothing but muddle and bankruptcy follow where there is no individual responsibility. Are you not surprised to learn that it was actually contemplated that the culminating point of the Science and Art system, and its necessary complement, the Kensington museum, was to be dissevered from that system, and placed in the had in the hands—of whom? Can you guess? His Grace the Lord Archbishop of Canterbury, the Lord Chancellor, the Speaker of the House of Commons, the Bishop of London, —(why not Archbishop Manning and Dr. Cumming, and Mr. Spurgeon as well?)—the First Lord of the Admiralty (not sufficiently engaged in inventing *Devastations*), the Lord Chamberlain, the Home Secretary, the Colonial Secretary (with the Ashantee war on his hands), the Indian Secretary, the Lord Chief Justice of the Queen's Bench, also of the Common Pleas, the Attorney-General, (hardly recovered from his Tichborne labours), the Solicitor-General, the Master of the Rolls—not having lots of leisure—besides some thirty others of the highest distinction, well worked with other business. You will ask why burthen that most excellent, over-worked prelate, the Archbishop of Canterbury, whom I respect much, with the additional work of settling if Hanley School of Art should or should not borrow a tea-cup or dish as a pattern from the Kensington Museum? Or if any particular object should be bought for its use, and what price should be paid for it? Why was this proposed? Because a hundred years ago the Archbishop of that day was named by an Act of Parliament to see that a lottery was fairly drawn, which lottery was to be the means of raising the wind to establish the British Museum. That immoral lottery created the Archbishop, and Chancellor, and Speaker trustees, to see fair play, and now they have grown to a corporation of about fifty trustees. In simplicity and doubt, you will ask, are fifty trustees the proper administrators of public money to the extent of hundreds of thousands a year for Science and Art? Would the Potteries trust these fifty great men to get them 20, or even 10 per cent. profit on their pottery wares? I think not. But what said the present Duke of Somerset, and Lord Canning, afterwards Governor-General in India, and Lord Houghton, and Joseph Hume, in 1850, who then were Royal Commissioners to inquire into the way in which these Churchmen, these lawyers, these Ministers, &c., had performed their duty as trustees of the British Museum? "On the whole," says the Duke of Somerset (the present duke, whom they have muzzled by making him a trustee, &c.), "the conclusion has been forced upon us, that the mode in which the trustees have exercised their functions of government in the Museum has not been satisfactory." Mr. Gregory (whom Mr. Gladstone has sent out as Governor of Ceylon) assured the House of Commons in 1859 that the British Museum was "in hopeless confusion; valuable collections wholly hidden from the public, and great portions of others in danger of being destroyed by damp and neglect." In 1866, the *Edinburgh Review* said:—"The state of the collections is a national disgrace. An overcrowded building, most unsuitable for exhibition, most unhealthy to visitors, and destructive to many objects from insufficient ventilation; ill-cared for and ill-lighted; specimens of sculpture disfigured with dirt; specimens of natural history crowded in cases which are not dust-tight, and sluttishly neglected; labels wanting—throughout an air of sleepy, slatternly shabbiness."

I think I can make you best understand what would be the working of the proposed change, by showing you what now happens to a Hanley student who comes up to London to visit the British Museum and the South Kensington Museum. We will suppose that he comes up to town towards the end of the Christmas holidays. He arrives at Euston Station. No railway terminus is within a mile of the British Museum, so he has to take a cab, or walk. He goes there on a Tuesday. He finds the gates closed. He asks for admission. He is told that the Museum is not open on Tuesdays, except to a party of fifty. "Oh," says the student, "perhaps you will allow me to wait and join the party." "Nothing of the kind—you are no party of fifty, and can't be admitted." "Please, sir, may I come to-morrow?" "No; to-morrow is the beginning of our washing-up week." "Then can't I enter for a whole week?" "No; it's our general wash, and we shall be in the thick of soap-suds and steam." The student waits until the washing days are over, and presents himself on a Saturday morning, at ten o'clock, when he is told there is no admittance till twelve. At last he gains admittance. Looking like a "young man from the country," he is made to sign his name in a book. The policeman looks at him well and puts his mark in a book to count him. He finds, notwithstanding the washing, that the museum looks very dark, and smells very fusty. Being a plumber and glazier by trade, and interested in windows, he perceives that there are no adequate arrangements for opening the windows and for ventilation. He passes through the statue galleries, but cannot see many of the objects for want of light, and does not understand the labelling, as he has not been taught Latin and Greek. He wishes to look at some etchings of ornament, and rings a bell at the print-room door, where he is told he must get a special permission, so he cannot enter now. His brother, being a working jeweller at Sheffield, and having read Mr. Lowe's speech at the last Cutlers' feast, which informed him that the Treasury had spent several thousand pounds in jewellery, he makes an effort to see it, but fails altogether. He is sent from passage to passage, to find out where it is. He is made to ring a bell, and is finally told that he must apply to the learned keeper, who is not to be found, and whom he has not the honour of knowing. His son Tom, being something of an entomologist, he wanders about for an hour or so on a commission to find the insects, which, as well as most of the specimens of natural history, are imperfectly labelled, and many of them so crowded and dusty that he cannot see them properly. By this time he has caught what is well known as the "museum headache," so he seeks for refreshment. He descends to the vaults of the building, there to find that he cannot get any, because the trustees have given up that business. Mr. Melly, his member, had given him an introduction to Mr. Winter Jones, to obtain an admission to the reading-room, but he found he had left it behind him, and so he could not get admission. Now, let me contrast these antiquated obstructions with the facilities which the Hanley student will find at the Kensington Museum. He comes up by the railway from Hanley, not to Euston, but to South Kensington Station, which puts him down within some 200 yards of the museum. He finds the place open every day in the week at ten o'clock. It is never closed for cleaning and repairs. I could tell the Archbishop the secret how to do it, if his Grace really desired to do the work. Three days it is open until ten at night. (Mr. Panizzi would have done the same for the reading-room at the British Museum, but the Archbishop and the forty-nine trustees prevented him.) The Hanley student is counted in by a turnstile. He is not called upon to sign his name or to give up his umbrella. If his wife and the baby are with him, baby is even admitted. Being an art student, he can consult the Art Library and Educational Library by showing his ticket, and he gets admission for a week for sixpence. He can draw any object he sees. He finds every object labelled, and is told what the nation has paid for it. He finds chairs and benches in plenty to sit upon. He can eat when he pleases. Even princes and princesses are glad to come to the refreshment room. He can wash his hands when he wants to do so. He finds the light perfect for the pictures, &c. Appropriate, new, and unobtrusive decoration, the work of his fellow-students, he may find everywhere. The clean mosaic and tile floor contrast favourably with the dusty, brown-paper coloured stone and wooden floors of the British Museum. The buildings are cool in summer and of equal warmth in winter. He can breathe freely and gets no headache. He can look freely at the jewellery and the priceless gems lent by the Duke of Marlborough, the Duke of Devonshire, or Mr. Beresford Hope, without disturbing or boring a very learned keeper. The spirit of the place has always sought to attract the public, its paymasters, to come as often as possible, and give them a hearty welcome.

Hanley students! Art and science students throughout the country! I appeal to you. Are you going to permit this work of the Prince Consort's—matured and organised with great attention and the labour of years—to be destroyed, and this insult to his memory to be perpetrated? Will you suffer the means of your own instruction to be taken away, or muddled with old world-decaying notions? If my opinion, based upon fifty years' official experience, be worth anything, I publicly and with confidence assert that the project is impracticable, and if attempted must fail. If I know the feelings and common sense of the nation, it will not stand it, just as they would not stand the Zanzibar Contract or the Match-tax, and other errors of a similar source. I call upon you all to tell your wishes in a constitutional voice to your representatives in Parliament, to urge them to protect your best interests and rights, and this national property, from unprincipled invasion and threatened indignity, and I offer to you, and all interested in Science and Art instruction, my humble services, if I can be any use during the rest of my life, to preserve from the hands of the ignorant spoiler your privileges, and the institution which the Prince Consort founded.

The first consignment of Queensland sugar, made with a view to test the English market, was brought to auction on Friday last, by Messrs. W. Anderson and Co., at the London Commercial Sale Rooms, and partly disposed of, the prices realised being considered satisfactory. The sugars sold were from the Government establishment on the island of St. Helena, Moreton Bay.

There is said to be enough iron ore in the neighbourhood of the Black River Falls, Minnesota, to supply the whole demand of the United States for the next ten centuries. The State geologist is authority for the statement.

The telegraph is making rapid strides in South America. It is expected that in September, Valpariso, Santiago di Chili, Buenos Ayres, Montevideo, Rio de Janeiro, Bahia, and Pernambuco, will be linked together by wires.

It is proposed to enlarge the St. Philip Canal, at the outlet of the Mississippi River, at an estimated expenditure of 12,000,000 dollars.

ANNUAL INTERNATIONAL EXHIBITIONS.

The following rules have been issued by her Majesty's Commissioners for the preparation of diagrams of ancient and modern buildings of all countries in Division II., Class 9 (civil engineering), architectural and building contrivances, of the Exhibition of 1874:—1. The diagrams should be of a bold scenic character. 2. They should be executed on canvas, and may be in oil colour or distemper. 3. They may be executed in colours or in monochrome. 4. They should be perspective views. 5. Each diagram should be at least 5 feet by 10 feet, but single diagrams ought not to occupy more than 10 feet in height and 20 feet in length. 6. Each diagram should be attached to a roller, and sent rolled. 7. The scale should be clearly marked upon each diagram. 8. Her Majesty's Commissioners would be glad to have the right of purchasing the diagrams, if for sale, at the prices attached to them.

EXHIBITIONS.

RISE OF INTERNATIONAL EXHIBITIONS.

The following sketch of the growth of exhibitions is taken from the Philadelphia *Centennial Chronicle*:—

"The taste for public exhibitions has ever been the evidence of the industrial and commercial activity of a people. If we turn back to ancient history, we find that the great wealth of the cities of the Mediterranean was due to the fact that the bazaars of Tyre and Carthage brought together, through commerce, the wonderful riches of the then known world. At a later period, Rome, after having conquered many peoples, desiring to assimilate them under the dominion of the Cæsars, commenced public exhibitions, at which were brought together the different productions of the globe, comprising precious stones, pearls, rare woods, steel armour, crystals, amber, embroidered cloths, and other objects of value. After the invasion of the Roman Empire by barbarian hordes, this industrial chain was broken, to be taken up again in the Middle Ages; for the great fairs held at Leipzig, Nijni Novgorod, &c., were certainly national exhibitions. In Italy and France, county and town fairs have been held for many years; and these all go to prove that, as the cause of civilisation advances, so does the desire for public exhibitions.

At a later date, 1699, an exhibition was held in Leyden, which, among other curiosities, contained a Norwegian house built of beams, side by side with a mermaid's hand, a crocodile, a Roman lamp, a Persian pipe, Arabian jewels, Chinese paper, Egyptian linen, &c., &c. In 1756 and 1761, prizes were offered by the Society of Arts in England. France in 1797, founded the first of her national fairs, at which were 110 contributors. The second took place in 1801, with 229 exhibitors.

"This was specially an International Exhibition, and due to the efforts of the French Government; for the Minister of the Interior issued a notice inviting the contributions of other nations, and stating that prizes would be given, particularly, however, to inventors in improvements in wool machinery. For the purpose of securing greater perfection in this machinery, the exhibition was postponed for some months. Special committees of experts were formed in each department of France, who made the selection of those articles of manufactures and practical inventions deemed worthy of a place. This exhibition was held in the Grand Court of the Louvre. The report of the jury is very interesting, indicating, as it does, the appreciation then held by practical men of the value of these exhibitions, as follows:—'There is not an artist or inventor who, once obtaining thus a public recognition of his ability, has not found his reputation and business largely increased.' Special attention was paid to the cost of each article, and the best means of diminishing that cost, to the advantage of all concerned. The parties receiving the gold medal on this occasion dined with Napoleon, then First Consul. These exhibitions were kept up for several years, as follows:—The third was held in 1802, with 540 exhibitors; the fourth in 1806, with an increase to 1,422; the fifth in 1819, with 1,663; the sixth in 1823, with 1,648; and others in 1827, with 1,795; in 1834, with 2,447; in 1839, with 3,281; in 1844, with 3,960; and the eleventh in 1849, with 4,494 exhibitors.

"In Great Britain, exhibitions were held at London by the Society of Arts in 1846, 1847, 1848, 1849; at Cork, in 1852; and at Dublin, in 1853. The results of 1819 and 1844 were so very satisfactory, that in 1849 the English Government became much interested, and the first steps were taken for the International Exhibition of 1851. This, the first of the really great exhibitions, was visited by 6,039,000 paying visitors, there were 13,937 exhibitors, and the receipts were over 2,500,000 dollars, with a balance after paying expenses of over 1,000,000 dollars. As an evidence of the attention given, and the effect upon the minds of able and experienced judges, of the advance shown by our own country at that exhibition, the following extract is taken from the report of the French Commissioners; first making reference to the United States, France, and Great Britain, as the three nations showing the most progress in this direction, it continues as follows:—'Massachusets, to the west of the Atlantic, occupying a territory much less fertile than the basins of the Mississippi, the La Plata, or the Amazon—Massachusets has grown by agriculture, but principally by mechanical and manufacturing industry. It has placed itself at the head of genius and art, in the midst of one hundred and twenty states of the New World. To its too limited territory has been added the wealth of two oceans; to the whale fisheries of the Polar Seas have been sent more fishermen than the entire population of the countries washed by their waters. Seeking in Asia the treasures of the equator, the precious drugs, perfumes, &c., of the torrid zone, it cancels the obligation with blocks of pure ice taken from its own lakes. To gain from her flowing waters an astonishing power, falls, cataracts, and rapids are made use of to move machinery. It has not been sufficient that we should have Cambridge as an Alma Mater; but to that have been added Manchester, Glasgow, Leeds, and Halifax. For the half century now before us, she prepares against the Colossus of British industry a war of giants; it has already commenced. New England opens the second war of independence, and the conquest shall be the independence of arts.' The committee in this report devote some 300 pages to our progress up to that date, taking in state by state.

"That the history and results of the world's fairs and Industrial Exhibitions have shown steady and healthy growth, appears from these figures:—London, 1851, 13,937 exhibitors, 6,039,000 paying visitors; Paris, 1855, 23,754 exhibitors, 5,162,000 paying visitors; London, 1862, 28,653 exhibitors, 6,211,000 paying visitors; Paris, 1867, 50,226 exhibitors, 9,921,698 paying visitors.

PHILADELPHIA EXHIBITION.

The following is the classification adopted by the United States Commission on the International Universal Exhibition of 1876:—

Department I.

Raw Materials, Mineral, Vegetable, and Animal.

Group 10.—Minerals, ores, building-stones, metals, and metallurgical products.

Group 11.—Agricultural products used chiefly for food.

Group 12.—Arboriculture and floriculture.

Group 13.—Forest products.

Group 14.—Aromatic, oleaginous, saponaceous, stimulating, and narcotic substances of vegetable growth, vegetable drugs, and perfumes.

Group 15.—Fibrous substances of vegetable and of animal origin used in the arts.

Group 16.—Animals, live stock, &c.

Group 17.—Fish and aquatic life and fish products.

Group 18.—Animal products used as food, or as the basis of manufactures, exclusive of aquatic products.

Group 19.—Preserved meats, vegetables and fruits.

Department II.

Materials and Manufactures used for Food, or in the Arts the result of extractive or combining processes.

Group 20.—Extracts and compounds of animal or vegetable orgin, used chiefly for food.

Group 21.—Potash, soda, and ammonia, salt, bleaching powders, fertilising compounds, mineral acids.

Group 22.—Oils, soaps, candles, illuminating and other gases.

Group 23.—Chemical and pharmaceutical preparations.

Group 24.—Paints, pigments, dyes, colours, turpentines, oils, and varnishes.

Group 25.—Patent medicinal compounds, perfumery, essences, pomades, cosmetics, aromatic vinegars, &c.

Group 26.—Cements, artificial stone, concrete, and beton.

Group 27.—The ceramic art, terra-cotta, faïence, porcelain and glass.

Group 28.—Explosive and fulminating compounds.

Department III.

Textile and Felted Fabrics, Apparel, Costumes, and Ornaments for the Person.

Group 30.—Yarns and woven goods of vegetable or animal materials.

Group 31.—Woven and felted goods, of wool or mixtures of wool.

Group 32.—Silk and silk fabrics, and mixtures of which silk is the predominating material.

Group 33.—Knit goods and hosiery, including underwear made of piece goods.

Group 34.—Clothing, ready-made clothing, military clothing, costumes, and clothing for special objects.

Group 35.—Hats, caps, boots, shoes, gloves, mittens, &c., straw, and palm-leaf hats, bonnets, and millinery.

Group 36.—Laces, embroideries, trimmings for clothing, furniture, and carriages.

Group 37.—Fine jewellery, and metallic or mineral ornaments, worn upon the person.

Group 38.—Ornaments, artificial flowers, coiffures, buttons, trimmings, fans, umbrellas, sun-shades, walking canes, and other ornaments of dress or adornment, exclusive of jewellery.

Group 39.—Paper, paste-board, card-board, wall-paper, and paper industry generally.

Department IV.

Furniture and Manufacture of general use in Construction and in Dwellings.

Group 40.—Heavy furniture for parlour, chamber, and the library.

Group 41.—Table furniture of glass, china, and metal.

Group 42.—Mirrors, stained and enamelled glass, cut and engraved window glass, and other decorative objects.

Group 43.—Apparatus and fixtures for heating, lighting, and cooking.

Group 44.—Hardware used in construction, exclusive of tools and implements.

Department V.

Tools, Implements, Machines, and Presses.

Group 50.—Machines, tools, and apparatus of mining, metallurgy, chemistry and the extractive arts.

Group 51.—Machines, tools and apparatus of agriculture and forestry, and of alimentary industry.

Group 52.—Machines and tools for working wood, metal, or stone.

Group 53.—Machines and implements of spinning, weaving, felting, paper-making, sewing, and making clothing and ornamental objects.

Group 54.—Machines and apparatus for type-setting, printing, stamping, embossing, and for making books; paper-working, miscellaneous hand-tools, machines, and appliances used in various arts. Cutlery.

Group 58.—Instruments and apparatus of medicine and surgery, of relief to the wounded; sanitary apparatus and methods.

Group 59.—Instruments and apparatus for the destruction of life, for hunting, trapping, and fishing.

Department VI.

Motors and Transportation.

Group 60.—Motors and apparatus for the generation and transmission of power, and for lifting and moving fluids.

Group 61.—Vehicles and apparatus of transportation on common roads.

Group 62.—Railways and railway plant.

Group 63.—Railway rolling stock and apparatus.

Group 64.—Hoisting and lifting apparatus.

Group 65.—Transportation upon suspended cables. Aerial transportation. Pneumatic transportation.

Group 66.—Boats and sailing vessels.

Group 67.—Steam-ships, steam-boats, propellors, and all vessels propelled by steam or other fixed motors.

Group 69.—Boats or vessels designed for special purposes.

Department VII.

Apparatus and Methods for the Increase and Diffusion of Knowledge.

Group 70.—Educational apparatus and methods.

Group 71.—Typographic aids to the preservation and dissemination of knowledge.

Group 72.—Charts, maps, and graphic representations.

Group 73.—Telegraphic instruments and methods.

Group 74.—Instruments of precision, and apparatus of physical research, experiment and illustration.

Group 75.—Meteorological instruments and apparatus.

Group 76.—Mechanical calculation, indicating and registering apparatus, other than meteorological.

Group 77.—Weights, measures, and coins; weighing and meteorological apparatus.

Group 78.—Chronometric apparatus; time measures of all kinds.

Group 79.—Musical instruments and accoustic apparatus.

Department VIII.

Engineering, Public Works, Architecture, &c.

Group 80.—Agricultural engineering.

Group 81.—Mining engineering.

Group 82.—Civil engineering.

Group 83.—Dynamic and industrial engineering.

Group 84.—Railway engineering.

Group 85.—Public works and architecture.

Group 87.—Submarine constructions, foundations, piers, docks, &c.

Group 88.—Military engineering.

Group 89.—Naval engineering.

Department IX.

Plastic and Graphic Arts.

Group 90.—Sculpture.

Group 91.—Painting.

Group 92.—Line drawing, engraving, and die-sinking.
Group 93.—Chromo-lithography and lithography.
Group 94.—Photography.
Group 95.—Industrial designs.
Group 96.—Mosaic and inlaid work.
Group 97.—Architectural designs and models.
Group 98.—Decorating and furnishing of interiors of public and private buildings.
Group 99.—Landscape gardening.

Department X.

Objects illustrating Efforts for the Improvement of the Physical, Intellectual, and Moral Condition of Man.

Group 100.—Physical development and condition.
Group 101.—Sanitary.
Group 102.—Benevolence.
Group 103.—Government and law.
Group 104.—Religious organisations and systems.
Group 105.—Education.
Group 106.—Institutions, societies, and organisations having for their object the promotion of science.
Group 107.—Co-operative associations.
Group 108.—Music and the drama.
Group 109.—Exhibitions of works of art and industry.

Vienna Industrial Exhibition, 1873.—The Vienna Exhibition absolutely closes on the 2nd November, without any final ceremonial.—The Artisans' Reports upon the Exhibition, prepared under the auspices of the Manchester Society for the Promotion of Scientific Industry, are to be published on November 1st. The reports are thirty-one in number.

THE FLORIDA SHIP CANAL.

The Board of Trade at Mobile have been memorialising the Congress of the United States for an appropriation to commence a survey for a ship canal, to open communication between the waters of the Gulf of Mexico and the Atlantic Ocean, through the Florida Peninsula. The proposed canal might commence at Tampa Bay, and the gulf side of Florida. At that point there is a naturally well-protected harbour, with ample depth of water for ships drawing 20 feet, and the channel could be permanently deepened. East of Tampa Bay, in a distance of 125 miles across the Peninsula of Florida, at its narrowest part, with one exception, the map shows on the Atlantic coast depths of 27 and 28 feet of water, quite close to the shore, and thence to the broad expanse of the Atlantic a free and unobstructed way for vessels. A breakwater will be required there to form an artificial harbour for the protection of vessels.

From all the information published on the subject, derived from those familiar with the proposed route of the canal, it is believed that a very efficient ship canal, with adequate depth of water, could be made without great cost. The land is level across the proposed route, with only a few feet elevation above tide water. The importance of such a canal cannot be overrated. The passage around the southern point of Florida, which vessels engaged in the North Atlantic trade, entering and leaving the Gulf, are compelled to make for about 500 miles, is narrow, subject to tornadoes, and is beset with concealed reefs, upon which a rapid current has a tendency to carry vessels. The consequent dangers are such that it costs on an average three-eighths of one per cent. more to insure for a Gulf than for an Atlantic port. Twenty-five years ago the amount of commerce compelled to use this passage was estimated at 320,000,000 dolls. per annum. Taking the increase of commerce since then at only ten per cent., the present commerce using the passage would be 352,000,000 dolls. per annum. If the value of the vessels is assumed on an average at eight-tenths of their cargoes, the property passing through the Straits of Florida will amount to 633,000,000 dolls. per annum. Three-eighths of one per cent. on this would give 2,376,000 dolls. as the increased amount of insurance which must be paid annually on account of the dangers of the Straits of Florida. This tax would, in ten years, or less time, amount to a sum sufficient, in all probability, to pay for the entire cost of the canal, and would in a great measure be saved by its possession. Nor is this the only saving that would be effected by the canal. A large additional saving to commerce would be accomplished from the use by vessels of the short and uninterrupted passage across Florida by the ship-canal, instead of the long and obstructed passage around the peninsula now used.

Mr. Cridland, the British Consul at Mobile, says that this proposed canal, once constructed, would be invaluable to that city, not only on account of savings to her business in insurance, &c., but because it would afford cheap water transportation to her route of commerce, while the routes of commerce of the South Atlantic ports must, of necessity, have expensive transportation by railroads. Assuming Selma, Alabama, as the point at which commences competition between Mobile and the two ports of the South Atlantic for the trade of the interior, the proposed canal will substitute 1,080 miles of water-transportation by river, ship-canal, and ocean, on the Mobile route for 437 miles of railroad, and 170 miles of ocean-transportation on the route *viâ* Savannah. Considering that the cost of water-transportation by ocean, good river, and ship-canal is at least eight times cheaper than that of railroad-transportation, it is clear that Mobile will enjoy from the canal great advantages over the South Atlantic ports in competing for the trade of the interior. The foreign exports which now pass around the 600 miles of dangerous navigation of the Florida Pass, taking the year ending June 30, 1871, would amount to 767,562,000 dollars, whilst others estimate the total at 1,087,000,000 dollars. If the latter figures are correct, and the statement that the construction of the Florida ship-canal would reduce the premiums on insurance 3-8ths of 1 per cent., the annual saving to commerce from this source alone would amount to 2,878,734 dollars, and in freight it would save as much more.

To estimate the interest on time saved would be difficult, but the distance, for instance, between the port of Mobile or any northern or foreign port, would be shortened for steam-ships two or three days, coming in or going out, or four or six days in the round trip, and for sailing vessels, six or eight days, or fourteen days the round trip. But the advantages of such a route does not end here. Mr. J. J. Williams, who surveyed the Tehuantepec route, under the direction of the United States Government, estimates that 2,000,000 tonnage would be added to the commerce of the Gulf if a canal were cut across the Isthmus of Panama, a fact that vastly enhances the importance of this project. Further, it is thought that had a canal existed the past thirty years insurance companies would have made better dividends at a premium of one-half of what they have usually charged. Its great importance is too obvious to enlarge upon. The State of Alabama has already memorialised Congress for its survey and construction, and the Committee of the Senate promptly responded by recommending an appropriation to that effect. Other States are preparing to move in the matter. The National Board of Trade, sitting at New York City, in October, last year, unanimously resolved to memoralise Congress for the same object. All commercial nations would be benefited by the construction of the Florida Ship-Canal.

The *American Manufacturer* says that about 7,000 acres are cleared of timber each week day in the United States. Of the annual crop 75,000,000 dollars worth goes to fuel, and twice as much to fencing. The locomotives in North America consume no less than 700,000 cords, or 500 acres a year.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,094. Vol. XXI.

FRIDAY, NOVEMBER 7, 1873.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

NOTICES TO MEMBERS.

Ordinary Meetings.

The One-Hundred-and-Twentieth Session of the Society, will commence on Wednesday, the 19th November, when the opening address will be delivered by Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman of the Council.

The following are the dates of the Wednesday evening Meetings, the chair being taken at eight o'clock:—

1873.	November	—	—	19	26	
,,	December	3	10	17	—	—
1874.	January..........	—	14	21	28	
,,	February	4	11	18	25	
,,	March	4	11	18	25	
,,	April	—	8	15	22	29
,,	May	6	13	20	27	

The Annual General Meeting will be held on June 24th, at four o'clock. No visitors are admitted to this Meeting.

For the Meetings previous to Christmas, the following arrangements have been made:—

November 19.—Opening Address by Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman of the Council.

(On this evening the Prince Consort's Prize, the Prizes gained at the Technological Examinations, and the Medals awarded during the last Session, will be presented by the Chairman.)

November 26.—"On the Manufacture of Iron and Steel," by Sir Francis C. Knowles, Bart.

December 3.—"On Australian Vines and Wines," by J. T. Fallon, Esq.

December 10.—"On Mechanical Processes for producing Decorative Designs on Wood Surfaces," by Thomas Whitburn, Esq.

December 17.—"Whitby Jet and its Manufacture," by John A. Bower, F.C.S., Science Master, Whitby School.

Each Member is privileged to introduce two friends to every Meeting, and a book of blank tickets has been forwarded for this purpose.

Cantor Lectures.

The first course of Cantor Lectures for the ensuing Session will be "On Spectrum Analysis as aided by and aiding the Arts," by J. Norman Lockyer, Esq., F.R.S., and will consist of two lectures, to be delivered on Monday evenings, the 24th November and 1st December.

Lecture I.—November 24th, 1873.

On the application of Photography to Spectroscopic Researches.

Lecture II.—December 1st, 1873.

On Spectroscopy in its quantitative relations.

The second course will be on the "Chemistry of Brewing," by Dr. Charles Graham (University College, London), and will consist of seven Lectures, to be commenced on Monday, the 8th December; two to be delivered before Christmas, and the remaining five after Christmas, as follows:—

Lecture I.—December 8th, 1873.

Historical and Preliminary.—History of brewing. Varieties of grain used. Chemical examination of the properties of cellulose, starch, dextrine, grape sugar, elutus, &c. Action of nitrogenised substances on starch.

Lecture II.—December 15th, 1873.

On Malting.—The germination of seeds. Chemical changes produced. Examination of the processes of steeping, germination, and kiln-drying. English and Bavarian methods contrasted. Chemical examination of malts, with some analytical methods adopted for the use of the master brewer (Braumeister).

Lecture III.—January 12th, 1874.

On mashing.

Lecture IV.—January 19th, 1874.

On Boiling. Hops, their properties and uses.

Lecture V.—January 26th, 1874.

On fermentation. (Primary.)

Lecture VI.—February 2nd, 1874.

On fermentation. (Secondary.)

Lecture VII.—February 9th, 1874.

The beer of the future.

These lectures will include a chemical examination of the chief features of the methods of brewing adopted in England, Scotland, Germany, Belgium, and Norway, with proposals for the prevention of acidification and other destructive changes which occur in beer. The lectures on fermentation will include an account of the nature and chemical functions of the various yeast plants. During the course, chemical tests will be described for the guidance of the brewer in the mashing, boiling, and fermenting processes, and for testing the purity of the water and utensils used.

Other courses will also be given during the Session, one by Professor Barff, M.A., having been already arranged. These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture.

Tickets for the above lectures will be forwarded to Members, with the *Journal*, in due course.

PRIZE CABS.

His Royal Highness the Prince of Wales, President of the Society, inspected, on Saturday morning, in the courtyard of Marlborough-house, the four cabs selected by the Society of Arts' judges, viz., an improved hansom by Messrs. Forder and Co., of Wolverhampton; a two-wheeler of novel construction, by Thorn, of Norwich; a four-wheeler by Lambert, of London; and a four-wheeler by Quick and Norminton, of London. The two latter can be used either open or shut. His Royal Highness expressed himself pleased with the vehicles, and considered them improvements on those at present in use. It is understood that his Royal Highness gave an order for one of Messrs. Forder's for use at Sandringham.

FOOD COMMITTEE.

The Committee met on Monday last. Present—Mr. Benjamin Shaw (in the chair), Sir Antonio Brady, Major-General Eardley-Wilmot, R.A., F.R.S., the Rev. J. E. Hall, Mr. J. Y. Manley, Mr. E. C. Tufnell, and Mr. J. A. Youl.

The Secretary laid before the Committee a shoulder of mutton, which, under his superintendence, had been preserved in a refrigerator for twenty-six days. This meat was in a sound and excellent condition. The Committee directed the Secretary to have the joint cooked, and report upon it. It was cooked on the following day, and the Secretary reports that it was in capital order, and most excellent in flavour. The lowest temperature to which it was exposed whilst it remained in the refrigerator was 34° Fahr., as shown by a minimum thermometer enclosed with it. The Committee had also before them specimens of meat preserved in a raw state by a secret process in Buenos Ayres, in the month of April last, as certified by the Consul of that place. Portions of it were cooked and tasted by the Committee.

TECHNOLOGICAL EXAMINATIONS.

The Programme of Examinations in the technology of the Arts and Manufactures of the country for 1874, is now ready for issue. These examinations will be held annually, in conjunction with the examinations of the Science and Art Department, and due notice will be given of the particular subjects selected each year.

The subjects for the year 1874 will be Cotton, Paper, Silk, Steel, Carriage-building, Pottery and Porcelain, Gas Manufacture, Glass-making, and Cloth Manufacture. Candidates, in order to obtain certificates in any of these subjects, must pass the examinations of the Science and Art Department in certain sciences, which are specified in the programme as bearing upon the particular art or manufacture. In addition to these, special papers will be set in the technology of each manufacture, by examiners appointed by the Society of Arts.

The following Prizes are offered by the Society of Arts in each of the nine subjects.

To the best candidate in Honours, £10.

To the best candidate in the Advanced Grade, £7.

To the best candidate in the Elementary Grade, £5.

The following special additional Prizes are offered:—

By the Worshipful Company of Clothworkers, a Scholarship of one hundred guineas, to be awarded to the best Candidate in Cloth Manufacture, presuming that in the opinion of the Council he reaches a sufficiently high standard. The Candidate who obtains this Scholarship must spend at least one year in some place of scientific instruction, to be approved by the Council of the Society of Arts and by the Court of the Clothworkers Company.

By Wyndham S. Portal, Esq., to the Second and Third best Candidates in the Elementary Grade, Paper Manufacture:—

A Prize of	£3
A Prize of	2

By G. N. Hooper, Esq., to the Second and Third best Candidates in the Elementary Grade, Carriage Building:—

A Prize of	£3
A Prize of	2

By the Worshipful Company of Spectacle Makers, to the Second-best Candidate in Honours in the Advanced Grade and in the Elementary Grade respectively, in the Manufacture of Glass:—

A Prize of	£5	5
A Prize of	3	3
A Prize of	2	2

The examinations of the Science and Art Department will be held during the first three weeks of May, the technological paper being worked on the evening of the 16th May. The dates of the Science subjects are given in the Science Directory, published by the Science and Art Department.

In order that these Examinations may really be successful in promoting technical education in this country, it is desirable that encouragement should be given to candidates by the offer of prizes and scholarships. With this object the Council appeal to the trade guilds of the city of London, to merchants and manufacturers, and to members of the Society generally, to aid them by contributing to the prize fund.

While expressing their thanks for the assistance they have already received, both from the companies of the City of London and from private individuals, the Council would repeat the appeal, made last year, when the scheme of Technological Examinations was first put forward, for further funds to enable them to prosecute and carry out in its entirety the plan which has been drawn up.

GENERAL EXAMINATIONS, 1874.

The Programme of Examinations for 1874 is now ready, and may be had gratis, on application to the Secretary.

These Examinations, in 1874, will be held on the evenings of the 21st, 22nd, 23rd, and 24th April. The Time-table has been arranged as follows :—

TUESDAY, April 21, From 7 to 10 p.m	WEDNESDAY, April 22, From 7 to 10 p. m.	THURSDAY, April 23, From 7 to 10 p.m.	FRIDAY, April 24, From 7 to 10 p.m.
Arithmetic. Logic. Floriculture.	Theory of Music English History. German. Spanish.	Political Economy. French. Fruit and Vegetable Culture.	Book-keeping. English Language. Italian.

FRIDAY, April 24, 6 to 7 p.m.—Dictation.

The rule which formerly prevented a candidate who had once obtained a first-class certificate in a subject from being again examined in that subject with a view to gaining a prize, has, in accordance with the wish expressed at the Conference, held on the 27th June, 1873, been rescinded. In future, therefore, a candidate who has obtained a first-class certificate in a subject may be again examined in that subject, but not more than one first-class certificate in any subject will be counted for the Prince Consort's Prize, or for the Council Prize to Females. A candidate having taken the first prize in any subject cannot again take a prize in that subject, nor can a candidate take a prize of the same grade twice in any subject.

The Elementary Examinations, held by the District Unions and Local Boards, for which papers are furnished by the Society, are fixed for the 10th, 11th, and 12th March.

Full details in reference to the Examinations are given in the Programme, copies of which should be applied for to the Secretary of the Society of Arts, by all intending to come forward as candidates, or otherwise interested in the Examinations.

A discovery of considerable economic value has just been made in Newfoundland in the shape of a bone-stone, which, in texture and quality, rivals the far-famed oil-stone of Turkey for sharpening the finer edged tools, and is of unlimited extent.

It is estimated that the cotton crop of California in 1873 will amount to a thousand bales, of which nearly half will be exported, the remainder being required for home consumption.

In the first ten days of October, 29 ships, of an aggregate burthen of 55,200 tons, passed through the Suez Canal. The transit revenue collected by the company during the ten days was £23,400.

The Turkish Minister of Posts and Telegraphs has intimated that a new line of telegraphic communication with Greece has been opened by way of Tchesme and the island of Scio.

A recently published statement shows that during the twelve months beginning with September, 1872 and ending August, 1873, there were 1,300 accidents upon railways in the United States, by which 341 persons were killed, 1,410 injured.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The sixth and concluding lecture of the third course of Cantor Lectures for the Session, "On Wines; their Production, Treatment, and Use," was delivered by J. L. W. THUDICHUM, Esq., M.D., on Monday evening, May 26th, 1873, as follows :—

LECTURE VI.

The Wines of Germany. Riessling, a type of bouquetted wines. Classification of the Wines of the World, as determined by quality, quantity, value in the market of highest and lowest qualities. Active ingredients of Wine ; use of chemical analysis ; use of Wine to the healthy, whether old or young. Wine, under what conditions preferable to all other alcoholic liquids. Wine should be a beverage, not a dram. Use of Wine to the delicate and sick. Selection and prices of Wine. Proposed modification of the import duties, to adjust them to the climatic difficulties of Spain and Portugal.

The principal wine-producing districts of Germany are the valleys of the Rhine and its tributary rivers. There is also wine produced on the Saale and the Elbe, but the nature of the product is such that it never forms an article of trade out of the producing districts. German Austria also produces much wine, of which a small quantity is exported, notably wines of Vöslau. For our present purpose, we must confine ourselves to a consideration of the typical German wines, namely, those of the Rhine. They are characterised by a peculiar bouquet, the product of the Riessling grape. It may be estimated that about half the vines of the Rhine valley consist of Riessling plants, and it is probable that this vine is indigeneous to the Rhine valley. It grows in other parts of the world when transplanted to them, but has never yet been found to produce the high qualities of wine such as it yields in the Rhine-gau. Being a small vine, its fruit is developed near the soil, and receives its radiation of heat; its bunch is not large ; its grapes are also of small size, with little juice and much acid, with a hard skin, capable of withstanding inclemencies of the seasons, and with great ability to ripen late in the year, while hanging on the vine, almost to the beginning of the winter frosts. In very warm years its musts are very sweet, and the wine, after fermentation, retains a small quantity of sugar. In hotter climates, such as Styria and Hungary, it becomes granulated on the stock, and the wines become too sweet, too fiery, and are without any of the bouquet which distinguishes Rhine wine. In the Palatinate the Riessling is frequently accompanied by the Traminer. The name which this wine bears would indicate that it came from Tramin, a little town in Tyrol, but travellers who have visited Tramin on purpose have not found a single stock of this kind of vine in the district. This latter vine also occurs in pure sets, and is then used for wine made from its grapes only. It ripens somewhat earlier than the Riessling, and therefore yields a tolerable harvest even in years in which Riessling remains very bad ; but the flavour of its wine is always much slighter than that of Riessling. It has a thick and so called "fat" taste. It gives the impression of body with little acid and much smoothness. In exchange for that remarkable property it is, during its early stages, very much inclined to become viscid. The third variety of vine frequently grown on the Rhine is the Sylvaner, or Austrian ; its grapes are closely set on the bunch, and therefore rot easily in wet years. They are very juicy and sweet, particularly near the ripe husk, and give in good years an elegant spirited wine. But they are most commonly mixed with Riessling grapes, to which they impart mildness while receiving flavour. In Baden much wine is made from the Chasselas, there termed Gutedel; the well-known Markgräfler is made from this vine only (and I have lately learned from Australia that there is a probability of this vine yielding an excellent product there). In Alsatia and the Palatinate it enters, frequently to the extent of one-third, into the sets in the ordinary vineyards, and helps to produce a mild, though flavourless, wine of low alcoholicity. Another variety of vine grown on the Rhine is the Elbling, or Albe, and its variety, the Kleinberger. This vine has been supposed to be identical with the Pedro Ximenes of the sherry district, but in the first lecture (see *Journal*, p. 771) I fully explained the error which now for more than two hundred years has been repeated in many books and articles on grapes and wines. The characteristic Rhine-wine grapes are all small-sized; the Chasselas alone has medium sized grapes, and gives, with few exceptions, inferior wine. The Pedro Ximenes has large sized grapes; and is therefore a plant which can only succeed and mature fruit in the open air in the most southern parts of Europe, and would probably fail on the French shore of the Mediterranean. In the district of Rüdesheim a vine was formerly much cultivated which is termed the Orleans. At present it is almost extinct, less than one-half per cent. of the vines of the Rhine-gau being made up by this variety. The black or blue varieties of grapes grown on the Rhine are all descendants of the Burgundy pineau. Ingelheim and Assmaushausen are the centres of this production, of which much is now used for the manufacture of effervescent wines.

The wines of Alsatia have of late been much canvassed, mainly on German patriotic grounds. These wines are nearly all white, and genuinely German; they never found a market in France, and the only purchasers during the time of German protection were the Swiss. In consequence of these unfavourable conditions, the surface under viticulture in Alsace has during this century diminished by one third of what it was in 1800. Since the conquest in 1870 much Alsatian wine is carried into the interior of Germany and there consumed. There have been even enterprising travellers who have sold Alsatian "cabinet" wines. With regard to this it must be stated that there is no wine grown in Alsace which rises higher than the fifth grade of Rhine wine in general; and the best Rappoldsweiller wine (Ribeauvillé in French) sold at Strasburg is worth about 2s. per bottle. The Palatinate, or Rhenish Bavaria, produces a large quantity of middling and inferior white wine. The mode of training the vines is here altogether peculiar, and different from that in any other country. It is called the "double chamber cultivation" (Kammerbau), and "closed, low-frame training;" and can only be described by means of drawings, such as we have given in the Treatise on wine at pp. 531 and 532. In all the villages east and south of the village of Haardt the "open low frame training" is usual. The celebrated situations, Ruppertsberg, Deideshein, and Forst also have the open low-frame training. Palatinate wines are mostly made from the mixed set of vines, Riessling, Sylvaner, Chasselas, and Kleinberger; Traminer also enters, but, if possible, is made separate. The character of these mixed wines, in good years, is very agreeable, but never very high; they never reach the character of Rhine-gau Riessling wines. They begin to lose quality and bouquet in the fourth year, when Rhine-gau wines begin only to be fully developed. They are therefore mainly destined for rapid consumption during their younger years, and should not be kept, as they will never improve by keeping in the same manner or degree as Rhine-gau wines. For this reason Palatinate wines are relatively cheap wines, and as the annual production rises to 80,000 fuder, of 1,000 litres each—therefore 800,000 hectolitres,—they supply an agreeable beverage to a large portion of the population of Germany. In the estimation of the Germans, "Pfälzer" stands to "Rheingauer" wine in the same relation as in the estimation of the English "Marsala" stands to "Sherry." The wines of Rhenish Hessia are similar to those of the Palatinate on the one hand, and those of the Rhine-gau on the other. They are therefore frequently used at Mayence, in the place of either of them, being mixed with other Palatinate or Gau wine, to impart the desired flavour. The vineyard south of the Liebfrauenkirche, at Worms, produces the "Liebfraumilch," a Riessling wine of some bouquet. Before describing the wines of the Gau, we will make a moment's excursion up the Maine to look for the wines of Franconia. They are mostly sour liquids, which no one but a Franconian is likely to relish. I have tasted some of the best and dearest, at Würzburg, and find them fifth class, Stein and Leiste excepted. These latter reputed situations produce better liquids, and Stein in particular, perhaps owing to the peculiar bottles, termed "bocksbeutel," in which it is sold, enjoys a certain notoriety in England. But much of the wine which is sold under the name of Stein wine in London is Palatinate wine, which in Mayence and other places is filled into bottles of the shape of the bocksbeutel, and then sold as Stein. The Rhine-gau, or district north of the Rhine from Hochheim to St. Goar, produces the finest wines of Germany; they are so well-known, at least by fame, as hardly to require any special description. Hochheim, Rauenthal, Steinberg, Johannisberg, and many other names of almost equal reputation, occur on all wine merchants' lists, on all wine lists in hotels nearly all over the world. No doubt the best wines are splendid products of nature and art, but their quantity is very limited. The entire Gau produce in good years is about 10,000 stück, equal to nearly 20,000 butts. The Rhine-gau produces, therefore, about four-sevenths as much wine as the sherry district proper. But, as already stated, too much of what is now-a-days sold under high-sounding names is mixed wine having a basis of Palatinate or Hessian, and an accomplishment dose of Gau wine. It is to be hoped that the Germans will abandon this abuse of names, which are for the most part direct untruths and used with a full knowledge of their falsehood, and will introduce the Jerez system of Soleras, by which all falsehood (so long at least as the wines are Jerez grown) is avoided. Therefore I advise my audience never to buy hock by the false light of a name, but by the guidance of the tongue and the judgment of comparison with standards; even price is no criterion of origin, for the most genuine growths vary so much in quality in different years, or in different casks in the same year, that Schloss Johannisberg, as an example, is sold officially by the stewards of Prince Metternich at the castle itself, varying in price between two florins (3s. 4d.) per bottle and twenty florins (£1 13s. 4d.) per bottle. Now, if you consider that a good Palatinate wine ought to be obtainable in London at 2s. per bottle, and a good Rhine-gauer at from 3s. to 5s. per bottle, you have the limits of practicable prices for the larger quantity of hock. Cabinet wines will fetch high fancy prices, but can never be current articles of trade. Indeed, the traders do not like to deal with them, because they leave little profit when obtained, and then the quantity of these wines is so small that the business when completed is again unimportant. The consumption of hock in England has, indeed, diminished during late years, and when I consider the prices asked by the German dealers and their travellers, I am not astonished at this result. Sparkling hock, however, finds more favour in this country; and with regard to this, indeed, the playing with names has been abandoned. The finest sparkling Riessling wine is made at Eltville and Rüdesheim.

The Moselle wines are mostly fifth-class wines, and possess as little flavour as the Franconia wines, but are made with much more care. Sparkling Moselle is drunk in this country; it derives its flavour—supposed to be Muscatel—from elder-flowers, and is really a nice product of art. Muscatel grapes do not prosper upon the borders of the Moselle River.

The white wines of the Rhine are distinguished by never containing added distilled spirit; they are never coloured, plastered, or boiled, and in these respects are equal to the best products of the Gironde. For these reasons they are equally wholesome to drink; they produce none of the inconveniences of the brandied wines of Jerez and Oporto. Perhaps you have heard of military port, and of public dinners, and how the *delirium tremens*, which sometimes affects persons partaking of these drinks and festivities, is said to be caused by the coffee drunk after the dinner, and not by the brandy-wines drunk during the same. But humour cannot ward off the reality, which I have myself observed, that brandied wines, the ordinary ports and sherries of commerce, are sufficient to cause *delirium tremens* in habitual drinkers belonging to the higher classes of society. Of course a considerable quantity of such wines must be consumed before that result is attained, and the result is attained, in strong men particularly, without their passing at any time into the state of drunkenness. Now this extreme effect of the habitual use of excessive quantities of alcohol by means of loaded wines is never observed to arise from the use, even in very large quantities, of the natural wines, free from added brandy, of France or Germany. There are authentic cases of well-to-do, respectable persons, now living on the Rhine, who drink daily a large number of pints of the country wine of these parts (I am credibly informed up to sixteen pints), have never been known to be drunk, and suffer from no ailment referable to alcohol. Of course these cases are mere exceptions, and I only refer to them to show that even such quantities of alcohol as must be contained in such large volumes of weak wine are not able to produce alcoholic madness or *delirium tremens*. I would never advise or countenance the use of any alcoholic drink except in the most moderate quantity, such as to aid digestion, raise the power of the heart, and exhilarate the mind. I have stated the physiological limits of these quantities, based upon the serious experiments and observations, with the aid of chemical analysis, in some evidence which I gave some years ago before the Food Committee of this Society, and which has been printed in the *Journal*, and I can therefore refer to that for further particulars on the subject. Now, as to Rhine wine, the Germans say that there is no other beverage in the world which has the power to make men merry to the same extent, and causes them to sing in such strains and with such fervour. Wine has been praised by the poets of all ages and many nations, but the number of poems in praise of Rhine wine, and the number of melodies to which they may be sung, exceeds, I believe, that of all songs in praise of other wines taken together; and if we believe the testimony of the great German poets themselves, they have been indebted to Rhine wine for some of their best thoughts and feelings, just as were Anacreon and Horace to the wines of their respective times and countries. The latter even goes so far as to say, what I believe has never been disproved, that poems made by water-drinkers have never been known to become classic or even survive a season. This connection of wine with song has been deeply felt by some very practical people in this country, and the interesting work on wine by Mr. Shaw, for example, not only describes the wines but also gives the songs referring to wines of many nations. Such collections might be continued and extended to the praises in prose by classical writers, and in this collection the sermon of the priest on the Rochusberg, who estimated the goodness of God by the quantity of wine which he was enabled daily to consume (the sermon is recorded at full length in Goethe's works), should not fail to be included.

I regret to be unable in the space of time allotted to this lecture to speak of the wines of Switzerland, Italy, Hungary, Greece, Australia, and America. Italy is very active just now in promoting its agriculture; there are many viticultural societies throughout the peninsula, and they organise exhibitions and lotteries to sell the produce which is brought to them; but all these efforts will avail but little before viticulture, as a whole, is placed upon a more rational basis, and grapes are grown near to the soil, instead of, as now, high in the air. Italian wines, including those of Sicily, are singularly destitute of flavour, and in those which have any it is too often artificial, and in the white varieties produced by aromatic resins or gums. This artificial flavour I have, however, never found in the sweet and brandied wines of Sicily. The Marsalas, though brandied up to 36° proof-spirit, and sweetened with raisins or condensed must, are not plastered, and apparently not provided with extraneous flavours. Lately, some new kinds of Sicilian wines have been introduced into England which deserve commendation, because the alcohol in some of them is kept much below the quantities which prevail in Marsala.

Hungarian wines have been much commended, I may say vaunted, for a number of years, but their consumption has by no means increased. There are some firms whose names are identified with this Hungarian business, and who sell considerable quantities of wine, as is easily seen from the "duty-paid list" of the customs. But I am credibly informed that the importation of Hungarian wine is only a small part of the business of these firms, and that their principal business is done in port and sherry. Hungary has a great wine, namely Tokay, and a great vine, namely the Formint or Moslavina, from which Tokay is made. The other vines of Hungary produce no characteristic wines, no matter how much skill may be employed in the imitation of the great wines of places of reputation. And as regards the skill which is applied to the preparation of Hungarian wines, this must be very small indeed on nine out of ten properties. For only about one eighth of all Hungarian wine (of which the total quantity produced annually is much smaller than what is commonly stated) is supposed to be capable of being so prepared as to become fit for European or universal trade, and of this possible quantity only a small fraction, namely about 50,000 hectolitres, is annually exported from Pesth, the principal market for Hungarian wines. Taking a German stück as twelve hectolitres, we find that this exportation amounts to about 4,000 stück, being less than half the production of the Rhine-gau (10,000 stück per annum), and less than one ninth of the production of the Jerez district. The English public are not likely to become great consumers of Hungarian wines as long as they are treated as if they were cabinet and fine wines, and rated at prices which exclude them from current consumption, even among the rich.

The reputation of Greek wines has suffered much injury from the excessive praise of interested partisans and involved speculators. I believe that there are some varieties well worthy of public attention; but when it is attempted to make us believe that they excel Jerez amontillado, we must protest against such a perversion of the simplest matters of fact. Of Australian and American wines we have only very partial information. The Americans have a great inland market and a high protective tariff to aid their viticulture, but the Australians are desirous to export wine to the mother country, and we should like to see them, as well as other importers who will bring us wholesome, natural, cheap wines, successful.

Now you will, perhaps, inquire what I mean by a cheap wine. I propose to call cheap wines all those which can be sold retail in London at prices varying between twelve and thirty shillings per dozen bottles. Wines at prices varying between thirty and sixty shillings per dozen bottles I will term fine wines; and those at prices above sixty shillings I will term cabinet wines. The fine and cabinet wines are so limited in quantity, and so much sought after, that they can never become popular beverages. But amongst the cheap wines there are excellent qualities, fulfilling all the hygienic and gustatory conditions demanded for comfortable and wholesome living. The great bulk of all the wines of Jerez, Oporto, Lisbon, Barcelona, Valencia, Alicante, Cette, Bordeaux, of the Rhine, of Austria, and Hungary, are cheap wines. You may read of high prices in the lists of sherry exporters, such as £1,000 per butt; but these are idle fictions, which I will not stay to explain. There are not 200 butts of sherry at Jerez at any time which would fetch £200 per butt. The mass of sherry is exported at £15 per butt, and the average value of all sherry exported is £28 per butt. The same applies to Oporto. The mass of port wine is exported at a price somewhat between £22 and £25 per pipe, and the finer wines at £50 to £80 are few and far between. And so it is with all the places I have mentioned. The great bulk of their exports consists of cheap wines. It was upon the importation into England of cheap natural wines that the eye of the legislature was directed when the duty was reduced, and to this object the attention of all wine merchants must be directed who want to make a position other than that arrived at by a routine now become obsolete. We have some cheering facts of this kind before us; some Spanish houses sell Spanish natural, or nearly natural, wine (though it is plastered) at 12s. per dozen bottles; others sell red Catalonian wine, of claret character, free from brandy or sugar, at the same prices. Hérault wine is sold at the same price. It is said that these cheap wines are mere decoy birds put out by the relative houses to attract customers, and sold at prices which leave little or no profit to the vendors. Even if it were so, which I do not believe, I should consider this a great advantage, as it affords to the public the means of becoming acquainted with the cheapest qualities of wines which can be placed into the market without loss, and so as to pay expenses.

A classification of wines is always a process which is liable to cause much displeasure to those concerned; but I owe a few words to you on this subject, particularly in reply to inquiries addressed to me. I place sherry and its congeners at the head of all wines, even though I admit that it is deteriorated by plaster, brandy, colour, and dulce. If it were not so deteriorated, Jerez wine would be without question what I expect it to become in the course of a longer or shorter period. The second place of wines is occupied by those of the Alto Douro, port wines so called. This is even now apparent, though these wines are yet much deteriorated by the masses of brandy with which they are mixed. Third in rank come the wines of the Gironde, particularly those of the Médoc. They are superior to the former two classes by the absence of brandy and other admixtures; but they are inferior in body (extractives apart from alcohol) and vinosity, and are not rarely very acid. Fourth in rank I place Champagne and the white Burgundies. Fifth in rank I place the wines of the Rhinegau; sixth the red wines of Burgundy, Mâcon, and Beaujolais; seventh those of the Palatinate. Greek, Austrian, and Hungarian wine go into the sixth, seventh, and eighth categories; Tokay excepted, of which the sweet variety may be classed with the fourth, the szamorodnies with the seventh class. This classification is based upon the qualities, total quantities of products, prices, average success in years, in short it is the average result of a consideration of all the factors which make a wine of use to the greatest numbers at the least cost.

It is a general experience that the stronger wines are preferred in winter, while the natural wines are sought after in summer. In fact, the brandied wines are intolerable in hot, and not very useful, but bearable, in cold weather. Similarly it is found that delicate persons cannot bear the brandied wines, but are able to digest, and are benefitted by natural wines. All these conditions have been so ably put forth by many members of the medical profession, that I need not dwell upon them at length; we may compromise the question as long as we are unable to get the natural wines which we want and drink, that is to say, those with whom they agree may drink the fortified wines. But I have no doubt that as soon as the natural wines of Jerez and Oporto are freely obtainable in the market, they will press the brandied liquids out of consumption. Already a quantity of such natural wines, in the production of which I have taken some personal interest, has been imported into London, and the feasibility of the process, which was hitherto stoutly denied, has been proved.

You are aware that all wine imported into England pays a Customs duty, which for natural unfortified wine has been fixed by Parliament at one shilling per gallon. The law has most liberally defined as natural wine all wine which contains less than 26 per cent. of proof spirits, equal to 12 per cent. of absolute alcohol by weight, and 14·6 per cent. of absolute alcohol by volume. All wine which contains more than that proportion of spirit, or alcohol, is assumed to have received an addition of distilled spirit (or of wine containing distilled spirit), and is charged with a Customs duty of 2s. 6d., if it does not surmount, in its alcoholic strength, 42 per cent. of proof-spirits. All alcohol above 42 per cent. is charged the same duty per degree as distilled spirits, *i.e.*, 10s. 6d. per gallon of proof-spirit. Against this arrangement much opposition has been raised, particularly by the Spanish and Portuguese governments, and the traders in fortified wines, or rather in wines fortified to beyond 26 degrees. Upon ordinary sherries and ports, with their 35 to 42 per cent. of proof-spirits, the duty seems only a fair impost, inasmuch as if brandy by itself has to bear a heavy duty, it is not fair that that brandy should go into consumption almost untaxed when mixed with wines. But upon wines near to 26 per cent, the duty sometimes weighs heavily, and, with regard to these, a slight alteration seems judicious. I have explained in former lectures that viscosity and scuddiness disappear from southern wine when it contains 29 per cent. of proof-spirit; further, that flor (German, *kahn*, French, *fleur*, the mycoderma vini) disappears from wine when it contains 32 per cent. of proof-spirits. In order to permit wines to remain at such low alcoholicity, they should be charged (wines with from 26 to 32 per cent. of proof-spirits) a modified duty of 1s. 6d. per gallon only, instead of the 2s. 6d., which bears heavily upon them. All wines containing from 32 to 42 per cent. of proof-spirits should, as hitherto, be charged 2s. 6d., that is to say, the fair duty in proportion with the spirit excise.

I am reminded by the hand of the clock that my time is over and my task is completed. I have endeavoured to impart to you as much original matter as was in my power, and such, particularly as regards the wines of Spain and Portugal, has been obtained by me only at the cost of much travel and of much labour. It remains now for the public to turn this new information to the best possible use, then the objects which the Society had in view when they appointed me one of their Cantor lecturers will be fully attained. In conclusion, I beg to say that I highly appreciate the honour which the Society has conferred upon me, and thank most sincerely the several audiences of my lectures for their kind and patient attention.

(The lecture was illustrated by various typical specimens of Rhine wine, Palatinate, Rhinegau, Hochheimer, and Hessian, all of which, at the conclusion of the lecture, were tasted by many persons of the audience.)

In answer to W. A., the appearances he notices in casting would doubtless be caused by the presence of small air bubbles. The explosion would be produced by the sudden generation and expansion of vapours consequent on the sudden admission of the molten metal. Any moisture in such cases produces a serious explosion by its sudden transformation into steam.

According to the advices from Panama, extensive coal-fields have been found in the middle of the isthmus, between Panama and Aspinwall, and in communication with the Atlantic by the Rio Indio.

NATIONAL TRAINING SCHOOL FOR MUSIC.

LIEGE CONSERVATOIRE DE MUSIQUE.

In passing through Liège I took advantage of the opportunity to visit the conservatoire there. Since Mr. P. Le Neve Foster reported upon it in 1865, certain changes have taken place. This memorandum should therefore be regarded as an appendix or report supplemental to the one above mentioned.

1. The Conservatoire de Musique at Liège was established in 1827, by the nephew of Mehul. It is supported by funds provided—half by the Government, which contributes 80,000 francs, and half by the Municipality of Liège and the province. All classes of candidates are eligible for admission, irrespective of their nationalities. At the present time there are upwards of 350 students, male and female.

2. The general administration is under a Council of Administration, composed of distinguished men. The direction of the studies is confided entirely to the director, who lays down the methods of instruction to be pursued by the professors.

3. The Minister of Public Instruction, after consulting the wishes of the Director, gives the final sanction to the appointment of professors. "Répétiteurs," who may be regarded as acting in a capacity similar to that of the pupil-teacher at the South Kensington Art Training School, are appointed by the Director, and are paid small honoraria (100 or 200 francs per annum) as encouragements.

4. There are three grades or classes of Professors. Those in the first class, such as instructors in stringed instruments, receive from 2,400 francs to 3,000 per annum; instructors in wind instruments from 1,600 francs to 2,000 francs, and instructors in solfeggio and singing 1,200 francs. Each professor gives three lessons a week, of two hours' duration each.

5. The school is divided into two divisions, male and female, which attend respectively on separate days of the week. The male students attend on Mondays, Wednesdays, and Fridays, from 8·45 to 10·45, from 11 to 1, and from 3 to 5. The female students attend on Tuesdays, Thursdays, and Saturdays, from 11 to 1, from 2 to 4, or from 3 to 5, and from 4 to 6 or from 5 to 6. There are, in most cases, distinct professors for the male and female classes. In the female class some of them are women, and the "répétiteurs" selected from the female students. In both divisions the classes consist of eight students each, and a single lesson does not exceed two hours' duration. The students practice at their homes, and merely attend the Conservatoire for instruction.

6. Candidates for admission obtain, by successfully passing at a competitive examination, studentships as vacancies may occur. No outside amateur can enrol himself a student by payment. The course of instruction varies in extent between three and seven years. Those who are successful in entering the Conservatoire at an early age generally devote two years, or two and a-half years to "preliminary instruction." At the conclusion of each term the students undergo examinations. Those who have made no advance in their studies are dismissed by the director. Instruction in solfeggio and choral singing is obligatory for all students.

7. Concerts and lyrical performances are given by the students in the principal theatre in Liege, there being at the present time no accommodation for such performances in the Conservatoire.

8. The practice rooms are about the same size as those in the Paris Conservatoire. There are about twenty of them, with two moderate sized examination rooms. The general accommodation is, however, found to be inadequate to the requirements of the institution, and a change to new premises is contemplated.

9. The following is a tabular statement of the number of professors, &c., employed:—

	MEN.	WOMEN.
Class.	No. of Professors.	No. of Professors.
Solfeggio............	2	2
Piano	1 3 Répétiteurs.	3 3 Prof. Adjoints. 3 Répétiteurs.
Composition, Harmony, &c.	The Director. 1	The Director. 1
Choral Music	1	1
Singing	1	1 1 Répétiteur.
Piano and Insts. duets, trios, &c. ..	1	1
Organ	1	..
Operatic Music	1	..
Declamation	1	..
Violin	2 Professors. 3 Répétiteurs.	..

One Professor for each of the following Instruments:—Violoncello and Contrabasso, Flute, Clarionet, Oboe, Bassoon, Horn, Tuba, Trombone, Cornet.

Total number of Professors, 31; and 3 Prof. adjoints.

Total number of Répétiteurs, 10

10. The Director, M. Radoux, who has held the post of director only since last year, most courteously afforded all the information in his power, and has promised to forward, when ready, the new regulations which are under revision.

ALAN S. COLE.

Oct. 1873.

ANNUAL INTERNATIONAL EXHIBITIONS.

REPORT ON WINES FROM THE COLONY OF VICTORIA, AUSTRALIA.

By J. L. W. Thudichum, M.D.

1. I received from the agent, Mr. Levy, twenty-seven bottles of wine, which had been for some weeks in the Exhibition, standing upright.

2. When I received them I observed that they were all more or less turbid, and what is called out of condition, and this was confirmed by the tasting and closer examination of two samples.

3. I determined therefore to clarify the wines by deposition and decantation before tasting them, and with that view laid them in my cellar

in a horizontal position, so that the corks were submerged in wine.

4. When they were all brilliant, or nearly so, they were all skilfully decanted with the aid of a silver spout and aeriphore. Each bottle left a quantity of turbid, undrinkable residue, of which the quantity is below in each case mentioned in cubic centimetres. (A bottle of wine may be assumed to hold from 760 to 800 cubic centimetres.)

5. The wines were then tasted and the relative judgments recorded. These were confirmed by repeated trials, and are put forth as fair approximations to the truth.

6. The bottles were mostly well got up and properly corked; but some were badly corked with conical corks, of which the thin ends projected uselessly into the neck of the bottle.

7. This circumstance, and the fact of the wines having been standing cork uppermost and dry for some time in the Exhibition, may account for much of the turbidity in the wines, and may perhaps have caused some or all of them to be of lower quality than they were originally.

(1.) Victoria white wine (J. G. Francis), vintage 1869. 80 cubic cent. of thick, brownish residue; the rest brilliant. Is artificially coloured, contains either boiled wine or tannin in excess; possibly the must contained many rotten grapes. No flavour or value.

(2.) White Ivanhoe (Chas. Maplestone), vintage 1868; bottled 1870. 20 cubic cent. of thick residue, milky and flocculent. Probably Reissling; close taste. Little value.

(3.) Reissling (James J. Fallon). 33 cubic cent. of thick residue, rather brown, not very thick; contains spirit; is mousy.

(4.) Victorian white wine (J. G. Francis), vintage 1869. 60 cubic cent. of milky brownish residue. Clear taste, somewhat characteristic; confined odour; an attempt at bouquet.

(5.) Carbinet (Jas. J. Fallon). 10 cubic cent. at bottom, containing trifling amount of suspended matter. No resemblance to Bordeaux Carbinet wine; a sweet, sugary, not brandied wine; very clear, sound; sufficiently, not deeply coloured. A very nice thing, though, being sweet, somewhat dangerous. Reminds of young natural port wine, though less flavour. No expressed bouquet.

(6.) Verdeilho (Jas. J. Fallon). 20 cubic cent. undrinkable, but very trifling amount of suspended matter. Peculiar nice flavour; pure in taste; sweet, vinous, clear. A valuable wine; the best of all white varieties.

(7.) Shiraz (James J. Fallon). 40 cubic cent. thick and undrinkable; big particles floating. Wine with a half-colour (Schiller); no bouquet; touch of acid; sweetish, lastly bitter. An imperfect wine

(8.) Victorian red wine (J. G. Francis). Burgundy grape, vintage 1869. 25 cubic cent. thick and undrinkable. Dirty brownish red colour, fluorescent at margin; very unfavourable aspect; stinks; no Burgundy character; thin to taste; very astringent and bitter. Very bad wine; equal to wine sold at Lisbon at £4 per pipe.

(9.) Red Ivanhoe (Charles Maplestone). 20 cubic cent. residue, slightly turbid. Goodish colour; slight odour, but thin, peculiar bouquet; fresh taste; little vinosity.

(10.) Carbinet (F. C. Klemm). About 20 cubic cent. of undrinkable, suspended red colouring matter. Good colour; one colour only, but slightly brownish and fluorescent; slight bouquet, confined. Well kept wine, but somewhat brandied.

(11.) No. 1 Sauterne (Joseph Best), vintage 1871. 50 cubic cent. undrinkable and very milky. Strongly dosed with elder-flower; no similarity to Sauterne of any kind; confined taste. The flavour of elder is strongest on the tongue, less perceptible to the nose.

(12.) Victorian red wine (Joseph Best), grape (Hermitage and Pontignac), vintage 1870. 40 cubic cent. of thick (with red matter) undrinkable residue. Wine of half a colour (Schiller), amethystos-looking; curious little bouquet, perhaps elder flower (?).

(13.) Carbinet (F. C. Klemm). 60 cubic cent. thick (with red colouring matter) residual wine. Slight flavour; one colour; very astringent; sweet, and sharp like alum, increasing upon the tongue by contact. In Burgundy "tasse" shows colour of old wine, not young.

(14.) Hermitage (1869) (Carl Pahl). 5 cubic cent., thick with red matter, undrinkable. Peculiar little bouquet; one colour; faculty for quality.

(15.) Verdeilho (1872) (Carl Pahl). 12 cubic cent. of thickly turbid (brownish) residue. Like 6 and 17; flavour less than 6 and 17, but characteristic. There is faculty in this wine as in the others.

(16.) Pineau Blanc and Verdeilho (Bruhn Brothers). 40 cubic cent. of milky, turbid residue. Tastes of the sweetness of the verdeilho first, and of the sourness of the pineau afterwards. Would make good effervescent wine if properly treated.

(17.) Verdeilho (1871) (Carl Pahl). 60 cubic cent. residue; thick, reddish. Stinks; is brandied. Resembles No. 6 in some of its good qualities, but flavour is masked by a disagreeable taste.

(18.) Hermitage (187[illegible]) (Carl Pahl). 25 cubic cent. undrinkable. Thick, very red turbidity, and deposit crystalline. Young wine; a green wine, probably made from under-ripe grapes grown among weeds.

(19.) Carbinet sauvignon (Bruhn Brothers). 50

cubic cent. of thick, carmine-coloured residue; huge deposit. Slight flavour; a well-balanced wine; no Bordeaux flavour; sweetish astringency. Somewhat green, but a valuable wine; the best wine amongst the red varieties.

(20.) Victorian red wine (Jacob Deppeler). Grape, hermitage and Burgundy; vintage 1871. 60 cubic cent. of thick, dark-red residue; much deposit. Australian flavour; a smoky taste of Hungarian; green and astringent wine; wine of two colours, but colour not fine. The darkest coloured wine among the red varieties.

(21.) Hermitage (J. S. Johnston). 40 cubic cent. of turbid residue; no (or little) deposit. Scarcely one colour, about seven-eighths. A very good wine.

(22.) Reissling, 1871. 25 cubic cent. of somewhat turbid and undrinkable residue. Riessling flavour confined, but characteristic of plant; could be mistaken for a Rhine wine; probably brandied.

(23.) O. P. Reissling. 100 cubic cent. very turbid residue. Is brandied; has had raisins in making; no Reissling flavour; flavour like the rest, peculiarly disagreeable; sourish; probably bottled in an unfit state.

(24.) Sherry, 1871. 70 cubic cent. turbid residue, deposit. No sherry flavour; close taste; not brandied or sweetened, nor coloured.

(25.) Burgundy, 1870. 8 cubic cent. of residual wine turbid; red deposit coating internal surface of bottle. Good flavour; little green; not bad to drink.

(26.) Ngarveno (John Davies). 15 cubic cent. residual wine; ochry deposit. A thin wine, probably with Reissling in it; confined odour and taste.

(27.) August Heine, Bendigo. 13 cubic cent. turbid residue; but little deposit. No flavour; bitterish; unpleasant taste left on tongue after drinking.

8. The producers must be commended for stating the names of the vines from which the wines were made, the years and places of production. I can discern in all these wines a certain future, provided always that their production and treatment is effected in obedience to scientifically established truths.

9. The Exhibition contains two photographs of Victoria vineyards, exhibiting accurately the conditions under which wines are most frequently reared in that colony. One is the well-trimmed clean vineyard attached to the habitation of a man of property, well off in the world. The other is a vineyard intended for profit, in a disorderly state, filled up two feet in height from the soil with a thicket of weeds, out of which the vines struggle to sunlight.

10. I believe that some of the wines tasted proceed from well-kept vineyards, others from such vineyards filled with weeds; the wines which I have termed green seem of the latter class.

11. On the whole the wines are such as to encourage the hope that, by continued improvements in culture (foremost the eradication of weeds) and in wine-making, the colonists may succeed in producing wines for their own consumption, and have some over for export. I have not had any statements as to prices and quantities produced. I should advise the colonists to produce clean and uniform staple articles of a cheap kind, without losing themselves in excessive variations. For this purpose co-operation by means of companies seems essential.

12. The wines were mostly below 26 per cent. of spirit, but many were slightly fortified. None were plastered or (with exception of one) artificially coloured; none contained artificial saccharine matter. Two sweet wines of low alcoholicity seemed to be sweet by a natural process of fermentation at a high temperature. There was evidently not a single attempt to imitate or counterfeit composite kinds of wines, such as ports or sherries; and in this principle I see a guarantee of progress in the future.

13. The Australian colonists must ascertain the most suitable varieties of wines for their several localities suitable for its culture. For this purpose they should establish agricultural experimental stations, supported and controlled by the State, to which scientific men, and particularly chemists, should be attached. At these stations the agriculturists could receive all necessary advice to aid them in overcoming the undoubtedly great and numerous difficulties which impede the production of good wine in new countries.

EXHIBITION OF 1874.

Her Majesty's Commissioners have issued the following special note on the fine arts division:—

1. The attention of artists and manufacturers is especially called to Division I. of the subjects chosen for the series of Annual International Exhibitions. Hitherto the exhibition of works of fine art has been too much limited to the display of pictures and sculpture, dissociated from purposes of utility; and it may be doubted whether a picture on enamel or on pottery, destined to be applied to a piece of furniture, or a sculpture in wood intended for a picture-frame, however great its merits, would find any place in the exhibitions of the Royal Academy of London or in any of the numerous other exhibitions of the works of artists. Still less would a Cashmere shawl or a Persian carpet, the chief excellence of which depended upon its combination of colours, find in any of these exhibitions its proper place.

2. Such a complete separation of artistic work from objects of utility may indeed be said to be only the characteristic of modern times; for in the ancient and mediæval periods the highest art is to be found in alliance with the meanest materials of manufacture. The Etruscans painted on vases of clay subjects which still charm us by their beauty of composition and skilful drawing; and the finest works of Raffaelle were designed as decorations for hangings to be made of wool.

3. It is intended that these exhibitions shall furnish

the opportunity of stimulating the revival of the application of the artist's talents to give beauty and refinement to every description of object of utility, whether domestic or monumental.

4. In the annual exhibitions every work in which fine art is a dominant feature will find proper provision made for its display. Painting, on whatever surface, or in any method, sculpture in every description of material, engravings of all kinds, architectural design as a fine art, every description of textile fabric of which fine art is a characteristic feature, in short, every work, whether of utility or pleasure, which is entitled to be considered a work of excellence from the artistic point of view, may be displayed in the exhibitions under the division of fine art. Whilst the manufactures which fall within Division II. will have been brought under review in a series of ten years, the fine art division will recur annually, so that the greatest possible encouragement may be given to progress in the application of art to objects of utility.

5. Every artist workman, moreover, will be able to exhibit a work of merit as his own production, and every manufacturer may distinguish himself as a patron of art by his alliance with the artistic talent of the country. In the fine art section the artist may exhibit a vase for its beauty of painting, or form, or artistic invention; whilst a similar vase may appear in its appropriate place among the manufactures of the appointed year on account of its cheapness, or the novelty of its material.

The committee appointed to arrange and carry out the exhibition of foreign and colonial wines in 1874 desire to call attention to the advantages that may be obtained by exhibiting wines on this occasion, and to point out that it affords a better opportunity of bringing the wines of Australia more directly before the notice of the English and Continental buyers than has ever before been available. The arrangements for seeing, tasting, and obtaining samples of the wines will allow of close and careful comparison with the various Continental wines exhibited of the same character and class; which comparison, the committee venture to hope, will be of some value. The committee also will be glad if exhibitors, where practicable, will send specimens of the soil where wines of a superior excellence or quality are grown, together with particulars of climate, temperature, &c., and information as to mode of growing, making, and maturing the wines, where those processes differ from the methods ordinarily in use on the Continent; to which might be added, age of the vines, per-centage of saccharine in the must, produce per acre, &c., &c.

The committee are of opinion that, if a majority of the growers will send specimens and information as here suggested, it cannot fail to have a material and beneficial influence, not only in extending the consumption of colonial wines, but also in improving and perfecting their growth and manufacture, by the interchange of statistics and experience with growers of the older and more famous wine countries.

In order to perfect the illustrations in the class of civil engineering, architectural and building contrivances, her Majesty's Commissioners have decided to make special arrangements for exhibiting large photographs of new architectural buildings, especially gentlemen's country houses. Photographers are invited to submit views of such buildings and to send them suitably framed to the Exhibition Buildings on the 5th March, 1874. Only those photographs will be eligible which measure not less than 24 inches by 18 inches.

Her Majesty's Commissioners have decided that a portion of the London International Exhibition of next year shall consist of a collection of paintings or drawings representing such ancient and modern buildings, public or private, as are remarkable for architectural beauty or style. They trust that proprietors of pictures of this kind likely to be interesting to the public will be disposed to lend them for exhibition. Her Majesty's Commissioners are particularly desirous of obtaining large paintings of a scenic character, or like diagrams. To those proprietors of interesting specimens of architecture who, not already possessing pictures of them, may be desirous of having them painted for this Exhibition, the Commissioners are prepared to furnish the names of students of art schools who are competent to produce such representations, together with their terms.

Her Majesty's Commissioners have decided to invite the owners of pictures painted by the following artists to intimate their willingness to lend such works for the International Exhibition of 1874, and they request to be favoured with any information respecting them.

Painters in Oil.—John Constable, R.A., died 1837; Augustus Egg, R.A., died 1863; David Roberts, R.A., died 1864; David Wilkie, R.A., died 1841.

Painters in Waters Colours.—J. Coney, died 1833; J. S. Cotman, died 1842; F. Mackenzie, died 1854; S. Prout, died 1852; A. Pugin, died 1832; J. M. W. Turner, R.A. (architecture only), died 1851; C. Wild, died 1835.

Growers and importers who desire to inspect the vaults in the Royal Albert Hall, which will be applied for the purposes of the Exhibition, may do so on presenting their cards at the Queen's entrance of the Royal Albert Hall between two and four any afternoon up to Saturday, 15th November.

EXHIBITIONS.

Vienna Exhibition.—The exhibition was closed on Sunday afternoon, by two of the Archdukes, without ceremony. On the southern terrace three large military bands played the National Anthem. This was followed by cheers from the thousands of persons present.—Seventy thousand articles have been exhibited at the Vienna show, and 26,002 awards have been distributed. Of this aggregate number of premiums 421 were diplomas of honour, 3,024 medals for progress, 8,800 medals for merit, 8,326 medals for good taste, 978 medals for art, 1,998 medals for co-operation, and 10,465 diplomas of merit or honorable mention. These were awarded as follows:—Austria (without Hungary), 5,991; Germany, 5,066; France, 3,142; Italy, 1,908; Hungary, 1,604; Spain, 1,157; England and colonies, 1,156; Russia, 1,018; Switzerland, 722; Belgium, 612; Norway and Sweden, 534; Turkey, 470; Portugal, 441; United States, 411; Denmark, 309; Holland, 284; Roumania, 238; Japan, 217; Brazil, 202; Greece, 183; China, 118; Egypt, 75; Republics of Central and South America, 44; Persia, 29; Morocco, Tunis, and Tripoli, 20; Madagascar, &c., 10; Monaco, 9; Mexico, Siam, and Turkestan, each 1.—A Vienna telegram states that the number of visitors to the Exhibition from the opening day to the close was 7,254,687, of whom 2,196,360 entered without payment.

Industrial Exhibition at Trinidad.—The Corresponding Committee of the Society of Arts announce that an Industrial Exhibition will be held at Port-of-Spain, Trinidad, in the month of December.

Prizes for Designs of Philadelphia Exhibition Building, 1876.—The United States Centennial Commission, at a meeting held in Philadelphia, on August 8th, according to the *Polytechnic Bulletin*, awarded the premiums of 1,000 dollars to each of the authors of the best ten of the competing designs for the 1876 Exhibition Building. From these ten the design for the building will be selected, it being understood that their authors have the privilege of amending their designs before competing for the main prize.

HINTS TO COLONISTS ON THE CULTIVATION OF SILK.

By B. Francis Cobb.

(Continued from page 899.)

On the 23rd April, 1873, a paper by Mons. A. Roland was read at the Society of Arts, and published in the *Journal* of the Society, No. 1,065. It is to be hoped that this paper has been copied into the Colonial newspapers, for colonists should study it well, especially those parts relating to "education in the magnanerie" and "appliances," and bear in mind that when M. Roland speaks of the "Lhou," the colonist has probably the identical leaf, although somewhat changed by acclimatisation, in the common Cape mulberry, which was imported into the Cape years ago by the Dutch East Indiamen coming from Japan.

Neither M. Roland nor any other guide can give all the instruction necessary to suit every position, and colonists must exercise their own ingenuity in making their arrangements as complete as possible for their own requirements. For instance, M. Roland says nothing, and probably has no knowledge, of the hot winds; yet the colonist knows well, from unpleasant experience, that it will be necessary to protect the worms from this, and, as it almost always comes from one quarter, a thick grove of trees may be made to do much to mitigate its effect.

The enemies of the silk worm are innumerable, and again the sagacity of the colonist must be exerted to find means to accomplish that for which no rules can be laid down. The ant, for instance, is probably one of the most troublesome and dangerous little insects of all the enemies of the worm. It is difficult to speak of instinct in connection with its strategical movements, and unless the rearer exercises the most constant care and vigilance, he will find himself outflanked and out-manœuvred by this most artful and aggravating little pest. Beetles, cockroaches, spiders, mice, rats, birds, and even monkeys will all destroy the worms if they have the chance, and the labour of three weeks or a month may be rendered futile in a single night.

Certain odours affect the worm unfavourably, while others, apparently of a similar nature, do not appear to be noticed by them. Thus, where a West-Coast negro woman had gathered what one might call an apron-full of leaves, except that the "apron" was formed by part of the only garment she wore, the worms refused to eat these leaves, while leaves gathered by a Kafir, and cut by him, were not objected to at all. Tar, known as coal-tar, and applied to the supports or legs of the stands, to prevent the ants climbing up, made the worms unquiet, while vegetable, or Stockholm tar, although giving out a more powerful scent, did not disturb them to the same extent.

It has been stated by an authority entitled to every respect, that if four lightning conductors were erected at a distance of a few feet from each corner of the magnanerie, to about six feet elevation above the highest point of the roof, and at the mean level of the roof connected by wires, such an arrangement would prevent a good deal of the disturbance the worms suffer from when the air is charged with electricity, as, shortly before a thunderstorm—a period of considerable danger to the worm, especially at the last stages shortly before mounting, for this frequently induces diseases already alluded to. The condemned wire-rigging of ships make cheap and excellent conductors for such a purpose, and the experiment should be well worthy a fair trial.

The drying the cocoons is important, but simple. Almost any sort of an oven will suffice. To destroy the vitality of the chrysalis at as low a temperature as possible is what is required, and generally that of 160° to 200 Fahr. is sufficient. It should be borne in mind that the lower the temperature at which the pupa is killed the better for the cocoon, too great a heat making the silk brittle. An old-fashioned brick oven is very good, for if it be closed, and the cocoons allowed to remain until it is cold, they will be found partially desiccated; but the best method, where it can be adopted, is by dry or high pressure steam; not only is all danger of scorching removed, but the colour of white cocoons is better preserved. An ordinary iron-bound cask makes a very good means for operating. It should be fitted with divisions, for resting the cocoons upon, of basket ware, or anything else that will allow the steam to penetrate easily, and not discolour the cocoons, avoiding iron wire, &c., The lid is then fitted as tightly as conveniently can be, and a small tap fitted to it. Another tap for the admission of steam is placed below, and a trap for the drainage from the sides of the cask. On the steam being admitted from below, the lid tap is opened sufficiently to allow the air and steam to escape, and this tap must never be quite closed, for it is necessary that the steam should continue escaping. When the chrysalis has been killed, it will be found that the cocoons are dry, and only require desiccating by exposure to the sun and air, or a hot, dry room. It will be found that a good cask will stand quite sufficient pressure to keep the steam dry, provided the escape in the lid be not closed.

After the cocoons have been steamed for about twenty minutes they should be well dried in the sun, or by means of a heated apartment, and, when thoroughly desiccated, they may be packed in the most convenient form and sent to their destination. Press packing will not injure them if the desiccation be complete, but if any moisture remains they will mildew and spoil. Complete and thorough desiccation, so that the chrysalis will pound to dry dust, is an absolute necessity.

In concluding these hints, it cannot be too strongly impressed upon the colonist, that different places and climates require different modifications, that the intelligence of the colonist must be exercised to the utmost; and in the case of anything adverse happening, the cause must be sought for until discovered, when the remedy will generally be found to be easy. Experiments should be tried upon new grounds, and before committing one's self to any serious extent, rearing on a small scale should have demonstrated the suitability of both climate and leaf. The height above the sea-level has a considerable influence upon the time required for the worm to pass through all its stages, and the dryness or humidity of the atmosphere are equally important matters to be carefully studied and calculated for.

The following extract, from the speech of Professor Huxley, F.R.S., to the British Association, in 1870, demands the most careful consideration of all sericiculturists:—

"The silkworm has long been known to be subject to a very fatal infectious and contagious disease called the muscadine. Audouin transmitted it by inoculation. This disease is entirely due to the development of a fungus, *Botrytis bassiana*, in the body of the caterpillar; and its contagiousness and infectiousness are accounted for in the same way as those of the fly disease. But, of late years, a still more serious epizootic has appeared among the silkworms; and I may mention a few facts which will give you some conception of the gravity of the injury which it has inflicted on France alone.

"The production of silk has been for centuries an important branch of industry in Southern France, and, in the year 1853, it had attained such a magnitude that the annual produce of the French sericiculture was estimated to amount to a tenth of that of the whole world, and represented a money value of 117,000,000 of francs, or nearly five millions sterling. What may be the sum which would represent the money-value of all the industries connected with the working-up of the raw silk thus produced is more than I can pretend to estimate.

"Silkworms are liable to many diseases; and, even before 1853, a peculiar epizootic, frequently accompanied by the appearance of dark spots upon the skin (whence the name of 'pébrine,' which it has received), had been noted for its mortality. But in the year following 1853 this malady broke out with such extreme violence, that in 1856 the silk-crop was reduced to a third of the amount which it reached in 1853; and, up to within the last year or two, it has never attained half the yield of 1853.

"In 1858, the gravity of the situation caused the French Academy of Sciences to appoint commissioners, of whom a distinguished naturalist, M. de Quatrefages, was one, to inquire into the nature of this disease, and, if possible, to devise some means of staying the plague. In reading the report made by M. de Quatrefages, in 1859, it is exceedingly interesting to observe that this elaborate study of the pébrine forced the conviction upon his mind that, in its mode of concurrence and propagation, the disease of the silkworm is, in every respect, comparable to the cholera among mankind. But it differs from the cholera, and, so far, is a more formidable disease, in being hereditary, and in being, under some circumstances, contagious as well as infectious."

"The Italian naturalist, Filippi, discovered in the blood of the silk worms affected by this strange disease a multitude of cylindrical corpuscles, each about $\frac{1}{6000}$ of an inch long. These have been carefully studied by Lebert, and named by him, *Panhistophyton;* for the reason that, in subjects in which the disease is strongly developed, the corpuscles swarm in every tissue and organ of the body, and even pass into the undeveloped eggs of the female moth. But are these corpuscles causes or mere concomitants of the disease? Some naturalists took one view and some another; and it was not until the French Government, alarmed by the continual ravages of the malady, and the inefficiency of the remedies which had been suggested, despatched M. Pasteur to study it, that the question received its final settlement, at a great sacrifice, not only of the time and peace of mind of that eminent philosopher, but, I regret to add, of his health.

"But the sacrifice has not been in vain. It is now certain that this devastating, cholera-like pébrine is the effect of the growth and multiplication of the *Panhistophyton* in the silkworm. It is contagious and infectious because the corpuscles of the *Panhistophyton* pass away from the bodies of the diseased caterpillers, directly or indirectly, to the alimentary canal of healthy silkworms in their neighbourhood; it is hereditary, because the corpuscles enter into the eggs while they are being formed, and, consequently, are carried within them when they are laid, and for this reason, also, it presents the very singular peculiarity of being inherited only on the mother's side. There is not a single one of all the apparently capricious and unaccountable phenomena presented by the pébrine but has received its explanation from the fact that the disease is the result of the presence of the microscopic organism, *Panhistophyton.*

"Such being the facts with respect to the pébrine, what are the indications as to the method of preventing it? It is obvious that this depends upon the way in which the *Panhistophyton* is generated. If it may be generated by abiogenesis, or by xenogenesis, within the silkworm or its moth, the extirpation of the disease must depend ubon the prevention of the occurrence of the conditions under which this generation takes place. But if, on the other hand, the *Panhistophyton* is an independent organism, which is no more generated by the silkworm than the mistletoe is generated by the oak or the apple-tree on which it grows, though it may need the silkworm for its development in the same way as the misletoe needs the tree, then the indications are totally different. The sole thing to be done is to get rid of and keep away the germs of the *Panhistophyton.* As might be imagined, from the course of his previous investigations, M. Pasteur was led to believe that the latter was the right theory; and, guided by that theory, he has devised a method of extirpating the disease, which has proved to be completely successful wherever it has been properly carried out.

"There can be no reason, then, for doubting that among insects contagious and infectious diseases of great malignity are caused by minute organisms, which are produced from pre-existing germs or homogenesis; and there is no reason that I know of for believing that what happens in insects may not take place in the highest animals."

Finally colonists are reminded that these hints should not be taken as rules, but rather as aids to those who are endeavouring to enrich their different localities by introducing the cultivation of the most beautiful production yet known, which—though but the product of a worm—dates back to the periods of hoary antiquity, and has been handed down as a constant accompaniment of royalty to the present age.

OUR NATIONAL MUSEUMS.

The following article on this subject appeared in *Iron,* last week:—

"The question started by Mr. Cole, and to which we alluded to some length last week, is likely to receive some additional impetus by the publication of a correspondence between the Society of Arts and Mr. Gladstone, on the subject of the Bethnal-green Museum. The Society of Arts, having contributed to the cost of that museum, and watched its progress carefully, prepared a memorial for submission to the Government through the Premier, having for its end the suggestion that larger supplies should be voted by Parliament towards the establishment of museums, libraries, and galleries of science and art, in such of our large towns as are prepared to bear a certain share in the cost. The memorial was signed by sixty peers, and a hundred and thirty members of the House of Commons, who sunk political differences in their desire to promote a worthy object. A matter of etiquette prevented Mr. Gladstone from receiving a deputation on the subject, and he referred the Society to the Privy Council Office. But the memorialists respectfully declined to appeal to any one save the Prime Minister, and he has agreed to bring their suggestions before the notice of his colleagues. Thus the matter stands.

"The suggestion of the Society of Arts, like that of Mr. Cole, is only part of the great question of the reorganisation of the national museums. This may not be important enough for a 'cry,' nor can we hope that any government will take it up very earnestly. But, nevertheless, it is one of high importance, and one in which all who are concerned for the maintenance of our national superiority in manufactures must feel a deep interest. The necessity and utility of museums is acknowledged; their very existence proves this. All that remains is to maintain them efficiently and economically, a work which is by no means well done yet, and probably never will be until some comprehensive scheme of management is adopted. As at present constituted, museums may be broadly divided into three types—first, that of the South Kensington, Jermyn-street, and Bethnal-green museums in London, and the Albert Museum in Exeter—a type of the actually useful museum, where the artisan may see illustrations of manufacturing operations, and the artist may find examples of the masterpieces of old. Here everything is neat, orderly, and simple; no object is without a label, which explains clearly what it is; and spectators need not wander about among collecttions of incomprehensible curiosities, which excite in their minds wonder, but no interest. The second type is that of the British Museum, which is purely scientific. Museums like this are scattered over the country, containing vast numbers of useful specimens buried in drawers and cases, adorned with Latin labels; museums wherein the populace rove about with awe, partly at the monstrous objects displayed to their gaze, and partly at the tremendous names which they bear. These museums are only fitted for scientific persons; they are next to useless to others, unless, as has been lately done in the British and Ipswich Museums, superintendents and curators are willing to descend from their high level, and escort bodies of simpler folk through the collections, giving as they go some plain account of the more prominent objects. A third type of museum is scarcely to be found in any national collection. It is usually seen in small country towns, where dusty cases are arranged in ill-lighted rooms, and are made the receptacle of rubbish brought by resident gentlemen from all parts of the world—one giving a collection of minerals for which he has not room; another, a few drawers of butterflies of which he has grown tired. South Sea islanders' weapons, elephants' tusks, and other spoils of the chase are scattered about in corners and on walls, and the collection of oddments is dubbed a 'museum.' Our readers can draw on their own experience for other details on this subject, and we are much mistaken if they do not agree with us that the energy that is expended with but little useful result on our local and national museums is almost or entirely thrown away."

After recapitulation of the five points insisted upon by the Society of Arts in connection with the museums, the article concludes:—"We are disposed to go even farther than this, if necessary. If we are to have a good system of technical education, all our resources in the shape of museums must be thoroughly utilised in connection with it; and it will be no injustice to existing interests, or indignity to the memory of deceased donors, to totally reorganise the system—if it can be so called—on which our museums are managed. Unquestionably this is a great scheme, and one which must be attempted, if at all, by the Government. Vested interests will, as always, rise in opposition, but public opinion must insist on the best possible use being made of public property, whether in museums or elsewhere."

PUBLIC MUSEUMS AND LIBRARIES.

The Council propose, with the assistance of the Institutions, to publish monthly in the Society's *Journal* a return of the visitors to the following public museums and galleries, all of which are supported by Parliament. The following returns for October have been made up to the present date:—

	No. of Visitors.
British Museum	
National Gallery	
National Portrait Gallery	
Kew Gardens and Museum	
South Kensington Museum	65,497
Bethnal-green Museum	36,405
Geological Museum, Jermyn-street	2,552
Patent-office Museum	19,814
Edinburgh Museum of Science and Art	24,875
Edinburgh National Gallery	6,781
Edinburgh Museum of Antiquities	5,761
Royal Dublin Society:—	
Natural History Museum	
Botanic Gardens, Glasnevin	
Dublin National Gallery	
Zoological Society, Dublin	10,223
Museum of Irish Society, Dublin	
Tower of London	9,760
Greenwich Painted Hall	

The aggregate production of locks of all descriptions at Willenhall now exceeds 32,000 dozen per week. The locks vary in price from ½d. to 10s. apiece, and in size and style they present an almost infinite variety.

The total number of blast furnaces in America in 1810 was 153, yielding 54,000 tons of iron; at this time there are nearly 600, yielding 2,000,000 tons per annum.

THE TRADE OF GENOA.

The consular reports from Italy show a most satisfactory condition of affairs, more especially at the port of Genoa, which has contributed, in proportion to the importance of her position, to the remarkable commercial activity of the whole country. The progress in the trade, according to the custom-house registers, is really remarkable. The imports in 1869 were valued at £9,300,388, in 1870, £9,499,380, and in 1871 at £10,299,035. It is especially satisfactory to note the great increase in the exports, and to remark that the increase has taken place in all the important articles of home produce, namely, wine, oil, grain, silk, cotton, hemp, hardware, machinery, &c.; whereas, where there has been a decrease, it has been in articles not of home growth or manufacture, but in the re-export of foreign goods. The value of the exports in 1869 was £1,370,808, in 1870, £3,374,732, and in 1871 £4,449,324, The movement of shipping in the foreign trade had again increased in 1871 over all previous years, the largest proportion being in the hands of the Italians themselves.

In the coasting trade the tonnage had fallen off, and seems likely to further diminish so soon as the railways, coastwise and inland, put Geneva in communication with the rest of Italy. The coast line has been pushed on with energy on both sides. The line to Nice was finally open to traffic in the month of March, 1872. The tunnel through Geneva, uniting the east and west coast lines, was expected to be finished very shortly. On the east coast only about 4,000 metres of the principal tunnels have still to be excavated, and it is stated that the line can be opened the whole way to Spezzia by the end of 1873. The line from Savona towards Turin is now being steadily carried on, after a long pause caused by financial difficulties. The harbour works and various extensions and improvements, undertaken at the expense of the municipality, are being carried on continuously but slowly, as in spite of the enormous octroi duties imposed by the town, the financial position is not flourishing, and by no means keeps pace with the great fortunes being rapidly realised by the inhabitants. No one who has seen the quantity of new houses and of whole streets that have been built in the last ten years, would have expected the results of the recent census, which show only a trifling addition to the population; but the explanations are to be found in the very great increase in the population of Sampierdarina, and of all the villages or communes in the immediate neighbourhood. The increasing population having been fairly driven out of Genoa by the enormous octroi duties which are now imposed, not only, as formerly, on food and drink, but on everything, almost without exception, that passes the gates—not even excepting articles that, by the policy of the State, are allowed to pass the customs duty free. The imports of raw cotton had been considerable, whilst the cotton-mills and manufactories were unusually active. Power-looms were rapidly increasing in number, and the same progress seemed likely to follow with regard to spindles, the number of which, so far, had been small in proportion to the quantity of yarn required for the consumption of the former. The smaller industries had all flourished. The vermicelli and biscuit-bakers, soap-boilers, and candied fruit-makers profited especially by an increased demand for export.

From various causes alluded to by Mr. Brown, the British Consul, the trade of Genoa has met with a remarkable propulsion. The political features had been such as to favour in the highest degree the growth of every kind of financial undertaking. With the French defeats and the siege of the capital, the influence so long and arbitrarily exercised by Paris over the Stock Exchange of Italy has become a thing of the past. Genoa, as the richest and most commercial of Italian cities, was the first to take advantage of the opportunity of founding new institutions to supply the want so long felt of greater banking facilities at home, and the eagerness with which the first companies were taken up by the public induced more and more to come forward, till no less than seventeen fresh establishments, with limited liability, have been started, representing collectively a capital of £5,250,000 sterling. The price of Italian rente had steadily risen during the year, and this in spite of a very heavy income-tax, which came into effect in July. This increase in the value of the public securities argued a considerable amount of confidence on the part of the nation, largely justified by the actual course of events in the peninsula. Politically and financially, whether the peaceful and definite occupation of Rome, on the one hand, or the immensely increased production and improved income of the country on the other, is considered, everything has gone well for Italy. In the solution of the Roman question there is a solid guarantee of order and quiet for the future, while the very comforting returns of commerce and taxation show very satisfactory first fruits of the prosperity of a united Italy.

LEAD WATER-PIPES.

Pure water is a grand luxury, and so are other pure things; but it is not necessary to frighten nervous and ignorant people out of their wits about contamination.

The outcry against lead-pipes has been as loud in Paris as in London; but while our authorities have left the matters to chemists and the press, the Municipal Council of Paris has taken a different course, and expresses the results arrived at in the most straightforward language.

Petitions against the use of lead-pipes had been already sent to each member of the council, when an article appeared in a Paris journal, and was republished by several others, stating that the municipal authorities had received a petition that the committee of hygiene had pronounced against the use of lead-pipes, but that the authorities still persisted in employing them. All these assertions were flatly contradicted the other day at the meeting of the council. The administration had not received a petition, the committee had made no report at all on the subject, and the civic authorities did not use lead pipes; they were used by the water company and private individuals whom they supplied. Moreover, it was argued, the use of lead pipes dates back to a very remote period without any accident having been proved against them.

The employment of leaden pipes for water was declared to present no danger, but a patent had been taken out for the manufacture of leaden pipes lined with tin, and the petitions which have been referred to seem to have been drawn up and distributed about by a person interested in the new manufacture in question; and the same person was apparently the author of the article above alluded to, which appeared in various journals. As to the assertion that public opinion had been greatly affected, the council could only say that not a single complaint on the subject had reached it.

However, experiments had been made, and engineers, chemists, and medical men, who had made them, bore witness to the fact, that the passage of water through leaden pipes had caused no accident, and presented no danger whatever.

The opinion of the Academy of Sciences will be taken on the subject, and if any more accusations should be made against the administration, the prefect will appeal to the tribunals also.

A member of the Council said that if there were any sensation caused in the public mind it was that of fear that leaden pipes should be officially prohibited, and thus house proprietors put to great expense without any sanitary advantage whatever.

M. Belgrand, the able director of the water and sewage service of the city of Paris, said that the number of persons who paid for a supply of water in their houses in Paris was 40,000; and, taking the average length of the service-pipes at 40 metres, the total length of the service-pipes would be about 1,600,000 metres—just a thousand miles. The replacement of this length of pipe would cost a large sum of money; still if the necessity existed it must be done; but there really did not exist the slightest danger from the use of lead pipes.

Experiments had been made in the laboratory of the engineer charged with the testing of the illuminating power of gas, and the following are the results:—In operating with five litres of water concentrated by evaporation, the most sensitive tests did not denote the existence of salts of lead. It is true that distilled water has an active effect on lead, forming carbonate of lead, but it only requires an infinitesimal quantity of carbonate of lime in the water to prevent it acting on lead, and all the water used in Paris is in this condition, even rain-water, which meets in the atmosphere with lime, in the form of powder, in sufficient quantities to prevent action on lead. This fact serves to explain why leaden pipes last an almost indefinite period, while cast or wrought iron pipes are worn out in a few years.

There remain still some leaden conduits in Paris of the epoch probably of Philippe Auguste, which, if the water had any effect upon them, would by this time have been pierced like a sieve.

The authorities do not in any way oppose the use of pipes lined with tin; but they present the disadvantage of being dearer than the ordinary kind, and, moreover, the presence of the tin causes asperities where the soldering has taken place, which favour obstructions in the pipes.

The Prefect insisted on this point, that the city is completely disinterested in the question; it does not itself use any lead pipes. Lastly, leaden pipes which have existed in Paris for centuries have undergone no alteration whatever, either in their structure or their inner surfaces, a positive proof that water has no effect upon lead.

After listening to these arguments and explanations, the Council passed a special vote that the observations of the Prefect and of M. Belgrand should be inserted in the minutes.

MEASUREMENT OF CASKS.

In enumerating and describing the new instruments acquired by his departments in the course of the past year, the Warden of the Standards states that he has obtained from Berlin a specimen of the cubic apparatus for verifying casks, adopted by the German Standards Commission. Although some objections were raised to the proposed verification and stamping of casks in Germany, when the project of law for the regulation of weights and measures was before the Committee of the Federal Parliament, yet the proposition was eventually adopted at the express desire of the German wine-growers. The Warden suggests it as a subject worth consideration whether a similar regulation should not be adopted in this country, more particularly in respect of ale and beer casks. For a long period such a regulation was in force here, and was exercised by the Coopers Company of London. An Act of 1531, 23 Henry VIII., c. 4, directed that casks were to be made by artificers of the craft of coopers only. The barrel of beer was to contain 36 gallons, and of ale 32 gallons; the kilderkin was to contain half and the firkin a quarter of those quantities. They were to be of just and good measure, or else above and not under; and every artificer was to put his proper mark upon every one of them. No cooper was to make any other vessel for beer or ale of a greater or lesser number of barrels, unless he marked upon them the true and certain number of gallons they contained, to the end that every person might know the contents thereof. No other casks than were so marked were allowed to be used by beer and ale brewers under penalties. Regulations were also made relating to the construction and verification of soap casks. The Coopers' Company were empowered to search for all such casks, taking with them an officer of the mayor, and to examine them, and if found correct mark them with St. Anthony's cross; if defective they might seize them, and cause them either to be amended or burnt, and a penalty to be imposed on the owner. The regulations of this Act were, by 31 Eliz., c. 8, extended, so far as might be, to foreign casks imported into England, and used by brewers; the Coopers Company to gauge them, and mark their capacity upon them. The Warden of the Standards suggests that if such a regulation should be included in the contemplated legislative measure for improving our system of weights and measures, it would afford what would appear to be a much needed security to the public for obtaining their proper measure of the contents of casks; but that further inquiries upon the subject may be desirable, more particularly as to alterations in the capacities of casks which may occur from time to time after verification, arising from coopering.—*Times.*

THE LOWER DANUBE.

The most important provision of the Treaty of Paris, concluded in the year 1856, as regards the Danube, was the creation of two International Commissions, one called the European and the other the Riverain. The first, composed of delegates from Great Britain, France, Austria, Russia, Prussia, Turkey, and Italy, was charged with the task of executing the works necessary to clear the mouths of the river of the sandbanks and other obstacles, beginning at Issaktcha, a point about twelve miles above the commencement of the Delta; the necessary funds for carrying on the works to be obtained by levying tolls upon shipping. This Commission was to have lasted two years, and was then to have been succeeded by the Riverain Commission, composed of delegates from the states bordering on or traversed by the Danube, namely, Austria, Bavaria, Turkey, Wurtemburg, Wallachia, Moldavia, and Servia. The former Commission assembled at Galatz, in Nov., 1856, and, having caused a detailed survey of the whole field of the Delta to be made, they consulted several eminent engineers for the purpose of determining their choice of the particular outlet and channel best suited for improvement. Several plans were consequently furnished by persons who had studied the matter on the spot, but they differed so much from each other that the Commission was unable to come to a decision. Meanwhile, attention was devoted to the temporary improvement of the Sulina mouth and channel, and the bar was treated on a principle proposed by Sir Charles A. Hartley, the effect of which was most encouraging. Piers composed of double rows of piles, filled up and supported on each side by loose stones, were run out over the bar, so as to confine the water flowing out of the river, and form a continuation of the stream. This work was begun in April, 1858, when the depth of water on the bar was 10 feet. In 1861 the effect of the piers was to deepen the channel to 14 feet in January, and to 17½ feet in August. In 1863 there was a temporary reduction to 13½ feet, but henceforth, and up to this day, the depth of water over the Sulina bar has never been less than 16 feet; the variations now are between that and 20 feet. This great success not only enabled all ships of the ordinary size to enter or leave the river without lightening, but transformed the Sulina into the best port of refuge on this side of the Black Sea. Whilst these works were going on, political events and other circumstances prevented any decision from being come to respecting the final selection of the mouth for permanent improvement, and so much money had been spent by the Commission that it was at last resolved to make the works at Sulina permanent by consolidating the piers with massive stonework, which has been done, and to leave the choice of a better mouth an open question.

Consul Ward, to whose report we are indebted for this information, states that when the European Commission commenced its labours the trade on the Danube was carried on almost entirely in sailing-ships seldom drawing more than 12 feet of water. Steam navigation was, comparatively speaking, in its infancy. For the great majority of ships which ascended the river ten years ago a permanent minimum of 11 feet would have been sufficient, but the rate at which the traffic of ships has gone on increasing was quite unforeseen. Increase in the size of a ship implies, of course, an increased draught of water; and the average register tonnage of 428 or 513 tons corresponds with a draught which generally exceeds 15 feet, so all the steamers descending the river drawing 15 feet or more have to lighten to a draught of at least 6 inches less than the water over the shoals. The expense of lighterage ranges between £100 to £300 for each steamer, and it is attended besides with much loss of time, which to steamers is of very great importance. The want of a sufficient and permanent depth of water in the Sulina branch consequently raises the cost of steam navigation on the Danube very materially, and the expense of lightening is the more burdensome as it can never be foreseen or calculated. The insufficiency of the breadth of the channel is another source of expense, still more unforeseen and impossible to calculate. During the ten years, 1862 to 1871, 213 collisions, 525 strandings, and 12 wrecks were recorded by the commission, and were entirely caused by the difficulties of the navigation, in consequence of the narrowness of the stream. The British shipping suffered 44 collisions, 52 serious and 56 slight strandings. No approximate estimate can be made of the loss occasioned by the casualties, but in many cases it has been heavy. It has not unfrequently happened that a large ship grounding across the stream has stopped the passage entirely.

With regard to the commercial interests involved, we are likewise informed that during the period which has elapsed since the Russian war, the trade with Great Britain has increased still more than it did during the Russian occupation of the mouths of the river. The exports, consisting always of cereals, vary in quantity, according to the abundance or scarcity of the crops; on the whole there is a continued but decided increase, corresponding with the extension of agriculture. Indian corn is now so largely consumed in England that nearly the whole quantity exported by sea from the Principalities goes to Great Britian. Taking one year with another, the value of the exports to Great Britian may be stated at £1,500,000. The imports from Great Britain have also greatly increased, principally by reason of the facilities and cheapness of steam navigation, and, in a minor degree, by the introduction of new articles, such as agricultural steam machinery, and implements, portland cement, railway materials, and others formerly unused or unknown. The value of these imports may be set down at an average of £1,000,000; and, to give still further extension to British trade, greater facilities should be afforded to steam navigation, and the interests of the importers of British goods should not be so entirely sacrificed to those of the British shipping as they now are. The unfitness of the Sulina branch for the navigation of steam-ships has already been described. The only remedy now is to open the St. George's mouth, so as to enter at once into a broad, deep channel, requiring very little expense to improve it. It was calculated fifteen years ago that the cost of removing the bar and improving the channel would be £500,000, a sum considered to be too great for the navigation to bear. The experience gained by the construction of the piers at Sulina proves that similar works could be executed at St. George's at a cost much below the former estimate, and although £500,000 is a heavy burden on the navigation, the sum which the European Commission has already levied exceeds that amount, and £47,000 a year on the average continues to be levied for the purpose of paying the debt of the Commission, and of keeping up a bad channel. According to the amount of the tolls levied, and the value of the imports and exports by sea, it is obvious that the material obstacles to the navigation of the river affect Great Britain infinitely more than any other nation, and in a national point of view it is important to indicate how much British commercial interests would gain by their removal. Shipowners will make no complaint; they will submit to pay any rate of toll, and to bear with the inconvenience of the Sulina branch so long as they find the trade profitable, which no doubt they do. But what that trade would be if the St. George's Channel were opened, can easily be understood. The largest steam-ships which come to the Danube might then enter and leave, ascend and descend the river without lightening, without pilotage, and without the risks of collisions and groundings.

CORRESPONDENCE.

REVOLUTION INDICATOR.

Sir,—Ever since ships were propelled by steam, and more especially since the "screw" and "direct engines" were adopted, it has been a desideratum to provide a "revolution indicator," which would inform the officer on deck, and the engineer in charge of the engine, what are the number of revolutions per minute; and that this information should be obtainable immediately with accuracy by the officer on deck himself, without any reference by him to the engineer, or to any one else, and by both, without any necessity for counting the revolutions, which involves the further necessity of using a watch, and requires a lantern to be brought on deck at night to the officer of the watch on the bridge, which, in bad weather, is often impossible.

Various plans have been proposed, but none have as yet been successful. They have, as a general rule, been dependent upon the centrifugal action of weights, as in the "governor" devised by Watts. The motion of the ship, in rolling and pitching, seriously affects the accuracy of this description of "revolution indicator."

To men-of-war an accurate "revolution indicator" would be invaluable, particularly—

1. *In Fleets.*—Inaccurate station-keeping, which leads to much signalising, to reprimands, to irritation, to grievous waste of time, is caused chiefly by the unnoticed small accelerations and retardations of the engine, arising, amongst other causes, from changes in the mean pressure in the cylinder, and these again result from alteration in the vacuum, in the pressure of the steam in the boiler, or both. "Revolution indicators" would inform the engineer in charge and the officer on deck of any change in the number of revolutions, whether in excess of or in diminution of the number ordered to be maintained by the captain. In fogs, so common in the Channel, "revolution indicators" would be highly prized, and aid materially in keeping the fleet in close order.

2. *In Single Ships.*—Many a hazardous error in the assumed position of ships, and many a wreck, would have been prevented if the officer in charge of the deck could have detected immediately that the engines were being allowed to make more or fewer revolutions than had been ordered.

As it does not appear that there is any prospect of the want being supplied without the incentive (so often successful in previous cases) afforded by the offer of the Society of Arts medal, I submit that the Society offer their gold medal for the best "revolution indicator" fulfilling the following conditions:—

(1) Simple in principle and construction.

(2) Not easily disordered, and easily refitted in case of accident.

(3) Accuracy not dependent upon the ship being upright or steady.

(4) To indicate, wherever placed (and there should be one on deck and one in the engine-room) the revolutions per minute at all times, by night and day, immediately by simple inspection, without the necessity of counting, or the use of a watch.

(5) Moderate in first-cost and cost of fitting. Cost to be stated.

(6) Margin of inaccuracy not to exceed about two per cent.

(7) To be independent of the "Patent Log," the "Berthon Speed Indicator," and the "Counter," all of which instruments fulfil offices distinct from the desired "Revolution Indicator."—I am, &c.,

Alfred P. Ryder, *Vice-Admiral.*

5, Victoria-street, Westminster, October 9th, 1873.

THE SILK DEPARTMENT.—INTERNATIONAL EXHIBITION.

Sir,—When I, somewhat reluctantly, assumed the responsibility of reviewing this department, I did so fearlessly and in good faith. When I saw a notice in the *Warehousemen and Drapers' Trade Journal*, in which my opinions as regards the capability of the manufacturers of Coventry were disputed with considerable acerbity, I took no notice of the anonymous writer. Subsequently a letter, on a portion of the same subject, appeared in the *Times*, signed "William Ablett," which was in part conclusively answered by Professor Leone Levi.

I have to-day received a copy of the *Coventry Herald*, containing the accompanying letter, written by Mr. Thomas Stevens, of Coventry—whose looms at work and productions, shown at the International Exhibition, have excited so much admiration—defending himself, his brother manufacturers, and dyers of Coventry against the accusations of incompetency so freely charged by Mr. Ablett. I take no part in the controversy, but as sustaining the accuracy of the report published in the columns of the *Journal of the Society of Arts*, I leave the matter in the hands of Mr. Stevens, who seems to be well able to hold his own.—I am, &c.,

Francis Bennoch.

80, Wood-street, E.C., October 29th, 1873.

To the Editor of the Coventry Herald.

Sir,—Will you allow me to say a few words in reference to the article copied in your last from the *Warehousemen and Drapers' Trade Journal?*

Personally I have very little to complain of, except that the writer assumes that we do not manufacture ribbons.

It is very rarely that we are without an order of some kind for the very class of ribbon he gives the French the first place for; and we not only make for this market, but often for the Continent and America, expensively figured ribbons. The same writer, I believe, a few days ago wrote to the London *Times*, stating the enormous orders he used to get when he was in the Coventry trade. As large orders are given now, but, as then, are given verbally, and if the goods are wanted they are taken; if not, it is no order at all.

With regard to his assertion that Coventry can't compete with any Continental manufacturers of ribbon, and that she can only make a return when the foreign makers can't supply the market, this is so ridiculous that anyone acquainted with the matter knows that it is a thorough misstatement, and that orders are given in Coventry very early, especially for cheap ribbons. The largest manufacturer here of this class of ribbon has for several years successfully competed with the Swiss. He says Coventry can dye colours creditably; this has been proved over and over again during the last few years, and it is well-known that the best dyers in Coventry can dye colours as well as those on the Continent, in proof of which large quantities of coloured silk are sent to Coventry for that purpose. A further proof is, both English and foreign drysalters and dealers in dyeing materials prefer to carry Coventry dyed skeins of silk to show their colours; it is also admitted by German, French, and Swiss, that Coventry can dye aniline blues better than any place in the world. With regard to his statements about black silk dyeing, many of our manufacturers have tried the Continental dyers, but find there is no advantage whatever; that they can get it weighted as heavily in this country, dyed as brightly, and at a cheaper rate, and in less time, than on the Continent; in fact, one of our black dyeing establishments is as large (with one exception) as half a dozen such houses on the Continent; and there is now in Coventry 20 times as much black silk used and ribbons made as there were 15 years ago, when this said writer was in the trade.

As for Coventry manufacturers not having any double, treble, four, or six shuttle battens, it will, perhaps, be information for the writer to know that there are ten times as many as there were 15 years ago. The watered ribbons he speaks of, to my own certain knowledge, foreign houses have offered large sums to Coventry people to get the method and machinery that we have to water these goods.

In reference to his theory that Coventry manufacturers should throw the silk, and, he assumes, dye it, it is absurd.

We know what silk we want to make our goods of, and can get it by giving orders, as good as a foreigner; and I have always understood that the division of labour is the proper way to produce goods cheap.

Lord Palmerston used to say that "any fool could find fault," but it is much better when they can show us how to improve. This same writer came to Coventry some years ago, as, he said, to revolutionise the ribbon trade; but he so utterly failed that ever after he has been like some men who fail in love-making, and for the remainder of their life take every opportunity of saying that all women are false, and not to be trusted. So he, every time he has the chance, declares Coventry to be unable to compete with a foreigner; and, what is worse, refuses any answer to what he says to be published in the *Warehousemen and Drapers' Trade Journal*,

Yours truly,
THOMAS STEVENS.

THE CHEQUE BANK.

SIR.—The writer of the article in the last number of the *Journal* on the Cheque Bank, while generally hopeful of the success of the "experiment," intimates apprehension of more than one "possible drawback," though recognizing that "in practice" they may not "prove of any importance." Had he stated that all cheques of the Cheque Bank are crossed cheques, and drawn to order, he would have supplied the answer to his hypotheses. For, since the cheques are crossed, the writer is entirely wrong in saying that any rogue finding cheques of the Bank would have "nothing to prevent his getting the money for them at any bank in connection with the Cheque Bank." A crossed cheque may pass through any number of hands as money; but it will not be finally cashed unless presented by a banker, who will know from whom he received it, whilst the feature of the indorsement of cheques to order diminishes the number of cases of improper use of cheques generally, because it goes to supply means of detection. An accomplice ready to take the cheque of the Cheque Bank would not help the original culprit much. Any other individual would merely receive the cheque more readily than one not of the Cheque Bank; in fact, an ordinary person would take it just as he would a bank-note; that is to say, usually not without some knowledge of the person giving it to him. There is no protection needed for the public beyond such precautions as are at present exercised against forged and stolen notes. Under any possible supposition the innocent holder of a cheque of the Cheque Bank, having received the cheque as the genuine representation of money in the Bank—which it must be under whatever circumstances, short of forgery of the paper and form—will be protected; the cheque will be, and cannot but be, cashed when presented, like any other crossed cheque.

The proper question—one of public morals—is whether temptation is thereby held out to crime; or it is, what are the facilities for dishonesty allowed to the finder of a cheque-book or cheque-form, or of a cheque filled up and signed? As to the latter, the finder has to personate the individual to whom the cheque is made payable, and commits a forgery; so thus he runs risk. As to the former, should he forge a name, or even sign a fictitious name, he runs risk; whilst, moreover, he must pay the cheque to some person whose name, real or fictitious, will be on the face and back of the cheque. Thus there are difficulties calculated to deter commission of the apprehended acts.

It remains only to consider the position with the bank of the depositor of the money in the bank who has lost a cheque-book or cheque-form, or a cheque that he had signed and filled up. He could scarcely have had the loss excepting through carelessness, therefore he, and not the bank, might properly be made to suffer the consequences. But where a cheque-form had not been signed by the depositor, the Bank would have had no authority from him to pay the cheque, therefore it would be obliged to make good to him the money. When the Bank receives notice from a depositor of loss of a cheque-form or cheque-book, I believe that it merely requires indemnity against a double payment of the amount, and assistance, if needed, in discovery of any culprit; and supplies a new form or book for the cost of stamps and commission, amounting to one shilling for the book of ten cheques or forms. Probably, however, the Bank would decline further dealings with the careless customer.

In short, the question financial is one for the shareholders of the Bank, who, like those of other banks, must suffer to some extent from forgeries; and there is none that concerns the public, unless it be said that every new thing possessing intrinsic value is to be rejected on the score of morals, because the introduction of it might be followed by some amount of crime.—I am, &c.,

EDWARD HALL.

6, Claverton-street, St. George's-square, S.W.,
October 29th, 1873.

EXPLOSIVE AGENTS.

SIR,—More than twenty years ago I became acquainted with the formula for the composition of a white powder that was said by the inventor, a French chemist, to be at least two-thirds stronger than common gunpowder. As I found it to be very readily manufactured, and without danger, I made up a considerable quantity in the form of the old Enfield ball-cartridge. I furnished many gentlemen belonging to various volunteer corps with a few rounds of ball cartridge, charged with 50 grains of white powder instead of 75, the usual quantity. They were all fired off at their respective butts, and the general expression was that the bullet was rather quicker in reaching their targets than with their own powder, also that they felt much less recoil on their shoulder, as was naturally to be expected from the diminished charge. My French white powder is, therefore, in every respect a fair and practical substitute for common gunpowder, especially as chemically considered; it yields 1,165 volumes of gas and vapour for one fired, while the common only yields 1,022 for one.

Some years since I forwarded, by desire, thirty rounds of white powder ball-cartridge, Enfield pattern, to the Board of Ordnance for trial, but they were returned to me, unopened and untried, because they contained chlorate of potash, as also because I unfortunately, at the same time, recommended the greasing of the barrel by some means after discharge, an operation that the Board considered to be incompatible with military practice, but now, however, universal. So long ago as the year 1827 I adopted grease for the barrel at each discharge when out buck-shooting in Southern Africa, and astonished the Cape Dutchmen with the comparative silence and quickness of my shots.

The manufacture of this white powder is entirely free from danger, as all the ingredients, when alone, are uninflammable. The chlorate, prussiate, and sugar, are ground separately into fine powder, in a common flour mill, and afterwards thoroughly mixed by passing through a continuous cylindrical sieve in such quantities as may be required for delivery. It is to be noted also, that some of the chemical compounds recently put forward as substitutes for common gunpowder can be properly guaranteed.

There are several objections to the general use of this white powder as a substitute for the common. It is liable to take fire if strong acid should be accidentally spilt upon it, an accident very unlikely to occur, for acids are not usually kept in powder magazines, or in ammunition waggons. It is incapable of granulation, an inconvenience in handling, but not all affecting its efficiency. And finally that it is too quick of ignition, for, in the opinion of the artillerists of the present day, slow, that is bad, powder is more efficacious in causing range and penetration than quick, that is good, powder. They formed their opinion upon experiments with the photochronograph, but do not take into account the temporary yielding or pulsation of our modern guns, built wholly of soft iron, whereby a per-centage of the force of the explosion is lost, as regards the explusion of the bullet by quick, that is strong, powder, which, if the body of the gun be an absolutely unyeilding mass, would, of course, produce the longest range and greatest penetration. A very simple experiment proves, however, that white powder is not too quick; for if the long vent or touchhole of a heavy piece of ordnance be primed with it, a considerable portion of time will elapse between the firing of the priming and the explosion of the charge.

In order to remove prejudice I have of late made a black granulating powder, quite equal in explosive,—I should rather say "expulsive"—power, by merely substi-Russian lampblack, the purest carbon known, for the cane sugar in the French formula. This black and granulated powder can scarcely be distinguished in appearance from the common, but 50 grains of it does the work of 75 grains of ordinary black.

The process I adopt for granulation of my species of gunpowder dispenses with the old-fashioned corning-house of our powder-mills, and would, therefore, entirely remove all danger of explosion, which, generally speaking, takes place with loss of life about once a month. My granulating process is precisely the same that had been carried on for some centuries past in the manufacture of seed macaroni, which has of late years been patented by a fiction in law as a new invention for the purpose of making coarse pottery. My system will deliver the finished powder in the shape of dry, hard grains, of any required size, into the powder-casks or other receptacles, ready for immediate transport, without the intervention of the hand of man during the whole process, with the exception of supply and regulation. None of the many chemical preparations now put so prominently before the public are really fair and practical substitutes for common black, such as are the two powders above described, both equally suited for small arms, shells, and heavy artillery, but not possessed of patent right. I charged a two-inch mortar in the possession of one of the great firework makers in the borough, wadded up to the muzzle, and, on firing it, he declared that in the course of his experience he had never met with such powerful stuff, and so manageable too.—I am, &c. H. W. R.

Reading.

NOTES ON BOOKS.

Principles of Decorative Design.—By C. Dresser, Ph.D., &c. (*Cassell, Petter, and Galpin*). The object of this book is to assist the art-education of those who seek a knowledge of ornament, as applied to our industrial manufactures. The greater part of it has already appeared in the pages of Messrs. Cassell's "Technical Educator," but some fresh matter has been added, and the whole revised. The first chapter is general and introductory, and the subjects of the succeeding chapters are as follows:—"Colour," "Furniture," "Decoration of buildings," "Carpets," "Curtain materials, &c.," "Hollow vessels," "Hardware," and "Stained glass." There is thus given a tolerably comprehensive sketch of the various means by which decoration may be applied to our dwelling-houses and their surroundings, and the book is therefore one containing much information, not only for the artificer and workman, but for everyone who cares to surround himself with forms of beauty and truth, in place of the insipid and trivial shapes unhappily but too often produced by the builders and furnishers of the day. It is a very noticeable fact, that while in furniture of the more expensive sort the best and purest taste is very frequently shown, yet the reign of tawdriness and bad taste is by no means at an end, as regards the common house furniture of our middle-classes. Doubtless, much has been done in the way of educating the tastes of every rank of life, nor is it by any means the least important among the many successful tasks the Society has accomplished, that it has been mainly instrumental in cultivating an artistic and educated taste for beautiful forms among those whose means forbid the enjoyment of such forms in any material other than what is common and inexpensive. One of the most potent means of education is provided by the facility with which—through improved industrial processes—the common objects of our every-day life may be beautified and adorned. Naturally the growth of a purer taste produces a larger demand for objects of art-workmanship, and hence again arises the need for a higher education of the workman—a need the Society was the first public body to recognise, and which it always has done, and always will do its best to supply. For books of this character there is, therefore, a large and increasing demand, and if they are well and carefully prepared they are certain to meet with a ready acceptance at the hands of the great working-class public.

Catalogue Methodique de la Bibliotheque de l'Ecole des Beaux Arts.—Par Ernest Vinet. (*Paris*). The library of the Ecole des Beaux Arts is of recent formation; it was only opened in the beginning of the year 1864, and from that time till the end of last year thirty-two thousand persons had visited the reading-rooms. When M. Vinet was appointed "librarian" of the school in 1862, there was really no library; a few books in the class-rooms, and a few more in the lofts were all the literary treasures, and the latter were inaccessible; in two years he collected a valuable library, since largely increased; and in 1864 a convenient reading-room was opened for students, artists, and lovers of art. M. Vinet has now provided the readers with a complete catalogue, a rare thing in the Paris libraries. The catalogue in question is classified, and provided with an alphabetical index of authors' names and titles of anonymous works; and the classification is the same as that adopted by M. Vinet in the "Bibliographie des Beaux Arts," which is now in course of publication. The entrances and references are very full. These two works are valuable contributions to the bibliography of the arts, so well commenced by our own Department of Science and Art.

Studies of Blast Furnace Phenomena.—By M. L. Gruner. Translated by L. D. B. Gordon, F.R.S.E., &c. (*H. S. King and Co.*)—The name of M. Gruner is naturally better known in France than in England, though to those, even in this country, who have studied deeply and scientifically the subject of blast furnaces it is sufficiently familiar. Mr. Gordon has been led to translate his "Etude sur les Hauts Fourneaux" by the consideration that iron-masters and others, to whom alone the work would be specially interesting, are in general not likely to read a technical book in a foreign language. For it should be understood that this is entirely a technical work, and one of a decidedly abstruse nature. M. Gruner founded his treatise principally upon the well-known experiments of Mr. Lowthian Bell, the President of the Iron and Steel Institute, and their results he has digested into a concise and convenient form. It is only within a comparatively short period that any really scientific observations have been made on the physical phenomena of the blast furnace, but the present work alone may serve to show how rapid has been the progress of such knowlegde under the efforts of the energetic investigators who have worked at the subject. The first part of the treatise is devoted to accounts of recent modifications in the furnaces and their practical and economical effects. Such changes have of late chiefly consisted in their enlargement, and the results of this are elaborately calculated. The next principal point is the discussion of the theory proved by Mr. Bell, that the ratio of $\frac{CO^2}{CO}$ in the escaping gases is the index to the working of the furnace. Then follow sections on the caloric consumed, on that absorbed by the reduction of the ores, &c., and by the fusion of the slag, the decomposition of the limestone, &c., on that lost by radiation, on that received by the furnace, and on the sensible heat carried off by the gases. Following come numerous examples of various furnaces, giving the calorific power of coke consumed. There are then some remarks on the effects of various modifications in the furnaces and the methods of working, and some final pages on certain French furnaces. The appendix contains various notes by the translator, and includes "A Brief History of the Theory of the Blast Furnace," &c., as well as a set of tables for calculations.

GENERAL NOTES.

Dear Coal.—Some correspondence has lately been going on in the *Times* on the subject of carriage of coal by railway companies. It appears that one company refused to carry coals from the pit's mouth to a private consumer, upon the ground that by doing so they would "give offence to their customers, the coal merchants." It is understood that this refusal is based upon a decision gven in the case of Oxlade *v.* the Great Western Railway Company, some time ago, to the effect that they were not "common carriers of coal." A writer in the *Times* suggests that herein lies the secret of the dearness of coal, and if this argument is unsound, at least it appears that the present distress might be alleviated by such private competition.

Channel Passage.—With reference to the improvement of Boulogne harbour, and to the conference which was held some short time ago between Sir Edward Watkin and the Minister of the Interior, M. Deseilligny, at Boulogne, it is stated that the Enquete Nautique has reported in favour of the proposed improvements of the harbour, and that the public inquiry, or Enquete d'Utilité Publique, is summoned to meet on the 28th November, after which the question will go finally before the Department of Ponts-et-Chausées, and then on to the Chamber. It is also said that the Folkestone Town Council have resolved to support any scheme having for its object the enlargement of the harbour and retention of the Continental traffic.

Central Asian Railway.—M. de Lesseps is undauntedly pursuing his project for a railway from Orenburg to Peshawur. Through the Russian ambassador at Paris, M. de Lesseps has obtained a passport authorising him and his son to travel through the provinces from Orenburg to Samarcand, in order to enable him to convey to the public a personal assurance of the soundness of his scheme. The great promoter is still sanguine, and talks of having the line from Orenburg to Samercand completed and opened for traffic within six years.

Philadelphian Carpet Manufacture.—There are between 5,000 and 6,000 weavers employed in the 250 carpet manufactories of the Richmond district, Philadelphia, besides about 8,000 reelers and spoolers. The number of looms is estimated at 8,000, from which 800,000 yards of ingrain damask, Venetian, two and three-ply carpets are turned out weekly. The number of yards manufactured annually has averaged 41,600,000. The amount of capital invested, 3,000,000 dols.

Old Railway Tickets.—Curiosity has occasionally been attracted by the question of what becomes of all the cancelled railway tickets? The average number issued in Paris is about 30,000 daily, making an annual total of 10,940,000, and the figure for the whole of France is calculated at 40,000,000. The weight of each morsel of cardboard is one gramme, and the sum realised by the companies selling them wholesale to the paper-makers, to be remade, is from 16,000 to 18,000 francs.

Technical Education in Belgium.—The Antwerp branch of the "Denier des Ecoles" Society has just opened a technical school for young ladies from the Belgian middle classes. The pupils, who are to contribute a nominal monthly fee of three francs towards their schooling, will not only be enabled to learn in that establishment some profession or trade suited to their capacities and inclinations, but, in addition to this, they will be permitted to follow a course of instruction in four modern languages.

Dearness of Coal in France.—The Parliamentary Commission which was recently appointed by the French Assembly to inquire into the causes of, and the remedies for, the present high price of coal, has presented its report. It appears that the annual consumption of coal in France in 1860 was 14,000,000 tons, of which 6,000,000 tons were imported. At present the consumption is 22,000,000 tons, of which 8,000,000 tons are imported. The home production has, therefore, increased from 8,000,000 tons to 14,000,000 tons in the 13 years. The export is trifling, only 350,000 tons against 200,000 tons in 1860. No practical measures for alleviating the present dearth of fuel are brought forward in the report, but some good has been done by the facts which have been collected, especially those relating to the actual coal area in France. This is stated to cover 864,500 acres, but a large proportion of it has not yet been explored, and nothing appears to be known as to the cost at which the coal can be raised in the unexplored districts.

Submarine Navigation.—It is stated that there is now being constructed at Cronstadt a submarine vessel of enormous dimensions. In it two thousand tons of iron and steel have been employed. It is propelled by two powerful air-engines, will be armed with a formidable ram, and will carry all the means for fixing to the hulls of vessels large cylinders of powder which it can afterwards explode by electricity. Two glass eyes will enable the crew to find their way about, and they may choose their course at what depth they please below water.

Silk in Turkey.—The production of silk, all kinds inclusive, in this country between the years 1846 and 1857 was equivalent to the yearly average of 960,000 lbs., worth £916,000 sterling, of which quantity, 152,670 lbs., of the value of £141,250, were produced by factory labour. From 1858, in which year the production was first affected by disease, to the present day, the yield has gradually fallen off, and the average yield of the last fourteen seasons has not been more than 393,000 lbs., valued at £620,000. Of this production, however, from 80 to 90 per cent. has been factory-reeled silk. Hand-reeled silk ceased to be produced in 1857. At this day 90 per cent. of the yield in cocoons is converted into reeled silk by factory labour. The balance of the crop not manipulated in the factories is represented by produce exported in its first form of cocoons.

New Zealand Gold.—The yield of gold in New Zealand up to the end of 1872 was 6,718,218 ounces, valued at £25,814,260, of which the north island furnished 734,269 ounces, worth £2,563,307. This gold is obtained by lode-mining in igneous rocks belonging to the Neozoic epoch. The south island furnished 5,983,979 ounces, value £23,250,953, chiefly obtained from the metamorphic rocks by alluvial washing.

Tonic Sol-fa Teachers' Association.—This Institution (in union with the Society) has just published its fourth annual report, the tone of which is very satisfactory. The object of the association is the mutual improvement in music of its members, and to this end it holds meetings and weekly classes for the study and practice of music. One of these, the theory of music and staff notation, is specially intended to prepare for the Society's examination. The present number of members is 66.

South American Cattle.—The importation of live bullocks from America to the Clyde by the New York steamers is now an established fact. Two of these bullocks were brought over about the end of July by Messrs. Henderson Brothers, the owners of the Anchor line of Clyde and New York traders, and landed safely in Glasgow. These were succeeded by two in each of the two following steamers, and all met with a ready demand. Messrs. Bell and Sons, early in August, began to import on their own account, and brought over six in almost each of the steamers arriving that month. In September the numbers increased to ten, and even twelve, per steamer. The total import of bullocks in July numbered four; in August, thirty-eight; in September, seventy-two.

Paper as a Building Material.—The use of paper as a substitute for wood in the construction of railway carriages has long been known, and paper wheels have been used successfully in the United States—in which country paper collars, hats, shirts, waistcoats, and other "notions" seem first to have originated—but the use to which this material can be put seems now to be without limit, as there is a paper church actually existing near Bergen, which is is capable of containing about 1,000 people. It is circular within, and octagonal without. The relievos outside, and the statues inside, the roof, the ceiling, are all of *papier maché*, rendered waterproof by saturation in vitriol, lime water, whey, and white of egg.

The Coal Fields of China.—There has long been much talk of the extensive coal fields within the Chinese Empire, but nothing definite has been published concerning them. M. Louis Strauss, Consul for Belgium at one of the Chinese ports, now furnishes the *Indépendance Belge* with the following figures as to the extent of the coal formation in the northern provinces of the Empire:—

	Sq. miles.
In Chiensi	9,000
In Chansi	28,000
In Tchyli	30,000
In Ching-King	20,000
	87,000

In addition to these there are the coal deposits of Formosa, an island off the Chinese coast, 10,000 square miles, making the total coal area 97,000 square miles.

Safes.—Some experiments have recently been made at Birmingham upon a new invention by Mr. Geering, of the Apollo Works. This consists in the arrangement at the back of the door and in front of the lock, or at any other required part, of a series of cylindrical steel rods or bars, which are carried by bearers in which they are capable of freely rotating. The rods are placed side by side, and as near together as is compatible with their perfect freedom of motion. In the experiments a dozen and a half of hardened steel drills, driven by steam power with a pressure of about half a ton, were employed to penetrate the iron and steel plates. On the tool coming in contact with the revolving bars, however, it made no impression on them. There was no "bite" for the drill on the steel rods, but instead there was a sound of the "clicking" of the rods quite loud enough to give an alarm. The noise is caused by the rotary motion of the rods, which on pressure from the drill turn on their axles and move from under the tool, thus preventing the drill having a bearing upon them. The experiments were of the severest kind, and in nearly every instance the steel drill was broken when it came in contact with the revolving rods.

Transmission of Motion.—Prof. Sylvester has recently made a discovery which is likely to create some interest, not only amongst mathematicians, but also amongst mechanicians and instrument-makers. By means of a sort of lazy tongs he has succeeded in converting spherical motion into plane motion, a result, we believe, hitherto looked upon as unattainable. This discovery will form the subject of a communication which Mr. Sylvester is announced to lay before the London Mathematical Society at its Annual General Meeting on Thursday next (November 13).—*Nature.*

Coinage in 1872.—The year 1872 was remarkable for an extraordinary and unceasing demand for all denominations of gold, silver, and bronze coin. The following was the weight of metal issued:—Gold, 119 tons; silver, 137 tons; bronze, 114 tons. The total number of pieces struck was 52,841,048, as against 30,022,404 during 1871, and their value, real or nominal, £16,426,663 10s. The value of the British coins struck during the year was—gold, £15,111,021 10s.; silver, £1,265,780 0s. 3d.; bronze, £47,341 3s. 1d. making a total of £16,424,142 13s. 4d.

Railways in Java.—The report has just been published of the Commission appointed some months ago to examine the question of the financial conditions on which a concession could be granted to private persons for the construction of railways in Java. The Commission were also instructed to indicate the direction to be taken by the several lines. The Commission propose that 960 kilometres of railway lines should be constructed. The concession will be granted by private tender to those who can provide the best guarantees, without distinction of nations. The concession is granted for ninety-nine years; when this term is expired the State becomes the owner. If the costs of construction exceed the estimate, the Government will contribute from sixty to ninety per cent. of the amount.

Soluble Glass in the Arts.—The employment of this substance in the arts is rapidly extending, and it has become indispensable in many industrial branches. It seems to be specially well adapted to the production of cements; when intimately mixed with fine chalk it is found that a hard cement will be formed in from six to eight hours. With powdered sulphide of antimony a black mass is produced, which is susceptible of taking a high polish, and possesses then a superb metallic lustre. Fine iron dust gives a gray-black mass of great hardness. Zinc-dust gives a gray mass of much hardness, and having a metallic lustre. Zinc castings can be readily repaired by its aid.—*Journal of the Franklin Institute.*

NOTICES.

THE LIBRARY.

The following works have been presented to the Library:—

Studies of Blast Furnace Phenomena. By M. L. Gruner. Translated by L. D. B. Gordon, F.R.S.E., F.G.S., &c. A. S. King and Co. Presented by the Publishers.

Transactions of the Institution of Naval Architects, Vol. xiv. Presented by the Institution.

Statistics of the Colony of Victoria for 1872. Part 3, Population.

The Journal of the Royal Geographical Society. Vol. xlii. Presented by the Society.

Waste Products and Undeveloped Substances, by P. L. Simmonds (new edition). Presented by the Author.

The following work has been purchased for the Library:—

Protection against Fire, by Joseph Bird.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Royal Geographical, 8½.
Tues. ...Anthropological Institute, 8. Mr. John Robinson, "On Modern Locomotives, designed with a view to Economy, Durability, and Facility of Repairs; together with some particulars of Duty Performed, and the Cost of Repairs."
Thur....London Mathematical Society, 8. Annual General Meeting.

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FRIDAY, NOVEMBER 14, 1873.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

NOTICES TO MEMBERS.

Ordinary Meetings.

The One-Hundred-and-Twentieth Session of the Society, will commence on Wednesday, the 19th November, when the opening address will be delivered by Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman of the Council.

The following are the dates of the Wednesday evening Meetings, the chair being taken at eight o'clock:—

1873.	November	—	—	19	26	
,,	December	3	10	17	—	—
1874.	January..........	—	14	21	28	
,,	February	4	11	18	25	
,,	March	4	11	18	25	
,,	April............	—	8	15	22	29
,,	May	6	13	20	27	

The Annual General Meeting will be held on June 24th, at four o'clock. No visitors are admitted to this Meeting.

For the Meetings previous to Christmas, the following arrangements have been made:—

November 19.—Opening Address by Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman of the Council.

(On this evening the Prince Consort's Prize, the Prizes gained at the Technological Examinations, and the Medals awarded during the last Session, will be presented by the Chairman.)

November 26.—"On the Manufacture of Iron and Steel," by Sir Francis C. Knowles, Bart.

December 3.—"On Australian Vines and Wines," by J. T. Fallon, Esq. On this evening Sir Daniel Cooper, Bart., will preside.

December 10.—"On Mechanical Processes for producing Decorative Designs on Wood Surfaces," by Thomas Whitburn, Esq.

December 17.—"Whitby Jet and its Manufacture," by John A. Bower, F.C.S., Science Master, Whitby School.

Each Member is privileged to introduce two friends to every Meeting, and a book of blank tickets has been forwarded for this purpose.

Cantor Lectures.

The first course of Cantor Lectures for the ensuing Session will be "On Spectrum Analysis as aided by and aiding the Arts," by J. Norman Lockyer, Esq., F.R.S., and will consist of two lectures, to be delivered on Monday evenings, the 24th November and 1st December.

Lecture I.—November 24th, 1873.

On the application of Photography to Spectroscopic Researches.

Lecture II.—December 1st, 1873.

On Spectroscopy in its quantitative relations.

The second course will be on the "Chemistry of Brewing," by Dr. Charles Graham (University College, London), and will consist of seven Lectures, to be commenced on Monday, the 8th December; two to be delivered before Christmas, and the remaining five after Christmas, as follows:—

Lecture I.—December 8th, 1873.

Historical and Preliminary.—History of brewing. Varieties of grain used. Chemical examination of the properties of cellulose, starch, dextrine, grape sugar, gluten, &c. Action of nitrogenised substances on starch.

Lecture II.—December 15th, 1873.

On Malting.—The germination of seeds. Chemical changes produced. Examination of the processes of steeping, germination, and kiln-drying. English and Bavarian methods contrasted. Chemical examination of malts, with some analytical methods adopted for the use of the master brewer (Braumeister).

Lecture III.—February 2nd, 1874.

On mashing.

Lecture IV.—February 9th, 1874.

On Boiling. Hops, their properties and uses.

Lecture V.—February 16th, 1874.

On fermentation. (Primary.)

Lecture VI.—February 23rd, 1874.

On fermentation. (Secondary.)

Lecture VII.—March 2nd, 1874.

The beer of the future.

These lectures will include a chemical examination of the chief features of the methods of brewing adopted in England, Scotland, Germany, Belgium, and Norway, with proposals for the prevention of acidification and other destructive changes which occur in beer. The lectures on fermentation will include an account of the nature and chemical functions of the various yeast plants. During the course, chemical tests will be described for the guidance of the brewer in the mashing, boiling, and fermenting processes, and for testing the purity of the water and utensils used.

Other courses will also be given during the Session, one by Professor Barff, M.A., having been already arranged. These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture.

Tickets for the first course are forwarded to Members with this *Journal.*

FOOD COMMITTEE.

The Food Committee will hold a meeting in the Society's Great Room, on Friday, the 21st November, at four o'clock, when James Harrison, Esq., of Melbourne, will lay before the meeting a full account of his proceedings in reference to his recent attempt to import frozen meat from Australia. Benjamin Shaw, Esq., Chairman of the Food Committee, will preside.

Members of the Society and their friends are invited to attend.

The meat which was preserved in tallow, by M. de la Peyrouse's process, and sent to Buenos Ayres and back in March last, by way of test, returned on September 11, and on examination it appeared that the result was by no means satisfactory.

TECHNOLOGICAL EXAMINATIONS.

The Programme of Examinations in the technology of the Arts and Manufactures of the country for 1874, is now ready for issue. These examinations will be held annually, in conjunction with the examinations of the Science and Art Department, and due notice will be given of the particular subjects selected each year.

The subjects for the year 1874 will be Cotton, Paper, Silk, Steel, Carriage-building, Pottery and Porcelain, Gas Manufacture, Glass-making, and Cloth Manufacture. Candidates, in order to obtain certificates in any of these subjects, must pass the examinations of the Science and Art Department in certain sciences, which are specified in the programme as bearing upon the particular art or manufacture. In addition to these, special papers will be set in the technology of each manufacture, by examiners appointed by the Society of Arts.

The following Prizes are offered by the Society of Arts in each of the nine subjects.

To the best candidate in Honours, £10.

To the best candidate in the Advanced Grade, £7.

To the best candidate in the Elementary Grade, £5.

The following special additional Prizes are offered:—

By the Worshipful Company of Clothworkers, a Scholarship of one hundred guineas, to be awarded to the best Candidate in Cloth Manufacture, presuming that in the opinion of the Council he reaches a sufficiently high standard. The Candidate who obtains this Scholarship must spend at least one year in some place of scientific instruction, to be approved by the Council of the Society of Arts and by the Court of the Clothworkers Company.

By Wyndham S. Portal, Esq., to the Second and Third best Candidates in the Elementary Grade, Paper Manufacture:—

A Prize of	£3
A Prize of	2

By G. N. Hooper, Esq., to the Second and Third best Candidates in the Elementary Grade, Carriage Building:—

A Prize of	£3
A Prize of	2

By the Worshipful Company of Spectacle Makers, to the Second-best Candidate in Honours in the Advanced Grade and in the Elementary Grade respectively, in the Manufacture of Glass:—

A Prize of	£5	5
A Prize of	3	3
A Prize of	2	2

The examinations of the Science and Art Department will be held during the first three weeks of May, the technological paper being worked on the evening of the 16th May. The dates of the Science subjects are given in the Science Directory, published by the Science and Art Department.

In order that these Examinations may really be successful in promoting technical education in this country, it is desirable that encouragement should be given to candidates by the offer of prizes and scholarships. With this object the Council appeal to the trade guilds of the city of London, to merchants and manufacturers, and to members of the Society generally, to aid them by contributing to the prize fund.

While expressing their thanks for the assistance they have already received, both from the companies of the City of London and from private individuals, the Council would repeat the appeal, made last year, when the scheme of Technological Examinations was first put forward, for further funds to enable them to prosecute and carry out in its entirety the plan which has been drawn up.

GENERAL EXAMINATIONS, 1874.

The Programme of Examinations for 1874 is now ready, and may be had gratis, on application to the Secretary.

These Examinations, in 1874, will be held on the evenings of the 21st, 22nd, 23rd, and 24th April. The Time-table has been arranged as follows:—

Tuesday, April 21, From 7 to 10 p.m	Wednesday, April 22, From 7 to 10 p m.	Thursday, April 23, From 7 to 10 p.m	Friday, April 24, From 7 to 10 p.m.
Arithmetic. Logic. Floriculture.	Theory of Music English History. German. Spanish.	Political Economy. French. Fruit and Vegetable Culture.	Book-keeping. English Language. Italian.

Friday, April 24, 6 to 7 p.m.—Dictation.

The rule which formerly prevented a candidate who had once obtained a first-class certificate in a subject from being again examined in that subject with a view to gaining a prize, has, in accordance with the wish expressed at the Conference, held on the 27th June, 1873, been rescinded. In future, therefore, a candidate who has obtained a first-class certificate in a subject may be again examined in that subject, but not more than one first-class certificate in any subject will be counted for the Prince Consort's Prize, or for the Council Prize to Females. A candidate having taken the first prize in any subject cannot again take a prize in that subject, nor can a candidate take a prize of the same grade twice in any subject.

The Elementary Examinations, held by the District Unions and Local Boards, for which papers are furnished by the Society, are fixed for the 10th, 11th, and 12th March.

Full details in reference to the Examinations are given in the Programme, copies of which should be applied for to the Secretary of the Society of Arts, by all intending to come forward as candidates, or otherwise interested in the Examinations.

THE GOVERNMENT AND OUR NATIONAL MUSEUMS.

The following is abridged from *Nature* of last week :—

We referred last week to the intention of the Government to transfer one of the metropolitan museums, under the control of a responsible Minister of the Crown, to the fifty irresponsible trustees of the British Museum, this step being contemplated without referring the question either for the opinion of the Science Commission now inquiring into these subjects, or for the authority of Parliament. We have learnt since that the measures for effecting this change are in active progress, Lord Ripon and the trustees of the British Museum having agreed that the transfer was to be made if practicable, Sir Francis Sandford, Mr. MacLeod, and Major Donnelly, on behalf of the Science and Art Department; and Messrs. Winter Jones, Franks, and Newton, on behalf of the trustees of the British Museum, are now busy as Commissioners to find out if the transfer be practicable.

What the Commissioners will propose as practicable is of course known only to themselves, if it be known even to them. Thus much, however, is known—The South Kensington Museum must remain the headquarters of science and art teaching, unless that too is to be put under the Archbishop of Canterbury and his co-trustees; and if not, then there must be a dual government in one and the same building, unless Mr. Lowe's project be abandoned.

The public has had already a specimen of this kind of dual Government at the South Kensington Museum, which has had disastrous results for science. When the "Boilers" were first erected in 1856, the Commissioners of Patents had assigned to them a portion at the south end of the building for exhibiting those mechanical and scientific objects which, under a fiction, were supposed to have derived their origin in "patents." It was necessary that the visitors to all parts of the "Boilers" and to the picture galleries should pass through the "Patent Division." The Lord President made sensible rules for admitting the public on three days, open from 10 a.m. to 10 p.m., and three days called "students' days," when persons not students paid sixpence each, or ten shillings a year, the object being to have three days free from crowds and kept quiet for study. After a while the Commissioners of Patents were scandalised at thus receiving public money (they are the instruments for taking seventy thousand a year from inventors, and misapplying it to general taxation), and they said they preferred crowds every day as the most convenient public arrangement. The authorities came to open discord on the point, and the matter could only be resolved by separating the "Patent" from the other collections. So the Patent Commissioners built a separate entrance for themselves. What has been the result? About eight millions of visitors to the South Kensington Museum, who would otherwise have seen the "Patent Museum," have not done so, and the commissioners have deprived themselves and their museum of the moral support of these great numbers. And what has been the result of this? The Chancellor of the Exchequer has been allowed to sack more than a million of pounds sterling, realised from the taxes imposed on inventors' patent fees, and has not allowed one farthing to be spent for the provision of a suitable building for the "Patent Museum." Anything more discreditable to the nation than the building now crowded with models cannot be conceived. Many of the passages are not eighteen inches wide! What the present Lord Chancellor, the head Patent Commissioner, would say if he were ever to see it, cannot easily be imagined. We advise his lordship to hold a board in the building as soon as possible. It will probably be the first board of patent trustees that ever sat there. We are satisfied that the result would be that he would instantly cause the present exhibition to be closed, and adequate space found elsewhere. Then what have inventors got in return for the tax of a million drawn from them? And what may not invention have lost by this indefensible principle of taxation?

Although, as we have stated, this proposal was made without reference either to the opinion of those to whom the interests of Science and Art are more precious than they are to the members of the present government, or to the opinion of the House of Commons, we learn that Mr. Mundella has extracted a promise from Mr. Gladstone that nothing shall be decided until Parliament meets again. Mr. Gladstone is perhaps surprised that there is any public interest in the subject. In the meantime, to assist him to form a correct judgment, we advise every learned society which takes any branch of science under its care to memorialise the Prime Minister, and point out the crying necessity of a minister who shall be responsible to Parliament for science, among other matters, and for all museums; that to transfer a museum already so represented to irresponsible trustees is a step worthy of the middle ages; and, finally, that while the South Kensington system represents everything that is best in the way of progress, so much, to say the least, cannot be urged in favour of the present management of the British Museum.

One of the first results in the rise in the price of coal has been the formation of a company in France, whose object is to utilise the power of the ocean tides on the French coast by proper machinery. The first experiment is to be made at St. Malo, where the tide rises nearly eighty feet, and overflows many square miles of flats.

The Yorkshire College of Science is likely to be soon commenced, as only £5,000 remains to complete the required amount, and on Monday last the promoters resolved to organise local committees to raise this sum.

Samples of the Philadelphia and Reading Railroad Company's coals are to be analysed, and the results sent to the Governments of Russia and France, in order to find if the American coals could be used on their railways.

An underground railway has been constructed in the city of Constantinople, and the contractors are now finishing up the termini. It will soon be open for traffic.

INDIAN HARBOURS.

The following letter appeared a short time back in the *Shipping and Mercantile Gazette.* It may perhaps serve to illustrate the paper on "Indian Harbours," read last session by Sir Arthur Cotton, R.E., at one of the Society's Indian Conferences:—

Sir,—Solid breakwaters, either of stone or concrete masonry, are of no permanent use, and are doing great harm in several places, by acting as gatherers or collectors of sand, mud, or shingle, and thus forming fresh bars or slopes on the weather sides. Again, if a vessel runs against this solid masonry, the result is wrecking the ship and destroying wholly or partially the expensive masonry of that breakwater, which was constructed professedly to protect ships from wreck and destruction. I have offered my propositions, through your journal, for a practical substitute for solid breakwaters, by floating timber breakwaters, described in the *Shipping and Mercantile Gazette* of April and May, 1872. These allow the sand or silt to go through them, by a triple screening, with the sea waters or waves, which latter become broken and reduced in their passage through the skeleton breakwater and over the dead water ballast, forming a quiet anchorage refuge for ships on its lee side, whenever a heavy gale is blowing on the weather side. The silt, sand, or gravel, which collects on the sea beds, after screening through the floating breakwater, can be removed by steam dredges, behind the breakwater, whenever required. Should an unfortunate ship be driven in a gale of wind, with loss of rudder and beyond control, against the floating timber breakwater, they would each, ship and breakwater, rebound to the blow, as a railway carriage does to a fixed railway buffer, which latter cannot be made to retreat or rebound, as the floating breakwater will and does. If these floating breakwaters, constructed on my principle, were effectively moored on safe anchorage grounds, they would endure and be perfectly effective, for 50 to 60 years at least, and could then be replaced by a new in place of an old breakwater. The cost would be from five to six times less than that of a solid or stone breakwater, the practical endurance of the latter being very doubtful in some cases, while in many others it proves to be a very destructible and also destructive construction. A very few years hence, perhaps months, will pass over the ruins of several stone breakwaters, which have been most wretchedly constructed, in defiance of the laws of nature and in contempt of real practical engineering. These floating timber breakwaters are the only real correctives for the yearly calamities, resulting principally from the south-west monsoon, in the Bay of Bengal, and in the Arabian Sea or the Indian Ocean. The present harbours of Calcutta, Madras, Rangoon, False Point, Cocanada, Masulipatam, and Colombo, in Bengal Bay, and Bombay, Kurrachee, and Cape Comorin, in the Indian Ocean, suffer more or less, and could be protected from yearly destruction by a face and flank of floating breakwaters, moored *en echelon.* These might be arranged in straight lines, or in curves or bows outward towards the sea, and not inwards, as bays, as the Holyhead breakwater was constructed, and which latter must sooner or later lead to its total destruction, by one of the gales from the Irish Channel. A portion of the Ramsgate Harbour was similarly misconstructed, with the bend inwards instead of outwards, and yet this false principle is occasionally supported.

If new harbours are to be constructed on the coasts of India, to meet the rapidly increasing commercial trade in imports and exports, the best situation of all that can be selected is the inner bay or natural harbour of Cutch, which is approached through the Gulf of Cutch, and has another outlet (or inlet) further northward, with a large piece of island ground lying between the two streams, with a sea frontage and a harbour frontage, the latter possessing all the advantages of Liverpool with none of its disadvantages, and will no doubt ere long be constituted the finest harbour in the world. The next in comparison is a little more southward, in the Gulf of Cambay, where, by forming a curved *echelon* of floating breakwaters on its seaside or entrance from the Arabian Sea, a magnificent harbour can thus be created and formed at a moderate outlay. The wonder and astonishment of any unprejudiced man must be felt and expressed that Bombay and Kurrachee have had the preference to Cutch and Cambay natural harbours, but it is possible and probable this resulted from the fact that Bombay merchants, and others equally interested in taking care of themselves, forget that the public benefit, or country's good, had also claims to be recognised, which must now soon be shown by the practical adoption of Cutch and Cambay Harbours for India. Hence Bombay and Kurrachee must, in a very few years, play second fiddle to the other two, which are each so much better in every possible circumstance. Sir Arthur Cotton's suggestions for new harbours are followed up by truly valuable propositions for the formation of a continuous line of canals along the coasts or shores of India, from Rangoon to Calcutta, on to Madras, to Cape Comorin, to Bombay, and onward in line internally to Moultan, with diverging, lateral, or spreading branches of rivers, canals, and steam tramways, from the proposed "Grand Shore Canal," which will traverse through about 2,500 miles of coast and country, from Rangoon to Moultan, spreading immense trade and commerce throughout India, by uniting all the great rivers and railroads with the canals and tramways, &c. The great question of cost or outlay for constructing these canals and steam tramways can be answered by the fact that when once accomplished (which they should be with all possible speed) at an expenditure of not less than £12,000,000 sterling, it can be followed up by another £12,000,000 sterling for harbour extension and improvements, which should follow, or keep pace rather, with the canal and tramway economic internal communications. The return interest on the capital outlay would surely and certainly be good, and by forming a sinking fund, the whole first cost and expenditure would be cleared from an immense revenue of tolls, collected from the canal dues on thousands of millions of tons of goods, minerals, cattle, manufactures, passing to and from India and all parts of the world. The future aggression of India from external foes would be met by our securing the goodwill of our 160,000,000 dependents.—Yours, &c.,

London, June 28, 1873. W. AUSTIN, C.E.

MEETINGS FOR THE ENSUING WEEK.

Tues. ...Zoological, 8½
Civil Engineers, 8. Discussion upon Mr. Robinson's paper, "On Modern Locomotives."
Statistical Society, 7¾. Inaugural Address by Dr. William A. Guy, F.R.S.

Wed. ...**SOCIETY OF ARTS, 8.** Opening Address of the One Hundred and Twentieth Session by Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman of Council.
Geological, 8. 1 Mr. J. W. Hulke, "Supplementary Note on *Hypsilophodon Foxii.*" 2 Mr. T. Mellard Reade, "The Drift-beds of the North-west of England—Part 1. Shells of the Lancashire and Cheshire Low-level Boulder-clay and Sands." 3. Mr. R. D. Darbishire, "Note on a Deposit of Middle Pleistocene Gravel near Leyland, Lancashire." 4. Mr. H. G. Fordham, "Notes on the Structure sometimes developed in Chalk."
Linnæan, 8. 1. Mr. Groves, "Monte Argentaro, its Flora in July." 2. Dr. Dickie, "Challenger Expedition—Bermudan Algæ." 3. Dr. Dickie, "Algæ of Mauritius." 4. Rev. C. A. Johns, "Germination of Delphinium."

Thur. ...Chemical Society, 8. 1. Mr. E. Divus, "On the Chemical Properties of Ammoniated Ammonia Nitrate." 2. Mr. H. J. Russell, "On the Action of Hydrogen on Silver Nitrate."

Fri ......**SOCIETY OF ARTS, 8.** Food Committee. Mr. James Harrison on his Recent Attempt to Import Frozen Meat from Australia.

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ERRATA.

Page 36, col. 1, line 10 from bottom, for "16 to 20 inches" read "1½ to 1⅞ inches."

Page 130, col. 2, lines 43 and 67, and page 131, col. 1, line 3, for "Rev. A. Rigg" read "Dr. Rigg."

Page 380, col. 2, line 33, for "R. B. Biddulph" read "R. Biddulph Martin.'

Page 631, col. 2, line 29, for "Lima" read "Siena."

Page 775, col. 2, line 28, for "Wheatman Smith" read "Taylor Brothers."

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